FINAL DRAFT REPORT

ESTUARINE WETLAND RESTORATION MONITORING PROTOCOL

Prepared by:

Charles A. Simenstad, Curtis D. Tanner, and Ronald M. Thom
WETLAND ECOSYSTEM TEAM, FISHERIES RESEARCH INSTITUTE
UNIVERSITY OF WASHINGTON

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APPENDIX A: MATRIX I RESULTS

The following section presents the results of the first matrix questionnaire (Matrix I) circulated among UEMWG representatives and their respective agencies. For a particular estuarine habitat, The top row lists assemblage species (columns) in code form and the left column lists habitat functions (rows). Respondents were requested to provide their best professional judgement as to the importance of each habitat function to the assemblage species using the following system:

0 = no relationship
1 = relationship of **low** importance
2 = relationship of **medium** importance
3 = relationship of **high** importance
4 = significant relationship suspected, but no data available

The purpose of Matrix I was to identify relationships of **high** importance between fish and wildlife assemblage species and the various habitats. These relationships were the focus of later efforts to determine specific **attributes** accounting for habitat functions (see Matrix II).

The results presented here are preceded by a key to assemblage species codes. It is important to note that at this early stage in the development of the Protocol, Deep Subtidal habitats were grouped together. Later review determined the need to divide this group into two categories, referred to in the Protocol as Nearshore Subtidal Soft Substrate and Nearshore Subtidal Hard Bottom. Each cell in the matrix represents a different UEMWG participant response. Not all participants felt qualified to respond for all assemblage species, thus the large number of blank cells. Where no respondent identified a particular relationship as being of high importance, the cell was shaded and the relationship not considered in future questionnaires. Finally, this matrix was reviewed at the Port Townsend workshop (see Introduction to Protocol) for accuracy. Any entries in the lower left cell of each relationship indicates a consensus at the workshop for suggested change that overrode previous responses.

KEY TO CODES USED IN MATRIX I RESULTS

Code	Common Name	Latin Name
amc	American coot	*Fulica americana*
amg	American goldfinch	*Spinus tristis*
amw	American wigeon	*Anas americana*
bfh	bufflehead	*Bucephala albeola*
bfs	buffalo sculpin	*Enophrys bison*
bgb	bay goby	*Lepidogobius lepidus*
blb	black brant	*Branta bernicla*
blr	black rockfish	*Sebastes melanops*
blt	black turnstone	*Arenaria melanocephala*
bpf	bay pipefish	*Syngnathus leoptorhynchus*
brr	brown rockfish	*Sebastes auriculatus*
cag	Canada goose	*Branta canadensis*
cbz	cabezon	*Scorpaenichthys marmoratus*
chs	coho salmon	*Oncorhynchus kisutch*
cks	chinook salmon	*Oncorhynchus tshawytscha*
cmr	common murre	*Uria aalge*
cms	chum salmon	*Oncorhynchus keta*
cog	common goldeneye	*Bucephala clangula*
com	common merganser	*Mergus merganser*
cos	C-O sole	*Pleuronichthys coenosus*
cpr	copper rockfish	*Sebastes caurinus*
crg	crescent gunnel	*Pholis laeta*
csa	cassin's auklet	*Ptychoramphus aleuticus*
csn	common snipe	*Capella gallinago*

Code	Common Name	Latin Name
ctt	cutthroat trout	*Oncorhynchus clarki*
dcc	double-crested cormorant	*Phalacrocorax auritus*
dej	dark-eyed junco	*Junco hyemalis*
dln	dunlin	*Calidris alpina*
dnc	Dungeness crab	*Cancer magister*
dvs	Dover sole	*Microstomus pacificus*
dvt	dolly varden	*Salvelinus malma*
ens	English sole	*Pleureonectes vetulus*
gbh	great blue heron	*Ardea herodias*
gdw	gadwall	*Anas strepera*
grs	green sturgeon	*Acipenser medirostris*
grs	great sculpin	*Myoxocephalus polyacanthocephalus*
grw	gray whale	*Eschrichtius robustus*
gry	greater yellowlegs	*Tringa melanoleuca*
gwg	glaucous-winged gull	*Larus glaucescens*
gwt	green-winged teal	*Anas crecca*
hgb	horned grebe	*Podiceps auritus*
hys	hybrid sole	*Inopsetta ischyra*
kld	killdeer	*Charadrius vocifenus*
klg	kelp greenling	*Hexagrammos decagrammus*
kpp	kelp perch	*Brachyistius frenatus*
lfs	longfin smelt	*Spirinchus thaleichthys*
lgc	lingcod	*Ophiodon elongatus*
lsp	least sandpiper	*Calidris minutilla*
lss	largescale sucker	*Catostomus macrocheilus*
mld	mallard	*Anas platyrhynchos*

Code	Common Name	Latin Name
mln	merlin	*Falco columbarius*
mrt	muskrat	*Ondatra zibethica*
mwf	mountain whitefish	*Prosopium williamsoni*
mwg	mew gull	*Larus canus*
noa	northern anchovy	*Engraulis mordax*
nor	northern oriole	*Icerus galbula*
nos	northern squawfish	*Ptychocheilus oregonensis*
osp	osprey	*Pandion haliaetus*
pac	Pacific cod	*Gadus macrocephalus*
pah	Pacific herring	*Clupea harengus pallasi*
phk	Pacific hake	*Merluccius productus*
phs	Pacific harbor seal	*Phoca vitulina*
plp	pile perch	*Rhacochilus vacca*
ppg	penpoint gunnel	*Apodichthys flavidus*
prs	prickly sculpin	*Cottus asper*
psa	pink salmon	*Oncorhynchus gorbuscha*
psc	padded sculpin	*Artedius fenestralis*
psd	Pacific sanddab	*Citharichthys sordidus*
psl	Pacific sand lance	*Ammodytes hexapterus*
pss	Pacific staghorn sculpin	*Leptocottus armatus*
ptc	Pacific tomcod	*Microgadus proximus*
qbr	quillback rockfish	*Sebastes maliger*
rbm	red-breasted merganser	*Mergus serrator*
rcc	raccoon	*Procyon lotor*
rcr	red rock crab	*Cancer productus*
rks	rock sole	*Pleuronectes bilineata*
rsc	rough sculpin	*Chitonotus pugetensis*

Code	Common Name	Latin Name
rtf	ratfish	*Hydrolagus colliei*
rth	red-tail hawk	*Buteo jamaicensis*
rvl	river lamprey	*Lampetra ayresi*
rvo	river otter	*Lutra canadensis*
rwb	redwing blackbird	*Agelaius phoeniceus*
sbd	short-billed dowitcher	*Limnodromus griseus*
sds	sand sole	*Psettichthys melanostictus*
seo	short-eared owl	*Asio flammeus*
sfs	surf smelt	*Hypomesus pretiosus*
sgs	song sparrow	*Melospiza melodia*
shp	shiner perch	*Cymatogaster aggregata*
sht	steelhead (rainbow) trout	*Oncorhynchus mykiss*
spb	snake prickleback	*Lumpenus sagitta*
sps	spotted sandpiper	*Actitis macularia*
ssc	soft sculpin	*Gilbertidia sigalutes*
ssd	speckled sanddab	*Citharichthys stigmaeus*
ssl	northern sea lion	*Eumetopias jubatus*
ssp	striped seaperch	*Embiotoca lateralis*
stf	starry flounder	*Platichthys stellatus*
stp	sturgeon poacher	*Agonus acipenserinus*
svs	savannah sparrow	*Passerculus sandwichensis*
tbs	tube-snout	*Aulorhynchus flavidus*
tss	threespine stickleback	*Gasterosteus aculeatus*
tsv	Townsend vole	*Microtus townsendii*
vgr	Virginia rail	*Rallus limicola*
wbl	western brook lamprey	*Lampetra richardsoni*
wep	walleye pollock	*Theragra chalcogramma*

Code	Common Name	Latin Name
wgr	western grebe	*Aechmophorus occidentalis*
wsg	whitespotted greenling	*Hexagrammos stelleri*
wsp	western sandpiper	*Calidris mauri*

MATRIX I RESULTS: EMMERGENT MARSH

	CKS	CMS	TSS	CTT	PSS	PRS	GBH	GWT	AMW	MLD	GDW	BFH	COG	CAG	BLB	AMC	KLD	CSN
FEEDING:							3	3	3	3	3	3	3	3		3	1	2
INVERTEBRATES	1 1	3 2	3 2	1 2	1 2	2 2	0	2	0	0	0	0	0	1	1	1	2	2
Benthic	2	3	3 4	1 4	3		3	4	3	4	3	3	3	3	0	3	3	3
Epibenthic							3	3	3	3	3	3	3	3		3	1	2
	3 3	3 3	3 3	1 3	3 3	3 3	2	1	0	0	0	0	0	0	0	0	2	2
	3	2	3 3	1 3	3		3	3	4	3	3	3	3	4	4	4	3	3
Pelagic																		
	1 0	1 0	1 0	1 0	1 0	0 0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1 1	3 3	1		0	0	0	0	0	0	0	0	0	0	0	0
Neuston									3									
	1 2	2 2	1 2	3 1	1 1	0 1	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1 3	4			0	0	0	3	3	3	0	0	0	0	0	0
VERTEBRATES			3										3					3
Demersal	0 0	0 0	0 0	3 0	1 0	0 0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1 4	2 4	1		3	0	0	0	4	4	0	0	0	0	0	4
Water Column			4				3					3						
	0 0	2 0	0 1	3 1	2 1	0 1	3	1	0	0	0	0	0	0	0	0	2	2
	1	1	1 3	2 3	1		3	0	0	0	3	0	0	0	0	0	0	3
Terrestrial							2											
	0 0	0 0	0 0	1 2	1 0	0 0	3	0	0	0	0	0	0	0	0	0	0	0
	1		1 0	1 0	1		3	0	0	0	0	0	0	0	0	0	0	0
PLANTS								3	3	3	3	2	4 1	2		3		
Emergent Vasc.	0 0	0 0	0 0	0 0	0 0	0 0	0	2	3	3	3	0	0	3	3	2	0	0
	1	2	2 4	1 4	1		4	3	3	3	3	3	3	3	4	3	0	4
													0					
Submergent Vasc.								3	3	3	3	2	4 1	2		3		
	0 0	0 0	0 0	0 0	0 0	0 0	0	0	0	0	0	0	0	0	0	3	0	0
	1	2	2 4	1 4	1		4	3	3	3	3	3	3	3	3	3	0	4
								0	0	0	0	0	0	0	0	0		
Macro algae								2	2	2	2	2	2	2		2		
	0 0	0 0	0 0	0 0	0 0	0 0	0	2	2	2	2	0	0	1	3	2	0	0
	3	2	2 4	1 4	1		4	4	3	3	3	3	3	3	4	3	0	3
	0								0	0		0	0	0	0	0		0
Micro algae																		
	0 0	0 0	0 0	0 0	0 0	0 0	0	0	2	2	2	0	0	0	0	0	0	0
	3	2	2 4	1 4	1		0	0	4	4	3	4	4	4	4	4	0	4

MATRIX I RESULTS: EMMERGENT MARSH

	CKS	CMS	TSS	CTT	PSS	PRS	GBH	GWT	AMW	MLD	GDW	BFH	COG	CAG	BLB	AMC	KLD	CSN
GENERAL								3	3	3	3	4 2	4 2	1		3		
Detritus	0 0	0 0	0 0	0 0	0 0	0 0	0	1	2	2	2	0	0	1	1	1	0	0
	3	2	2 4	1 4	2		4	4	4	4	4	0	0	4	0	4	0	4
Gravelling								3	3	3	3	3	3	3		3		
	0 0	0 0	0 0	0 0	0 0	0 0	0	1	2	2	2	0	0	2	2	2	0	0
	1	1	1 0	1 0	1		0	0	0	0	0	0	0	0	3	0	0	0
Carrion																		
	0 0	0 0	0 0	0 0	0 0	0 0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1 0	1 0	1		0	0	0	0	0	0	0	0	0	0	0	0
Salinity																		
	0 3	2 3	0 2	0 3	0 2	0 2	2	2	2	2	2	0	0	2	2	2	3	2
	1	1	3 4	1 4	2		0	0	0	4	0	0	0	0	0	0	0	0
Temperature																		
	0 3	0 3	0 2	0 3	0 2	0 2	2	2	2	2	2	0	0	2	2	2	3	2
	2	2	1 3	2 3	1		0	0	0	0	0	0	0	0	0	0	0	0
Sound																		
	4 3	4 3	1 2	4 3	0 2	0 2	3	3	3	3	3	0	0	3	3	2	3	3
	2	2	1 4	2 4	1		3	4	4	4	4	4	4	4	3	4	0	3
Light																		
	4 3	4 3	1 2	4 3	0 2	0 2	3	3	3	3	3	0	0	3	3	2	3	3
	2	1	1 4	1 4	1		3	4	4	4	4	4	4	4	3	4	0	3
Water/Sediment Quality							4										4	
	4 3	4 3	4 2	4 3	0 2	4 2	3	2	2	2	2	0	0	2	2	2	3	3
	3	3	2 3	2 3	2		3	3	3	3	3	3	3	3	3	3	3	4
Turbidity																		
	4 3	4 3	1 2	4 3	0 2	0 2	3	2	2	2	2	0	0	2	2	2	2	1
	2	2	1 4	2 4	1		4	0	0	0	0	4	4	0	0	0	0	0

MATRIX I RESULTS: EMMERGENT MARSH

	CKS	CMS	TSS	CTT	PSS	PRS	GBH	GWT	AMW	MLD	GDW	BFH	COG	CAG	BLB	AMC	KLD	CSN
REFUGE/PHYSIOLOGY:								2	1									
PHYS. COMPLEXI	4 2	4 2	4 2	2 2	1 2	3 2	3	3	3	3	3	0	0	1	1	2	2	2
Vertical relief	2	2	1 3	1 3			3	3	3	3	3	3	3	3	3	3	4	3
Horizontal edges							2	2	2	2	2	2	2	2		2		
	4 3	4 3	1 3	1 3	1 3	0 3	3	3	3	3	3	0	0	1	1	2	3	3
	2	2	1 4	1 0	1	0 0	0	4	3	4	4	4	4	4	4	3	4	3
Water movement																		
	2 1	2 1	4 1	2 1	2 1	2 1	1	1	1	1	1	0	0	1	1	1	1	1
	2	2	2 4	2 4	1		4	0	4	4	4	4	4	4	4	4	0	4
Bathymetric Features									3									
	3 2	3 2	4 2	3 2	2 2	2 2	2	1	1	1	1	0	0	2	2	1	2	2
	1	1	1 4	1 3			3	3	0	3	3	3	3	3	3	3	0	4
BIOLOGICAL COMPLEXITY:							3	3	3	3	3	3	3	3		3		
Emergent Vasc. Pl	4 3	4 3	2 3	2 3	0 3	0 3	3	3	3	3	3	0	0	3	3	3	3	3
	2	2	2 3	1 4			3	3	3	3	3	4	4	3	3	3	0	3
Submergent Vasc. Plants							3	3	3	3	3	3	3	3		3		
	0 1	0 1	2 1	3 0	1 0	0 0	0	0	0	0	0	0	0	0	0	0	0	0
	2	2	2 3	1 4			0	0	0	0	0	4	4	0	4	4	0	0
			0	0			0	0	0	0	0	0	0	0	0	0		
Macro Algae							3	3	3	3	3	3	3	3		3		
	0 1	0 1	0 2	2 1	1 2	2 2	2	1	0	1	1	0	0	0	0	0	0	0
	2	2	2 4	1 4			0	0	0	0	0	0	0	0	0	4	0	0
							0	0	0	0	0	0	0	0	0	0		
GENERAL																		
Salinity	0 2	2 2	0 2	2 2	0 2	0 2	2	2	1	1	1	0	0	1	1	1	1	1
	2	2	4	4			0	0	0	0	0	0	0	0	0	0	0	0
Temperature																		
	1 2	1 2	1 2	2 2	0 2	0 2	2	2	1	1	1	0	0	1	1	1	1	1
	2	2	4	4			0	0	0	0	0	0	0	0	0	0	0	0
Sound							2	2	2	2	2	2	2	2		2		
	4 3	4 3	1 2	3 2	1 2	1 2	2	2	3	3	3	0	0	2	2	2	2	3
	2	2	4	4			3	4	4	4	4	4	4	4	3	0	0	3
Light							2	2	2	2	2	2	2	2		2		
	4 3	4 3	1 2	3 3	1 2	1 2	3	3	3	3	3	0	0	3	3	2	3	3
	1	1	4	4			3	4	4	4	4	4	4	4	3	4	4	3
Water/Sediment Quality							2	3	3	3	3	3	3	3		2		
	4 3	4 3	1 2	2 3	1 2	4 2	3	2	2	2	2	0	0	3	3	2	2	3
	3	3	2 3	3 3	2		4	3	3	3	3	3	3	3	3	3	4	4
Turbidity							3	2	2	2	2	2	2	2				
	4 3	4 3	1 2	2 3	1 2	1 2	3	0	2	2	2	0	0	2	2	2	2	1
	2	2	2 3	2 3	2		0	0	0	0	0	0	0	0	0	0	0	0
							0											

MATRIX I RESULTS: EMMERGENT MARSH

	CKS	CMS	TSS	CTT	PSS	PRS	GBH	GWT	AMW	MLD	GDW	BFH	COG	CAG	BLB	AMC	KLD	CSN
REPRODUCTION								3		3	3			3		3		
SUBSTRATE	0 0	0 0	0	0 0	0	0	0	3	3	3	3	0	0	3	0	3	3	3
Riparian Vegetatio	1	1	1	1 0	1		3	4	4	3	3	0	0	3	0	3	3	0
																0		
Emergent Vasc. Plants								3		3	3			3		3		
	0 0	0 0	0	0 0	0	0	0	3	3	3	3	0	0	3	0	3	3	3
	1	1	1	1 0	1		0	4	4	3	3	0	0	3	0	4	0	0
Submergent Vasc. Plants																		
	0 0	0 0	3	0 0	1	3	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1 0	1		0	0	0	0	0	0	0	0	0	0	0	0
			0			0												
Macro algae																		
	0 0	0 0	0	0 0	1	3	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1 0	1		0	0	0	0	0	0	0	0	0	0	0	0
						0												
Sediment																		
	1 0	0 0	1	0 0	3	3	0	0	0	0	0	0	0	0	0	0	2	2
	3	3	1	3 0	1		0	0	0	0	0	0	0	0	0	0	0	0
ELEVATION																		
Subtidal	0 0	0 0	3	0 0	3	3	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1 0	1		0	0	0	0	0	0	0	0	0	0	0	0
Intertidal																		
	0 0	0 0	0	0 0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
	1	1	2	1 0	1		0	0	0	0	0	0	0	0	0	0	0	0
									0									
Riparian																	2	
	0 0	0 0	0	0 0	0	0	0	3	3	3	3	0	0	3	0	3	3	3
	3	3	1	3 0	1		3	4	4	3	3	0	0	3	0	3	3	0
GENERAL																		
Salinity	3 0	0 0	3	0 0	2	3	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	2	1 0	1		0	0	0	0	0	0	0	0	0	0	0	0
Temperature																		
	0 0	0 0	4	0 0	2	3	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	2	1 0	2		0	0	0	0	0	0	0	0	0	0	0	0
Sound																		
	0 0	0 0	4	0 0	4	4	0	3	3	3	3	0	0	3	0	2	2	3
				0			3	4	4	4	4	4	4	4	0	4	0	0
Light																		
	0 0	0 0	4	0 0	4	4	0	3	3	3	3	0	0	3	0	3	3	3
				0			3	4	4	4	4	4	4	4	0	4	0	0
Water/sediment Quality																		
	0 0	0 0	4	0 0	4	4	0	0	0	0	0	0	0	0	0	2	3	2
				0			4	4	4	4	4	4	4	4	0	4	4	0
Turbidity																		
	0 0	0 0	4	0 0	4	4	0	0	0	0	0	0	0	0	0	2	2	1
				0			0	0	0	0	0	0	0	0	0	0	0	0

MATRIX I RESULTS: EMMERGENT MARSH

	SBD	SPS	WSP	LSP	GRY	RWB	NOR	AMG	SVS	SGS	DEJ	OSP	MLN	RTH	PHS	TSV	MRT	RCC
FEEDING:	2	2	2	2	3	3	2	1	1	1		1						
INVERTEBRATES	2	3	3	3	3	0	0	0	0	0	0	0	0	0	0	0	2	2
Benthic	3	3	3	3	3	3	0	0	3	0	0	0	2	4	4	3	1	3
									3									
Epibenthic	2	2	2	2	3	3	2	1	1	1		1						2
	2	1	1	1	1	1	1	0	1	1	1	0	1	0	0	2	1	1
	3	3	4	3	3	4	0	0	4	0	0	0	4	4	4	3	1	3
									3									
Pelagic																		
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0
Neuston																		
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VERTEBRATES																		3
Demersal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	4	0	0	4	0	0	0	0	0	0	3	0	0	3	0	1	4
Water Column																		
	2	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	2	2
	0	3	0	0	3	0	0	0	0	0	0	3	0	0	3	0	1	3
		0			0													
Terrestrial												1	2	1				
	0	0	0	0	0	0	0	0	0	0	0	3	3	2	3	0	2	2
	0	0	0	0	0	0	0	0	0	0	0	4	3	3	0	0	1	3
												0			0			
PLANTS																	3	
Emergent Vasc.	0	0	0	0	0	0	0	3	3	2	2	0	0	0	0	0	2	2
	3	4	4	4	4	4	0	0	3	0	0	4	4	4	4	4	3	4
										3	3							
Submergent Vasc.																	3	
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4	4	4	4	4	0	0	0	4	0	0	4		4	4	4	4	4
																	0	
Macro algae					3													
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4	4	4	4	4	3	0	0	4	0	0	4	4	4	4	4	3	1
					0	0											0	
Micro algae																		
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4	4	4	4	4	0	0	0	4	0	0	4	4	4	4	4	4	4

MATRIX I RESULTS: EMMERGENT MARSH

	SBD	SPS	WSP	LSP	GRY	RWB	NOR	AMG	SVS	SGS	DEJ	OSP	MLN	RTH	PHS	TSV	MRT	RCC
GENERAL															4			
Detritus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4	4	4	4	4	0	0	0	4	0	0	4	4	4	0	4	4	4
Gravelling																		
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carrion																		
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
	0	0	0	0	0	0	0	0	0	0	0	4	0	3	0	0	0	4
Salinity																		
	2	2	2	2	2	0	0	0	0	0	0	0	0	0	2	2	2	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Temperature																		
	2	2	2	2	2	0	0	0	0	0	0	0	0	0	2	2	2	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sound																		
	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3	3	2
	3	3	3	3	3	4	4	4	4	4	4	4	3	4	3	4	4	4
Light																		
	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3	3	3
	3	3	3	3	3	4	4	4	4	4	4	4	3	4	3	4	4	4
															4			
Water/Sediment Quality																		
	3	3	3	3	2	0	0	0	0	0	0	0	0	0	2	2	2	2
	4	4	4	4	4	0	0	0	0	0	0	3	4	4	3	4	4	4
															4			
Turbidity																		
	2	2	2	2	2	0	0	0	0	0	0	0	0	0	3	0	2	2
	0	0	0	0	0	0	0	0	0	0	0	3	0	0	4	0	0	4
															4			

MATRIX I RESULTS: EMMERGENT MARSH

	SBD	SPS	WSP	LSP	GRY	RWB	NOR	AMG	SVS	SGS	DEJ	OSP	MLN	RTH	PHS	TSV	MRT	RCC
REFUGE/PHYSIOLOGY:																		
PHYS. COMPLEXITY	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Vertical relief	3	3	3	3	3	3	3	3	3	3	3	4	4	4	3	3	3	3
Horizontal edges																		
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	4	4	3	3	3	3	3	4	3	3	3	4	4	4
												0	0	0				
Water movement	4	4	4	4	4													
	1	1	1	1	1	0	0	0	0	0	0	1	1	1	2	0	0	0
	3	3	3	3	3	0	0	0	0	0	0	4	0	0	4	4	4	4
Bathymetric Featu	3	3	3	3	3													
	2	1	1	1	1	0	0	0	0	0	0	1	1	1	2	0	0	0
	4	4	4	4	4	0	0	0	0	0	0	4	4	4	3	0	4	3
BIOLOGICAL COMPLEXITY:						4	2	4	4	2	4	4	4				3	
Emergent Vasc. Plant	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	3	3	3
	3	3	4	4	4	3	3	3	3	3	3	4	4	4	4	3	3	3
Submergent Vasc. Plants																	3	
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	4	0	0	4	0	4	0
																	0	
Macro Algae																		
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0
															0			
GENERAL																		
Salinity	1	1	1	1	1	0	0	0	0	0	0	0	0	0	2	0	2	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Temperature																		
	1	1	1	1	1	0	0	0	0	0	0	0	0	0	2	0	2	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sound	2				2	1		1										
	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	2
	4	4	4	4	4	4	0	0	0	0	0	4	4	4	3	4	4	4
Light	3				2	1		1										
	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3	3	2
	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3	4	4	4
															4			
Water/Sediment Quality					2													
	3	3	3	3	3	0	0	0	0	0	0	0	0	0	2	2	2	2
	4	4	4	4	4	4	4	4	4	4	4	4	4	0	3	4	4	4
															4			
Turbidity																		
	2	2	2	2	2	0	0	0	0	0	0	0	0	0	3	0	2	2
	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0
															4			

MATRIX I RESULTS: EMMERGENT MARSH

	SBD	SPS	WSP	LSP	GRY	RWB	NOR	AMG	SVS	SGS	DEJ	OSP	MLN	RTH	PHS	TSV	MRT	RCC
REPRODUCTION									3				0				3	
SUBSTRATE	0	3	3			3	3	3	3	3	3	3	3	3	2	3	3	3
Riparian Vegetation	1	3	0	0	0	0	3	3	4	3	3	3	3	3	4	3	3	3
			0															
Emergent Vasc. Plants																	3	0
	0	3	3			3	3	3	3	3	3	0	0	0	3	1	1	1
	0	4	0	0	0	3	0	0	2	0	0	0	0	0	0	3	3	3
			0				0											
Submergent Vasc. Plants																		
	0	0	0			0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Macro algae																		
	0	0	0			0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sediment																		
	0	2	2			0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ELEVATION																		
Subtidal	0	0	0			0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intertidal																		
	0	0	0			0	0	0	0	0	0	0	0	0	3	0	0	0
	0	0	0	0	0	3	0	0	2	0	0	0	0	0	0	0	0	0
						3		3	3	3	3							
Riparian	0																	
	0	3	3			3	3	3	3	3	3	3	3	3	2	3	3	3
	0	3	0	0	0	3	3	3	2	3	3	3	3	3	0	0	0	0
			0															
GENERAL																		
Salinity	0	1	1			0	0	0	0	0	0	0	0	0	2	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Temperature																		
	0	1	1			0	0	0	0	0	0	0	0	0	2	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sound	0																	
	0	3	3			2	3	3	3	3	3	3	3	3	3	3	3	2
	4	4	0	0	0	4	4	4	4	4	4	4	4	4	4	4	4	4
Light	0																	
	0	3	3			2	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	0	0	0	4	4	4	4	4	4	4	4	4	4	4	4	4
Water/sediment Quality																		
	0	3	3			0	0	0	0	0	0	0	0	0	2	2	2	2
	4	4	0	0	0	4	0	0	0	0	0	0	4	4	4	4	4	4
Turbidity																		
	0	1	1			0	0	0	0	0	0	0	0	0	3	0	2	2
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
															4			

MATRIX I RESULTS: MUDFLAT

	PSS	STF	ENS	BGB	DNC	GBH	CAG	BFH	COG	DLN	CSN	WPS	LSP	SPS	SBD	GRY	PHS	RCC
FEEDING:							3	2	2	3	3	3	3 3	3	3	3		
INVERTEBRATES	2 1	3 3	1 3	2 1	1	0	0	0	3	3	3	3	3	3	3	3	3	3
Benthic	3	3	3		2	3	0	3	3	3	3	3	2	3	3	3	4	3
						0	0	0										
Epibenthic							4	2	2	3	3	4 3	3 3	3	3	3		
	3 3	2 3	3 3	3 3	3	3	1	2	3	3	3	3	3	3	3	3	3	3
	2	2	1		1	3	0	3	3	3	3	0	2	3	3	3	4	3
Pelagic																		
	1 0	1 0	1 0	1 0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1		1	0	0	0	0	0	0	0	0	0	0	0	4	0
Neuston										3								
	0 0	0 0	0 0	0 0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
	1	1	1		1	0	0	3	0	0	0	0	0	0	0	0	4	0
												3	3			3		
VERTEBRATES								4										
Demersal	2 0	1 0	0 0	0 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	2	1		2	3	0	0	3	0	3	0	0	4	0	4	3	3
Water Column																		
	1 2	0 1	0 1	0 2	3	3	0	2	3	0	0	0	0	0	0	2	3	3
	1	1	1		2	3	0	3	3	0	3	0	0	3	0	3	3	3
Terrestrial																		
	0 0	0 0	0 0	0 0	1	3	0	0	3	0	0	0	0	0	0	2	3	0
	1	1	1		1	3	0	0	0	0	0	0	0	0	0	0	0	3
						0			0								0	
PLANTS							3	3										
Emergent Vasc.	0 0	0 0	0 0	0 0	0	0	3	2	0	0	0	0	0	0	0	0	0	1
	1	1	1		1	4	4	4	4	4	4	4	4	4	3	4	4	4
							0	0							0			
Submergent Vasc.							3	3										
	0 0	0 0	0 0	0 0	0	0	3	2	0	0	0	0	0	0	0	0	0	0
	1	1	1		2	4	4	4	4	4	4	4	4	4	4	4	4	4
							0	0										
Macro algae								3	3		3						1	
	0 0	0 0	0 0	0 0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
	1	1	1		2	4	3	4	4	4	4	4	4	4	4	3	4	2
Micro algae																		
	0 0	0 0	0 0	0 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1		1	4	4	4	4	4	4	4	4	4	4	4	4	4

MATRIX I RESULTS: MUDFLAT

	PSS	STF	ENS	BGB	DNC	GBH	CAG	BFH	COG	DLN	CSN	WPS	LSP	SPS	SBD	GRY	PHS	RCC
GENERAL						4												
Detritus	0 0	0 0	0 0	0 0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1		2	0	4	4	4	4	4	4	4	4	4	4	4	4
Gravelling																		
	0 0	0 0	0 0	0 0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
	1	1	1		1	0	0	0	0	0	0	0	0	0	0	0	0	0
Carrion																		
	0 0	0 0	0 0	0 0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1		2	0	0	0	0	0	0	0	0	0	0	0	0	4
Salinity																		
	1 2	1 2	2 2	2 2	2	0	0	0	0	2	2	2	2	2	2	2	2	0
	1	2	2		1	0	0	0	0	0	0	0	0	0	0	0	0	0
Temperature																		
	1 2	1 2	2 2	2 2	3	0	0	0	0	0	0	0	0	0	0	0	3	0
		2	2		1	0	0	0	0	0	0	0	0	0	0	0	0	0
																	4	
Sound							4						3	3	3	3	3	
	1 2	1 2	4 2	4 2	1	3	3	3	3	3	3	3	3	3	3	3	3	3
					1	3	0	4	4	4	3	4	4	4	3	4	4	4
Light																		
	1 2	1 2	4 2	4 2	1	3	3	3	3	3	3	3	3	3	3	3	3	3
					1	3	0	4	4	4	3	4	4	4	3	4	4	4
																	4	
Water/Sediment Quality								3	3	3	3	3	3	3	3	3		
	2 2	2 2	4 2	4 2	2	2	2	2	2	2	2	2	2	2	2	2	3	2
	2	1	2		1	4	3	3	3	4	4	4	4	4	4	4	3	4
																	4	
Turbidity							0	4	4		0	0	0	0	0	0		
	2 2	2 2	4 2	4 2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
		1	1		1	3	4	3	3	0	4	4	4	4	4	4	4	4
																	4	

MATRIX I RESULTS: MUDFLAT

	PSS	STF	ENS	BGB	DNC	GBH	CAG	BFH	COG	DLN	CSN	WPS	LSP	SPS	SBD	GRY	PHS	RCC
REFUGE/PHYSIOLOGY:						3												
PHYS. COMPLEXI	1 3	1 1	1 1	3 3	2	3	1	3	3	3	3	3	3	3	3	3	1	2
Vertical relief	1	1	1		2	3	3	3	3	3	3	3	3	3	3	3	3	3
Horizontal edges						0											3	
	1 3	1 3	1 3	4 3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	1	1	1		1	4	4	4	4	4	4	4	4	4	4	4	4	4
Water movement						4												
	1 2	1 2	1 2	3 2	1	1	1	2	3	0	0	0	0	0	2	2	2	0
	1	1	1		1	4	4	4	4	4	4	4	4	4	4	4	4	4
Bathymetric Features						3												
	1 2	1 2	1 2	1 2	1	1	1	2	3	0	0	0	0	0	3	3	2	0
	2	2	2		2	3	3	3	3	3	4	4	4	4	4	4	3	4
												3	3					
BIOLOGICAL COMPLEXITY:																		
Emergent Vasc. Pl	0 0	0 0	0 0	0 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1		1													
Submergent Vasc. Plants																		
	0 3	0 3	1 3	3 3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	1	1	1		2													
	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0
Macro Algae																		
	0 3	0 3	1 3	1 3	3	3	1	1	1	0	0	2	2	2	2	2	2	0
	2	1	1		2	0	0	0	0	0	0	0	0	0	0	0	0	0
						0												
GENERAL																		
Salinity	1 2	1 2	2 2	2 2	2	0	0	0	0	0	0	0	0	0	0	1	2	2
	2	2	2		2	0	0	0	0	0	0	0	0	0	0	0	0	0
Temperature																		
	1 2	1 2	2 2	2 2	3	0	0	0	0	0	0	0	0	0	0	0	3	0
		1	1		1	0	0	0	0	0	0	0	0	0	0	0	0	0
																	4	
Sound																		
	1 2	1 2	4 2	4 2	1	3	3	3	3	3	3	3	3	3	3	3	3	0
		1	1		1	3	4	4	4	4	2	4	4	4	3	4	4	4
Light																		
	1 2	1 2	4 2	4 2	1	3	3	3	3	3	3	3	3	3	3	3	3	3
					1	3	4	4	4	4	3	4	4	4	3	4	4	4
																	4	
Water/Sediment Quality																		
	2 2	2 2	4 2	4 2	2	2	2	2	2	2	2	2	2	2	2	2	3	2
		1	1		1	4	3	3	3	4	4	4	4	4	4	4	3	4
																	4	
Turbidity																	4	
	2 2	2 2	4 2	4 2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
					1	0	0	0	0	0	0	0	0	0	0	0	0	0
						0	0	0	0	0	0	0	0	0	0	0	4	

MATRIX I RESULTS: MUDFLAT

	PSS	STF	ENS	BGB	DNC	GBH	CAG	BFH	COG	DLN	CSN	WPS	LSP	SPS	SBD	GRY	PHS	RCC
REPRODUCTION															0			
SUBSTRATE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Riparian Vegetation		1	1		1	3	3	0	0	0	0	0	0	3	1	0	0	0
Emergent Vasc. Plants						0	3								0			
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		1	1		1	4	4	0	0	0	0	0	0	4	4	0	0	0
							0											
Submergent Vasc. Plants															0			
	1	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0
		1	1		1	0	0	0	0	0	0	0	0	0	0	0	0	0
Macro algae															0			
	1	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
		1	1		1	0	0	0	0	0	0	0	0	0	0	0	0	0
Sediment															0			
	2	1	1	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0
		1	1		1	0	0	0	0	0	0	0	0	0	0	0	0	0
ELEVATION															0			
Subtidal	3	3	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
		2	2		2	0	0	0	0	0	0	0	0	0	0	0	0	0
Intertidal						0								0	0			
	0	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0
		2	2		1	4	4	0	0	0	0	0	0	4	4	0	0	0
																	3	
Riparian															0			
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		1	1		1	3	3	0	0	0	0	0	0	3	1	0	0	0
GENERAL															0			
Salinity	2	3	3	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0
		1	1		1	0	0	0	0	0	0	0	0	0	0	0	0	0
Temperature															0			
	2	3	3	4	3	0	0	0	0	0	0	0	0	0	0	0	0	0
		2	2		2	0	0	0	0	0	0	0	0	0	0	0	0	0
Sound														4	0			
	4	4	4	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0
		1	1		1	3	4	0	0	0	0	0	0	4	3	0	0	0
															0		3	
Light														4	0			
	4	4	4	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0
		1	1		1	3	4	0	0	0	0	0	0	4	3	0	0	0
															0		3	
Water/sediment Quality						4	4							4	4			
	4	4	4	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0
		2	2		2	0	0	0	0	0	0	0	0	0	0	0	4	0
Turbidity																		
	4	4	4	4	3	0	0	0	0	0	0	0	0	0	0	0	0	0
					1	0	0	0	0	0	0	0	0	0	0	0	4	0

MATRIX I RESULTS: SANDFLAT

	PSS	PSD	SSD	SDS	GBH	HGB	COG	DLN	CSN	LSP	SPS	GRY	DNC
FEEDING:					2		2	3	1	3	3	3	
INVERTEBRATES	2 2	2 3	3 3	2 3	0	0	0	2	1	3	3	3	0
Benthic	3	3	3	3	3	3	3	3	3	2	3	3	3
					0	0							
Epibenthic					3		2	3	1	3	3	3	
	3 3	3 3	3 3	3 3	1	1	3	2	2	2	2	2	3
	2	2	2		3	4	3	3	3	3	3	3	2
Pelagic													
	1 0	1 0	1 0	1 0	0	0	0	0	0	0	0	0	0
	1				0	0	0	0	0	0	0	0	3
Neuston													
	0 0	0 1	0 1	0 1	0	1	1	0	0	0	0	0	0
	1	2	2		0	0	0	3	0	0	0	0	3
								3		3	3	3	
VERTEBRATES													
Demersal	2 0	0 0	0 0	0 0	0	0	0	0	0	0	0	0	0
	1	1	1	3	3	3	3	0	3	0	0	3	3
Water Column					3								
	1 1	0 1	0 1	0 1	3	3	1	1	1	1	1	2	3
	1	1	1	3	3	3	3	0	3	0	0	3	2
Terrestrial													
	0 0	0 0	0 0	0 0	3	3	0	0	0	0	0	0	0
	1	1	1		3	0	0	0	0	0	0	3	
					0	0						0	
PLANTS					4	4	4	4	4	4	4	4	
Emergent Vasc.	0 0	0 0	0 0	0 0	0	0	0	0	0	0	0	0	0
Submergent Vasc.													
	0 0	0 0	0 0	0 0	0	0	0	0	0	0	0	0	0
					4	4	4	4	4	4	4	4	
Macro algae													
	0 0	0 0	0 0	0 0	0	0	0	0	0	0	0	0	0
					4	4	4	4	4	4	4	4	2
Micro algae													
	0 0	0 0	0 0	0 0	0	0	0	0	0	0	0	0	0
					4	4	4	4	4	4	4	4	

MATRIX I RESULTS: SANDFLAT

	PSS	PSD	SSD	SDS	GBH	HGB	COG	DLN	CSN	LSP	SPS	GRY	DNC
GENERAL													
Detritus	0 0	0 0	0 0	0 0	0	0	0	0	0	0	0	0	0
					4	4	4	4	4	4	4	4	
Gravelling													
	0 0	0 0	0 0	0 0	0	0	0	0	0	0	0	0	0
		1	1	1	0	0	0	0	0	0	0	0	
Carrion													
	0 0	0 0	0 0	0 0	0	0	0	0	0	0	0	0	3
		1	1	1	0	0	0	0	0	0	0	0	2
Salinity													
	1 2	3 2	3 2	2 2	0	0	0	0	0	0	0	1	3
	1				0	0	0	0	0	0	0	0	
Temperature													
	1 2	2 2	2 2	2 2	0	2	2	0	0	0	0	3	3
					0	0	0	0	0	0	0	0	
Sound													
	1 2	4 3	4 3	4 3	3	3	3	3	3	3	3	0	2
	1				3	4	4	4	3	4	4	4	
Light													
	1 2	4 3	4 3	4 3	3	3	3	3	3	3	3	1	2
					3	4	4	4	3	4	4	4	
Water/Sediment Quality								4 3	4 3	4 3	4 3	4	
	2 2	4 3	4 3	4 3	2	2	2	3	3	3	3	3	2
	2				3	3	3	3	3	3	3	3	2
Turbidity					3	4	4	0	0	0	0	0	
	2 2	2 3	2 3	2 3	3	3	3	3	3	3	3	3	3
	2												

MATRIX I RESULTS: SANDFLAT

	PSS	PSD	SSD	SDS	GBH	HGB	COG	DLN	CSN	LSP	SPS	GRY	DNC
REFUGE/PHYSIOLOGY:													
PHYS. COMPLEXI	1 2	1 2	1 2	1 2	1	2	2	0	0	0	0	1	2
Vertical relief				1	3	4	4	3	3	3	3	3	1
Horizontal edges								4	3				
	1 3	1 3	1 3	1 3	3	2	2	3	3	3	3	3	3
				1	4	4	4	0	0	0	0	0	1
Water movement					4	4	4						
	1 1	1 1	1 1	1 1	1	2	2	0	0	0	0	0	1
					3	3	3	4	4	4	4	4	
Bathymetric Features								3	3	3	3	3	
	1 1	1 1	1 1	1 1	1	2	2	1	0	1	1	1	1
				2	3	3	3	0	0	0	0	0	2
BIOLOGICAL COMPLEXITY:													
Emergent Vasc. Pl	0 1	0 1	0 1	0 1	1	0	0	2	0	0	0	0	2
	2			1									
Submergent Vasc. Plants													
	0 2	0 2	0 2	0 2	2	0	0	0	0	0	0	0	2
	2			1									2
Macro Algae					0	0	0	0	0	0	0	0	
	0 2	0 2	0 2	0 2	0	1	1	1	0	0	0	0	2
	2			1	3	3	3	3	3	3	3	3	2
GENERAL													
Salinity	1 1	3 1	3 1	3 1	0	2	2	0	0	0	0	0	3
					0	0	0	0	0	0	0	0	2 0
Temperature													
	1 1	2 1	2 1	2 1	0	2	2	0	0	0	0	0	3
					0	0	0	0	0	0	0	0	
Sound													
	1 2	4 2	4 2	4 2	3	3	3	3	3	3	3	3	2
					3	4	4	4	3	4	4	4	
Light													
	1 2	4 2	4 2	4 2	3	3	3	3	3	3	3	3	2
					3	4	4	4	3	4	4	4	
Water/Sediment Quality					4	3	3	4	4	4	4	4	
	2 2	4 3	4 3	4 3	2	2	2	3	3	3	3	3	2
													2
Turbidity					0	0	0	0	0	0	0	0	
	2 2	2 2	2 2	2 2	3	3	3	3	3	3	3	3	3
													1

MATRIX I RESULTS: SANDFLAT

	PSS	PSD	SSD	SDS	GBH	HGB	COG	DLN	CSN	LSP	SPS	GRY	DNC
REPRODUCTION													
SUBSTRATE	0	0	0	0	0	0	0	0	0	0	0	0	0
Riparian Vegetation		1	1		3	0	0	0	0	0	3	0	1
Emergent Vasc. Plants													
	0	0	0	0	0	0	0	0	0	0	0	0	0
		1	1		0	0	0	0	0	0	0	0	
Submergent Vasc. Plants													
	1	0	0	0	0	0	0	0	0	0	0	0	0
		1	1		0	0	0	0	0	0	0	0	2
Macro algae													
	1	0	0	0	0	0	0	0	0	0	0	0	0
		1	1		0	0	0	0	0	0	0	0	2
Sediment								3		3	3	3	
	2	0	0	0	0	0	0	0	0	0	0	0	3
		1	1		0	0	0	0	0	0	0	0	1
								0		0	0	0	
ELEVATION													
Subtidal	3	3	3	3	0	0	0	0	0	0	0	0	0
		2	2	2	0	0	0	0	0	0	0	0	2
Intertidal								3		3	3	3	
	0	0	0	0	0	0	0	0	0	0	0	0	3
					0	0	0	0	0	0	0	0	1
								0		0	0	0	
Riparian													
	0	0	0	0	0	0	0	0	0	0	0	0	0
		1	1	1	3	0	0	0	0	0	3	0	1
GENERAL								2		2	2	2	
Salinity	2	3	3	3	0	0	0	0	0	0	0	0	3
					0	0	0	0	0	0	0	0	
Temperature													
	2	2	2	2	0	0	0	0	0	0	0	0	3
					0	0	0	0	0	0	0	0	
Sound													
	4	4	4	4	0	0	0	0	0	0	0	0	2
					0	0	0	0	0	0	0	0	
Light													
	4	4	4	4	0	0	0	0	0	0	0	0	2
					0	0	0	0	0	0	0	0	
Water/sediment Quality								3		3	3	3	
	4	4	4	4	0	0	0	0	0	0	0	0	2
					0	0	0	0	0	0	0	0	
Turbidity													
	4	4	4	4	0	0	0	0	0	0	0	0	3
					0	0	0	0	0	0	0	0	

MATRIX I RESULTS: GRAVEL COBBLE

	CHS	CTT	DVT	SFS	CPR	PDS	BFS	GRS	WSG	PTC	PLP	STF	RVL	RRC	DCC	MW	WGB	HGB	BFH	LSP	SPS	RCC
FEEDING:															3						3	3
INVERTEBRATES	0 0	1 0	1 0	2 0	2	2 0	3 0	3 0	2	2	1	3 2	3 2	0	0	0	0	0	0	0	0	1
Benthic	2	2 3	1 3	2			2		2		2	2		3		3	3	3	3	2	3	
															0		0	0				
Epibenthic		2													3					3	3	
	2 3	2 3	2 3	3 3	2	3 3	2 3	2 3	3	3	3	2 3	2 3	2	0	2	0	0	2	3	3	3
	2	2 3	1 3	1			1		1		1	1		3		3	3	3	3	2	3	
Pelagic															0					3	3	
	3 0	3 3	3 3	3 0	3	0 0	0 0	0 0	1	2	1	0 0	0 0	0	0	0	0	0	0	0	0	0
	2	1 3	1 3	2			1		2		1	1		0		0	0	0		0	0	
Neuston															0							
	2 1	1 3	1 3	1 2	0	0 0	0 0	0 0	0	0	0	0 0	0 0	0	0	1	0	0	1	0	0	0
	1	1 3	1 3	1			1		1		1	1		0		0	0	0	3	0	0	
VERTEBRATES															3			3	3			
Demersal	0 0	0 0	0 0	0 0	0	0 0	1 0	2 0	0	0	0	0 0	0 0	0	0	0	0	0	0	0	0	0
	1	2 4	2 4	1			2		2		1	2		3		4	4	4	4	0	4	
Water Column			3												3			3	3			
	0	1 3	1 3	1 0	1	0 1	0 1	0 1	0	1	0	0 2	0 2	3	2	2	2	2	2	1	1	3
	2	2 3	2 3	2			1		1		1	1		3		3	3	3	3	0	3	
Terrestrial															4							
	0 0	0 3	0 3	0 0	0	0 0	0 0	0 0	0	0	0	0 0	0 0	0	3	2	3	3	2	0	0	0
	1	1 0	1 0	1			1		1		1	1		3		0	0	0	0	0	0	
		0	0												0		0	0				
PLANTS															4							
Emergent Vasc.	0 0	0 0	0 0	0 0	0	0 0	0 0	0 0	0	0	0	0 0	0 0	0	0	0	0	0	0	0	0	0
	1	1	1	1			1		1		1	1										
Submergent Vasc.															4							
	0 0	0 0	0 0	0 0	0	0 0	0 0	0 0	0	0	0	0 0	0 0	0	0	0	0	0	0	0	0	0
	2	1	1	1			1		1		1	1										
Macro algae															4				3			
	0 0	0 0	0 0	0 0	0	0 0	3 0	0 0	0	0	0	0 0	0 0	0	0	0	0	0	0	0	0	0
	2	1 4	1 4	1			2		1		2			2		4	4	4	4	4	4	
Micro algae															4							
	0 0	0 0	0 0	0 0	0	0 0	0 0	0 0	0	0	0	0 0	0 0	0	0	0	0	0	0	0	0	0
	1	1 4	1 4	1			1		1		1			4		4	4	4	4	4	4	

MATRIX I RESULTS: GRAVEL COBBLE

	CHS	CTT	DVT	SFS	CPR	PDS	BFS	GRS	WSG	PTC	PLP	STF	RVL	RRC	DCC	MW	WGB	HGB	BFH	LSP	SPS	RCC
GENERAL															4							3
Detritus	0 0	0 0	0 0	0 0	0	0 0	0 0	0 0	0	0	0	0 0	0 0	0	0	0	0	0	0	0	0	0
	2	1 4	1 4	1					1		1			4		3	4	4	4	4	4	
Gravelling															0							
	0 0	0 0	0 0	0 0	0	0 0	0 0	0 0	0	0	0	0 0	0 0	0	0	0	0	0	0	0	0	0
	1	1 0	1 0	1					1		1			0		0	0	0	0	0	0	
Carrion															0							3
	0 0	0 0	0 0	0 0	0	0 0	0 0	0 0	0	0	0	0 0	0 0	0	0	2	0	0	0	0	0	3
	1	1 0	1 0	1					1		1			0		0	0	0	0	0	0	
																3						
Salinity															0							
	3 3	3 3	3 3	2 3	3	2 2	2 2	2 2	2	3	3	1 2	2 2	1	0	0	0	0	0	1	1	2
	1	2 4	1 4	2					1		1			0		0	0	0	0	0	0	
Temperature															0							
	2 3	2 3	2 3	2 3	2	2 2	2 2	2 2	2	2	2	1 2	2 0	0	0	0	0	0	0	0	0	3
	1	1 4	1 4	1					1		1			0		0	0	0	0	0	0	
Sound															3					3		
	4 3	4 3	4 3	4 2	4	4 2	4 2	4 2	4	4	4	4 2	4 2	3	3	3	3	3	3	3	3	1
	2	2 4	4	1					1		1			4		4	4	4	4	4	4	
Light															3					3		
	4 3	4 3	4 3	4 2	4	4 2	4 2	4 2	4	4	4	4 2	4 2	3	3	3	3	3	3	3	3	2
	1	2 4	4	1					1					4		4	4	4	4	4	4	
Water/Sediment Quality															3							
	4 2	4 2	4 2	4 3	4	4 2	4 2	4 2	4	4	4	4 3	4 3	3	2	2	2	2	2	3	3	2
	1	2 3	3	1					2					4		3	3	3	3	4	4	
Turbidity															4							
	4 3	4 3	4 3	4 3	4	4 2	4 2	4 2	4	4	4	4 2	4 2	3	3	3	3	3	3	2	2	3
	2	2 3	3											0		0	0	0	0	0	0	

MATRIX I RESULTS: GRAVEL COBBLE

	CHS	CTT	DVT	SFS	CPR	PDS	BFS	GRS	WSG	PTC	PLP	STF	RVL	RRC	DCC	MW	WGB	HGB	BFH	LSP	SPS	RCC
REFUGE/PHYSIOLOGY:															3							
PHYS. COMPLEXI	1 2	1 2	1 2	1 3	3	1 1	1 1	1 1	2	1	3	1 3	1 3	2	2	0	2	2	2	1	1	3
Vertical relief		3	3						2					4		3	4	4	3	3	3	
Horizontal edges															4							
	4 3	4 3	4 3	1 1	4	1 3	1 3	1 3	2	1	4	1 3	1 3	3	2	2	2	2	2	3	3	3
		0	0						2		2			4		4	4	4	4	4	4	
Water movement															0					3	3	
	2 2	2 2	2 2	2 2	4	1 2	1 2	1 2	2	2	2	4 1	4 1	0	3	0	3	3	3	0	0	1
		4	4						1		1			0		4	0	0	0	0	0	
Bathymetric Featu	4	4	4																			
BIOLOGICAL COMPLEXITY:																						
Emergent Vasc. Pl	0 2	0 2	0 2	0 3	0	0 0	0 0	0 0	0	0	0	0 0	0 0	2	0	0	0	0	0	1	1	0
	1	1 4	1 4	1					1		1											
Submergent Vasc. Plants																						
	2 2	2 2	2 2	2 0	3	1 1	1 1	1 1	2	1	3	1 2	2 2	2	1	1	1	1	1	0	0	2
	2	2 4	1 4	1					1		1											
Macro Algae															4							
	1 1	1 1	1 1	1 0	3	2 1	3 1	2 1	3	1	3	1 2	1 2	2	2	1	2	2	1	1	1	2
	2	2 4	1 4	1					2		2			0		0	0	0	0	0	0	
GENERAL															4							
Salinity	3 2	3 2	3 2	2 3	3	2 2	2 2	2 2	2	2	2	1 2	2 2	0	0	0	0	0	0	0	0	3
	1	2 4	1 4	2					2					0		0	0	0	0	0	0	
Temperature															4							
	2 3	2 3	2 3	2 3	2	2 2	2 2	2 2	2	2	2	1 2	2 2	0	0	0	0	0	0	0	0	3
	1	1 4	1 4	1					1					0		0	0	0	0	0	0	
Sound															4							
	4 3	4 3	4 3	4 2	4	4 2	4 2	4 2	4	4	4	4 2	4 2	3	2	2	2	2	2	2	2	1
	2	2 4	4	1										4		4	4	4	4	4	4	
Light															4							
	4 3	4 3	4 3	4 2	4	4 2	4 2	4 2	4	4	4	4 2	4 2	2	3	3	3	3	3	3	3	2
	1	1 4	4	1										4		4	4	4	4	4	4	
Water/Sediment Quality															0					2	2	
	4 2	4 2	4 2	4 3	4	4 2	4 2	4 2	4	4	4	4 3	4 3	2	2	2	2	2	3	3	3	2
	1	1 3	3	1										4		3	3	3	3	4	4	
Turbidity															0							
	4 3	4 3	4 3	4 3	4	4 2	4 2	4 2	4	4	4	4 2	4 2	2	3	3	3	3	3	3	3	3
	1	1 4	4	1										0		0	0	0	0	0	0	

MATRIX I RESULTS: GRAVEL COBBLE

	CHS	CTT	DVT	SFS	CPR	PDS	BFS	GRS	WSG	PTC	PLP	STF	RVL	RRC	DCC	MW	WGB	HGB	BFH	LSP	SPS	RCC
REPRODUCTION															0					3	3	
SUBSTRATE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Riparian Vegetatio	1	1	0	1	0	1								0		0	0	0	0	0	0	
																				0		
Emergent Vasc. Plants															0							
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	0	1	0	1								0		0	0	0	0	0	0	
Submergent Vasc. Plants															0							
	0	0	0	1	4	1	1	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	0	1	0	1								0		0	0	0	0	0	0	
Macro algae															0							
	0	0	0	4	1	1	4	1	3	1	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	0	1	0	1								0		0	0	0	0	0	0	
															3							
Sediment															0							
	0	0	0	3	0	4	4	4	4	4	4	2	2	0	0	0	0	0	0	0	0	0
	1	1	0	1	0	3								0		0	0	0	0	0	0	
ELEVATION															0							
Subtidal	0	0	0	2	3	3	3	3	3	3	3	3	3	0	0	0	0	0	0	0	0	0
	1	1	0	1	0	1								0		0	0	0	0	0	0	
Intertidal															0							
	0	0	0	3	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
	1	1	0	1	0	3								0		0	0	0	0	0	0	
Riparian															0							
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	0	1	0	1								0		0	0	0	0	0	0	
GENERAL															0							
Salinity	0	0	0	2	3	2	2	2	2	3	3	1	3	0	0	0	0	0	0	0	0	0
	1	1	0	1	0	2								0		0	0	0	0	0	0	
Temperature															0							
	0	0	0	2	2	2	2	2	2	2	2	1	2	0	0	0	0	0	0	0	0	0
	1	1	0	1	0	2								0		0	0	0	0	0	0	
Sound															0							
	0	0	0	4	4	4	4	4	4	4	4	4	4	0	0	0	0	0	0	0	0	0
	1	1	0	1	0	1								0		0	0	0	0	0	0	
Light															0							
	0	0	0	4	4	4	4	4	4	4	4	4	4	0	0	0	0	0	0	0	0	0
	1	1	0	1	0	1								0		0	0	0	0	0	0	
Water/sediment Quality															0							
	0	0	0	4	4	4	4	4	4	4	4	4	4	0	0	0	0	0	0	0	0	0
	1	1	0	1	0	2								0		0	0	0	0	0	0	
Turbidity															0							
	0	0	0	4	4	4	4	4	4	4	4	4	4	0	0	0	0	0	0	0	0	0
	1	1	0	1	0	1								0		0	0	0	0	0	0	

MATRIX I RESULTS: EELGRASS

	CMS	KPP	SSP	SHP	SPB	TBS	BPF	CRG	PPG	DNC	BFH	CAG	BLB	GBH	GWG	CSN	SPS	LSP	GRY	OSP	PHS
FEEDING:																					
INVERTEBRATES	4 4	2 0	2 0	2 0	2 2	2 2	1 2	1 2	1 2	3	0	0	0	3	1	0	3	3	3	0	1
Benthic	2	3	3	3	1	1	1		3	2	3	3	0	3	3	3	3	3	3	4	4
Epibenthic																					
	3 3	3 3	3 3	3 3	3 3	3 3	3 3	3 3	3 3	3	2	1	3	3	3	0	2	2	2	0	2
	3	1	1	2	2	1	1		2	2	4	4	0	3	4	3	4	3	3	4	4
Pelagic																					
	1 1	1 1	1 1	1 1	1 0	2 0	1 0	0 0	0 0	2	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	2	3	3	3		1	2	0	0	0	0	0	0	0	0	0	0	4
			3																		
Neuston																					
	1 1	1 1	1 1	1 1	1 0	1 0	1 0	0 0	0 0	2	0	0	0	0	1	0	0	0	0	0	2
	1	1	2	2	2	3	3		1	2	0	0	0	0	0	0	0	0	0	0	4
VERTEBRATES										3									2		
Demersal	0 0	0 0	0 0	0 0	0 0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1		1	2	0	0	0	3	0	3	3	0	3	3	3
Water Column														2					2		
	1 0	0 0	0 0	0 0	0 1	0	0	0	0	3	2	0	0	3	3	0	0	0	0	1	3
	1	1	1	1	1	2	1		1	2	0	0	0	3	0	3	3	0	3	3	3
Terrestrial																					
	0 0	0 1	0 1	1 1	0 1	0	0	0	0	0	1	0	0	3	1	0	0	0	0	3	3
	1	1	1	1	1	1	1		1	1	0	3	0	3	3	0	0	0	0	2	0
														0	0					0	
PLANTS											4										
Emergent Vasc.	0 0	0 1	0 1	0 1	0 0	0 0	0 0	0 0	0 0	0	1	3	3	0	0	0	0	0	0	0	0
	1	1	1	1	1				1	1	3	3	0	4	0	3	0	0	0	4	4
											0	0	0			0					
Submergent Vasc.												2	3								
	0 0	0 1	0 1	0 1	0 0	0 0	0 0	0 0	0 0	0	1	3	3	0	0	0	0	0	0	0	0
	2	2	2	2	1				1	1	3	4	3	4	0	0	0	0	0	4	4
Macro algae												2	2		4						
	0 0	0 1	0 1	0 1	0 0	0 0	0 0	1 0	1 0	0	1	2	2	0	0	0	0	0	0	0	0
	3	2	2	2	1					2	3	3	1	4	3	3	0	0	3	4	4
Micro algae																					
	0 0	0 0	0 0	0 0	0 0	0 0	0 0	1 0	1 0	0	0	0	0	0	0	0	0	0	0	0	0
	3	2	2	2	2					1	4	4	4	4	4	4	4	4	4	4	4

MATRIX I RESULTS: EELGRASS

	CMS	KPP	SSP	SHP	SPB	TBS	BPF	CRG	PPG	DNC	BFH	CAG	BLB	GBH	GWG	CSN	SPS	LSP	GRY	OSP	PHS
GENERAL										2											
Detritus	0 0	0 0	0 0	0 0	0 0	0 0	0 0	1 0	1 0	3	0	0	0	0	0	0	0	0	0	0	0
	3	2	2	2	2				1	1	0	0	0	4	3	4	4	4	4	4	4
Gravelling																					
	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0	0	1	1	0	0	0	0	0	0	0	0
	1	1	1	1	1				1	1	0	0	3	0	0	0	0	0	0	0	0
													1								
Carrion										2											
	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	3	0	0	0	0	2	0	0	0	0	0	0
	1	1	1	1	1				1	2	0	0	0	0	4	0	0	0	0	4	0
															3						
Salinity										3											
	0 3	3 3	3 3	3 3	3 2	3 2	3 2	3 2	3 2	3	2	3	2	0	0	0	2	0	0	0	2
	1	1	1	1	1						0	0	0	0	0	0	0	0	0	0	0
												0	3								
Temperature										3											
	1 3	2 2	2 2	2 2	2 2	2 2	2 2	2 2	2 2	3	2	2	2	0	0	0	2	2	2	0	3
	1	1	1	1	1						0	0	0	0	0	0	0	0	0	0	0
Sound																					
	4 3	4 2	4 2	4 2	4 2	4 2	4 2	2 2	2 2	2	3	3	3	3	2	0	3	3	3	3	3
	2	1	1	1	1						4	4	3	3	4	3	4	4	4	4	3
Light																					
	4 3	4 2	4 2	4 2	4 2	4 2	4 2	2 2	2 2	2	3	3	3	3	2	0	3	3	3	3	3
	1	2	1	1	1						4	4	3	3	4	3	4	4	4	4	3
Water/Sediment Quality																					
	4 2	4 2	4 2	4 2	4 2	4 2	4 2	4 2	4 2	2	2	3	3	2	2	0	2	2	3	2	3
	3	2	2	2	2					2	3	3	3	4	3	4	4	4	4	4	3
Turbidity											4									3	
	4 3	4 2	4 2	4 2	4 2	4 2	4 2	4 2	4 2	3	3	3	3	3	2	0	2	2	3	3	3
	3	2	2	2	2						0	0	0	0	0	0	0	0	0	0	4

MATRIX I RESULTS: EELGRASS

	CMS	KPP	SSP	SHP	SPB	TBS	BPF	CRG	PPG	DNC	BFH	CAG	BLB	GBH	GWG	CSN	SPS	LSP	GRY	OSP	PHS
REFUGE/PHYSIOLOGY:																				0	
PHYS. COMPLEXI	3 2	3 3	3 3	3 3	2 2	2 2	3 2	3 2	3 2	2	2	1	1	2	2	0	2	2	2	1	1
Vertical relief	1	2	2	1				3		1	3	3	3	3	3	3	3	3	3	3	3
Horizontal edges																				0	0
	4 3	4 1	4 1	4 1	4 2	4 3	4 3	4 3	4 3	2	3	3	3	3	2	0	3	3	3	3	3
	2	2	2	2				2		1	4	4	4	4	4	3	4	4	4	3	3
Water movement																					
	4 2	4 2	4 2	4 2	4 2	4 2	3 2	2 2	2 2	2	2	1	1	1	2	0	0	0	0	1	1
	1	1	1	1				1		1	4	4	4	4	4	4	4	4	4	0	4
													3								
Bathymetric Features																3	3	3	3		
	2 2	2 2	2 2	2 2	2 2	2 2	4 2	2 2	2 2	2	2	1	1	2	2	0	0	0	0	1	1
	1	1	1	1				1		2	3	3	3	3	0	4	4	4	4	0	3
BIOLOGICAL COMPLEXITY:																				4	
Emergent Vasc. Pl	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	3	3	3	3	3	2	0	3	3	3	1	3
	1	1					1			1	4	3	3	3	3	3	3	4	4	3	4
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Submergent Vasc. Plants																					
	3 3	2 3	2 3	3 3	3 3	3 3	3 3	3 3	3 3	3	3	3	3	3	2	0	3	3	3	0	2
	2	2		2		2	2			3	4	0	4	0	0	0	0	0	0	0	4
Macro Algae																					
	2 2	3 3	3 3	2 3	2 3	2 3	2 3	3 3	3 3	3	3	0	0	3	2	0	0	0	0	0	2
	2	2		2		2	1	2		2	0	0	0	0	0	0	0	0	0	0	0
GENERAL										3											
Salinity	1 3	3 2	3 2	3 2	3 2	3 2	3 2	3 2	3 2	2	2	0	0	0	0	0	0	0	0	0	1
	1	1	1	1	1						0	0	0	0	0	0	0	0	0	0	0
Temperature										3											
	1 3	4 2	4 2	4 2	4 2	4 2	2 2	2 2	2 2	2	2	0	0	0	0	0	0	0	0	0	1
	1	1	1	1	1						0	0	0	0	0	4	0	0	0	0	0
Sound																					
	4 3	4 2	4 2	3 2	4 2	3 2	2 2	2 2	2 2	2	2	3	3	0	2	0	3	3	3	0	2
	2	1	1	1	1						4	4	3	3	4	3	4	4	4	0	3
Light																					
	4 3	4 2	4 2	4 2	4 2	4 2	2 2	2 2	2 2	2	3	3	3	2	2	0	3	3	3	3	3
	1	1	1	1	1						4	4	3	3	4	3	4	4	4	4	3
Water/Sediment Quality																					
	4 3	4 2	4 2	4 2	4 2	4 2	2 2	2 2	2 2	2	2	3	3	3	2	0	2	2	2	2	3
	3	2	2	2	2						3	3	3	4	3	4	4	4	4	4	3
Turbidity																					
	4 3	4 2	4 2	4 2	4 2	4 2	2 2	2 2	2 2	3	3	3	3	3	2	0	2	2	2	3	3
											0	0	0	0	0	0	0	0	0	0	4

MATRIX I RESULTS: EELGRASS

	CMS	KPP	SSP	SHP	SPB	TBS	BPF	CRG	PPG	DNC	BFH	CAG	BLB	GBH	GWG	CSN	SPS	LSP	GRY	OSP	PHS
REPRODUCTION																					
SUBSTRATE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Riparian Vegetatio	1		1				1			1	0	0	3	0	3	0	0	3	0	0	3	0
												0		0			0			0	
Emergent Vasc. Plants																					
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	1		1				1			1	0	0	0	0	0	0	0	0	0		0
Submergent Vasc. Plants																					
	0	4	4	4	4	1	3	1	1	3	0	0	0	0	0	0	0	0	0	0	
	1		1				1			1	0	0	0	0	0	0	0	0	0	0	0
Macro algae																					
	0	0	0	0	4	3	4	3	3	3	0	0	0	0	0	0	0	0	0	0	
	1		1			3	1			1	0	0	0	0	0	0	0	0	0	0	0
Sediment																					
	0	0	0	0	4	0	0	3	3	3	0	0	0	0	0	0	0	0	0	0	
	1		1			1	1			1	0	0	0	0	0	0	0	0	0	0	0
ELEVATION																					
Subtidal	0	4	4	4	4	4	4	3	3	3	0	0	0	0	0	0	0	0	0	0	
	1					3	2			2	0	0	0	0	0	0	0	0	0	0	0
Intertidal																					
	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	
	1					1	2			1	0	0	0	0	0	0	0	0	0	0	0
Riparian																					
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	1					1	1			1	0	0	3	0	3	0	0	3	0	0	3	0
												0		0			0			0	
GENERAL																					
Salinity	0	3	3	3	3	3	3	3	3	3	0	0	0	0	0	0	0	0	0	0	
	1									2	0	0	0	0	0	0	0	0	0	0	0
Temperature																					
	0	4	4	4	4	4	4	4	4	3	0	0	0	0	0	0	0	0	0	0	
	1									0	0	0	0	0	0	0	0	0	0	0	0
Sound																					
	0	4	4	4	4	4	4	4	4	2	0	0	0	0	0	0	0	0	0	0	
	1									0	0	0	0	0	0	0	0	0	0	0	0
Light																					
	0	4	4	4	4	4	4	4	4	2	0	0	0	0	0	0	0	0	0	0	
	1									0	0	0	0	0	0	0	0	0	0	0	0
Water/sediment Quality																					
	0	4	4	4	4	4	2	2	2	3	0	0	0	0	0	0	0	0	0	0	
	1									3	0	0	0	0	0	0	0	0	0	0	0
Turbidity																					
	0	4	4	4	4	4	2	2	2												
	1									0	0	0	0	0	0	0	0	0	0	0	0

MATRIX I RESULTS: DEEP SUBTIDAL

	LSS	RSC	PAC	PTC	WEP	NOS	MWF	RTF	STP	HYS	DVS	COS	DNC
FEEDING:													
INVERTEBRATES	3	3	3	3	1	3	3	1	2	2	2	2	3 1
Benthic			3	3	2			2	2	2	3	3	3
Epibenthic													
	1	2	2	2	2	2	2	2	3	3	3	3	1 3
			1							2	2	2	2
Pelagic													
	0	0	1	0	3	0	0	3	0	0	0	0	0 0
			3		3			1					3
													0
Neuston													
	0	0	0	0	0	0	0	0	0	0	0	0	0 0
			1					1		2	3	3	3
												0	0
VERTEBRATES													
Demersal	1	1	1	1	1	0	0	1	0	0	0	0	2 0
			3		2			2		1	1	1	2
													3
Water Column													
	0	0	0	0	0	0	0	0	0	0	0	0	0 3
			3		3			2		1	1	1	2
													0
Terrestrial													
	0	0	0	0	0	0	0	0	0	0	0	0	0 0
			1	1				1		1	1	1	1
PLANTS													
Emergent Vasc.	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
			1	2									
Submergent Vasc.													
	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
			1	2									
Macro algae													
	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
			2	2									
Micro algae													
	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
			2	2									

MATRIX I RESULTS: DEEP SUBTIDAL

	LSS		RSC		PAC		PTC		WEP		NOS		MWF		RTF		STP		HYS		DVS		COS		DNC	
GENERAL																										3
Detritus	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
					2		2																			
Gravelling																										
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
					1		1																			
Carrion																										3
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
					1		1																			
Salinity																										2
	3	2	3	2	3	2	2	2	3	2	3	2	3	2	3	2	2	2	3	2	3	2	3	2	1	2
Temperature																										3
	4	2	2	2	4	2	4	2	4	2	4	2	4	2	4	2	4	2	4	2	4	2	4	2	2	2
Sound																										
	2	2	2	2	4	2	4	2	4	2	2	2	2	2	2	2	2	2	4	2	4	2	4	2	4	2
Light																										
	2	2	2	2	4	2	4	2	4	2	2	2	2	2	2	2	2	2	4	2	4	2	4	2	4	2
Water/Sediment Quality																										2
	2	2	3	2	3	2	3	2	3	2	2	2	2	2	3	2	3	2	3	2	3	2	3	2	2	2
					2														2		2		2			
Turbidity																										
	2	2	2	2	3	2	3	2	3	2	2	2	2	2	3	2	3	2	2	2	2	2	2	2	1	3

MATRIX I RESULTS: DEEP SUBTIDAL

	LSS	RSC	PAC	PTC	WEP	NOS	MWF	RTF	STP	HYS	DVS	COS	DNC
REFUGE/PHYSIOLOGY:													2
PHYS. COMPLEXIT	1	4	0	0	0	2	2	0	1	1	1	1	3 1
Vertical relief			1	1									
Horizontal edges													2
	1	1	0	0	0	0	1	0	2	2	2	2	4 3
			1	1									
Water movement													
	2	4	1	2	2	2	2	2	2	2	1	1	1 2
			2	1									
Bathymetric Features													
	1	4	0	0	0	0	0	0	0	1	1	1	2 2
			2		2								
BIOLOGICAL COMPLEXITY:													
Emergent Vasc. Pla	0	0	0	0	0	0	0	0	0	0	0	0	0 0
			1	1	1								
Submergent Vasc. Plants													
	0	1	0	0	0	0	0	0	0	1	0	0	2 0
			1	2	1								3
Macro Algae													
	0	1	0	0	0	0	0	0	0	1	0	0	2 3
			1	2	1								1
GENERAL													
Salinity	3	3	3	2	3	3	3	3	2	3	3	3	1 2
Temperature													
	4	2	4	4	4	4	4	4	4	4	4	4	2 2
Sound													
	2	2	4	4	4	2	2	2	2	4	4	4	4 2
Light													
	2	2	4	4	4	2	2	2	2	4	4	4	4 2
Water/Sediment Quality													
	2	3	3	3	3	2	2	3	3	3	3	3	2 2
										2	2	2	2
Turbidity													
	2	2	3	3	3	2	2	3	3	2	2	2	1 3

MATRIX I RESULTS: DEEP SUBTIDAL

	LSS	RSC	PAC	PTC	WEP	NOS	MWF	RTF	STP	HYS	DVS	COS	DNC
REPRODUCTION													
SUBSTRATE	0	0	0	0	0	0	0	0	0	0	0	0	0 0
Riparian Vegetation			1					1					
Emergent Vasc. Plants													
	0	0	0	0	0	0	0	0	0	0	0	0	0 0
			1					1					
Submergent Vasc. Plants													
	0	0	0	0	0	0	0	0	0	0	0	0	0 3
			1					1					
													0
Macro algae													
	0	0	0	0	0	0	0	0	0	0	0	0	0 0
			1					2					
Sediment													
	4	4	0	0	0	4	4	0	4	0	0	0	1 2
			1					1					
ELEVATION													
Subtidal	3	2	3	3	3	3	3	3	2	3	3	3	3 3
			2										
Intertidal													
	0	0	0	0	0	0	0	0	0	0	0	0	1 0
			1					2					
Riparian													
	0	0	0	0	0	0	0	0	0	0	0	0	0 0
			1					1					
GENERAL													
Salinity	3	3	3	3	3	3	3	3	3	3	3	3	3 2
Temperature													
	4	4	4	4	4	4	4	4	4	4	4	4	4 2
Sound													
	4	4	4	4	4	4	4	4	4	4	4	4	4 2
Light													
	4	4	4	4	4	4	4	4	4	4	4	4	4 2
Water/sediment Quality													
	4	4	4	4	4	4	4	4	4	4	4	4	4 2
										3			
Turbidity													
	2	2	3	3	3	2	2	3	2	2	2	2	2 3

MATRIX I RESULTS: WATER COLUMN

	PSA	CM	CHS	CKS	STH	RVL	WBL	NOA	PAH	LFS	SFS	SSC	PSL	WG	DCC	CO	RBM	MW	CO	GD	BFH	OSP	SSL	PHS
FEEDING:																				1	2	4	4	4
INVERTEBRATES	0	0	0	0	0	0	0	0	0	0	0	0	0											
Benthic	1	1	1	1	1 2			1	1	2	1		1	2	2	2		2	2	2	2			
Epibenthic																				1	2	4	4	4
	0	0	0	0	0	0	0	0	0	0	0	0	0											
	1	1	1	1	1 2			1	1	1	1		1	2	2	2		2	2	2	2			
Pelagic															4	4	4	4 2	4	4	4	4	4	4
	3 2	3 2	2 2	3 3	3 2	0	0	3	3	3	3	3	3	0	0	0	0	0	0	2	2	0	0	0
	3	3	2	3	2 4			3	3	3	3		3											
																		3					3	3
Neuston															4	4	4	4 2	4	4	4	4	4	4
	1 1	2 1	3 1	2 1	2 1	0	0	1	1	1	1	0	1	0	0	0	0	1	1	2	2	0	0	0
	2	2	2	2	2 2			2	2	2	2			2										
VERTEBRATES					4									3 3	3 3	3 2	3 2	3 2	3	3	3	3 3	3	3
Demersal	0	0	0	0	0	0	0	0	0	0	0	0	0											
	1	1	1	1	1 1			1	1	1	1													
Water Column					3									3 3	3 3	3 3	3 3	3 2	3	3	3	3 3	3	3
	0	0	3	3	3	3	3	0	0	0	0	0	0	3	3	3	3	3	3	0	3	3	3	3
	2	2	3	3	3 2			1	2	2			2											
Terrestrial														0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0											
	1	1	1	1	1 0			1	1	1	1		1	3	3	3	3	3		3	3	3	3	3
														0	0	0	0	0	0	0	0	0	0	0
PLANTS																								
Emergent Vasc.	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1			1	1	1	1		1											
Submergent Vasc.					4									4	4	4	4	4	4	4	2	4	4	4
	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1			1	1	1	1		1								2			
Macro algae					4									4	4		4	4	4	4	4	4	4	4
	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1			1	1	1	1		1			2								
Micro algae					4									4	4	4	4	4	4	4	4	4	4	4
	0 0	0 0	0 0	0 0	0 0	0 0	0 0	2 0	0 0	0 0	0 0	0 0	0 0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1			1	1	1	1		1											

MATRIX I RESULTS: WATER COLUMN

	PSA	CM	CHS	CKS	STH	RVL	WBL	NOA	PAH	LFS	SFS	SSC	PSL	WG	DCC	CO	RBM	MW	CO	GD	BFH	OSP	SSL	PHS
GENERAL					4									4	4	4	4		4	4	4	4	4	4
Detritus	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1			1	1	1	1		1					3						
Gravelling					0									0	0	0	0	0	0	0	0	0	0	0
	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1			1	1	1	1		1											
Carrion					0									0	0	0	0	0	0	0	0	0	0	0
	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1			1	1	1	1		1											
																		3						
Salinity					4									0	0	0	0	0	0	0	0	0	0	0
	1 3	1 3	2 3	3 3	3 3	3	3	3	3	2	2	3	3	0	0	0	0	0	0	0	0	0	2	2
	1	1	1	2	2			1	1															
Temperature					3									0	0	0	0	0	0	0	0	0	0	0
	2 3	2 3	2 3	2 3	2 3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	0	3	3
	1	1	1	1	1			1	1															
																							4	4
Sound					4									3	3	3	3	3	3	3	3	3	3	3
	4 3	4 3	4 3	4 3	4 3	4	4	4	4	4	4	4	4	3	3	3	3	2	2	3	3	3	3	3
	2	2	2	2	2																			
Light					4									3	3	3	3	3	3	3	3	3	3	3
	4 3	4 3	4 3	4 3	4 3	4	4	4	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3	3
	2	2	2	2	2																			
																							4	4
Water/Sediment Quality					3									3	3	3	3	3	3	3	3	3	4	3
	4 3	4 3	4 3	4 3	4 3	4	4	4	4	4	4	4	4	2	2	2	2	2	2	2	2	2	2	2
	2	2	2	2	2				2															
																								4
Turbidity					3									4	4	4	4	4	4	4	4	3	4	4
	4 3	4 3	4 3	4 3	4 3	4	4	4	4	4	4	4	4	3	3	3	3	2	3	3	3	3	3	3
	2	2	2	2	2																			
																							2	2

MATRIX I RESULTS: WATER COLUMN

	PSA	CM	CHS	CKS	STH	RVL	WBL	NOA	PAH	LFS	SFS	SSC	PSL	WG	DCC	CO	RBM	MW	CO	GD	BFH	OSP	SSL	PHS
REFUGE/PHYSIOLOGY:					4									4	3	4	4	4	4	4	4	0	3	3
PHYS. COMPLEXI	0	0	0	0	0	0	0	0	0	0	0	0	0											
Vertical relief	1	1	1	1	1 4									3	3									3
Horizontal edges					4									4	4	4	4	4	4	4	4	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0											
	1	1	1	1	1 4									3										
Water movement					4									4	4	4	4	4	4	4	4	0	4	4
	2 2	2 2	2 2	2 2	2 2	3	3	2	2	2	2	3	3	2	2	2	2	2	2	2	2	2	2	2
	1	1	1	1	1 4																			
Bathymetric Features					4									4	4	4	4	4	4	4	4	0	4	4
	0 2	0 2	0 2	0 2	0 2	2	2	2	2	1	1	2	2	2	2	2	2	0	0	0	0	0	2	2
	1	1	1	1	1 4																			
BIOLOGICAL COMPLEXITY:																								
Emergent Vasc. Pl	0 0	0 0	0 0	0 0	0 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1																			
Submergent Vasc. Plants					4									4	4	4	4	4	4	4	4	0	4	4
	0 0	0 0	0 0	0 0	0 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1																			
Macro Algae					4									0	0	0	0	0	0	0	0	0	0	0
	0 0	0 0	0 0	0 0	0 0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1																			
GENERAL					4									0	0	0	0	0	0	0	0	0	0	0
Salinity	1 3	1 3	2 3	3 3	3 3	2	2	2	3	2	2	3	3	0	0	0	0	0	0	0	0	0	2	2
	2	2	2	2	2			1	1															
Temperature					4									0	0	0	0	0	0	0	0	0	0	0
	1 3	1 3	2 3	2 3	2 3	2	2	2	2	1	1	2	2	2	2	2	2	0	0	1	1	0	3	3
	2	2	2	2	2			1	1															
																							4	4
Sound					4									3	3	3	3	3	3	3	3	3	3	3
	4 3	4 3	4 3	4 3	4 3	4	4	4	4	4	4	4	4	3	3	3	3	2	3	3	3	3	3	3
	2	2	2	2																				
Light					4									3	3	3	3	3	3	3	3	3	3	3
	4 3	4 3	4 3	4 3	4 3	4	4	4	4	4	4	4	4	3	3	3	3	2	3	3	3	3	3	3
	2	2																						
Water/Sediment Quality					3									3	3	3	3	3	3	3	3	4	3	3
	4 3	4 3	4 3	4 3	4 3	4	4	4	4	4	4	4	4	2	2	2	2	2	3	2	2	3	2	2
	2	2	2	2	2			2																
																							2	2
Turbidity					3									0	0	0	0	0	0	0	0	0	0	0
	4 3	4 3	4 3	4 3	4 3	4	4	4	4	4	4	4	4	3	3	3	3	2	3	3	3	3	3	3
	2	2																						
																							4	4

MATRIX I RESULTS: WATER COLUMN

	PSA	CM	CHS	CKS	STH	RVL	WBL	NOA	PAH	LFS	SFS	SSC	PSL	WG	DCC	CO	RBM	MW	CO	GD	BFH	OSP	SSL	PHS
REPRODUCTION																								
SUBSTRATE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Riparian Vegetation					0			1	1	0				3	0	0	0	0	0	3	0	3	0	0
																				0		0		
Emergent Vasc. Plants																								
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
					0			1	1	0				4	0	0	0	0	0	4	0	0	0	0
Submergent Vasc. Plants																								
	0	0	0	0	0	0	0	0	3	0	1			0	0	0	0	0	0	0	0	0	0	0
					0			1	3	4				0	0	0	0	0	0	0	0	0	0	0
Macro algae																								
	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
					0			1	3	4				0	0	0	0	0	0	0	0	0	0	0
Sediment																								
	0	0	0	0	0	0	0	0	1	0	3	4	3	0	0	0	0	0	0	0	0	0	0	0
					0			1	2	0				0	0	0	0	0	0	0	0	0	0	0
ELEVATION																								
Subtidal	0	0	0	0	0	0	0	0	3	3	0	3	3	3	0	0	0	0	0	0	0	0	0	0
					0			2	2	3				0	0	0	0	0	0	0	0	0	0	0
Intertidal																								
	0	0	0	0	0	0	0	0	2	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0
					0			1	2	3				0	0	0	0	0	0	4	0	4	0	4
Riparian																								
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
					0			1	1	0				3	0	0	0	0	0	3	0	3	0	4
																				0		0		
GENERAL																								
Salinity	0	0	0	0	0	0	0	0	3	0	3	3	3	0	0	0	0	0	0	0	0	0	0	0
					0			2	1	4				0	0	0	0	0	0	0	0	0	0	0
Temperature																								
	0	0	0	0	0	0	0	0	2	0	2	2	2	0	0	0	0	0	0	0	0	0	0	0
					0			2	2	4				0	0	0	0	0	0	0	0	0	0	0
Sound																								
	0	0	0	0	0	0	0	0	4	0	4	4	4	0	0	0	0	0	0	0	0	0	0	0
					0				4					4	0	0	0	0	0	4	0	4	0	4
Light																								
	0	0	0	0	0	0	0	0	4	0	4	4	4	0	0	0	0	0	0	0	0	0	0	0
					0				4					4	0	0	0	0		4	0	4	0	4
Water/sediment Quality																								
	0	0	0	0	0	0	0	0	4	0	4	4	4	0	0	0	0	0	0	0	0	0	0	0
					0			2	2	3				4	4	4	4	4	4	4	4	4	4	4
Turbidity																								
	0	0	0	0	0	0	0	0	4	0	4	4	4	0	0	0	0	0	0	0	0	0	0	0
					0				4					0	0	0	0	0	0	0	0	0	0	0

APPENDIX B: MATRIX II RESULTS

The following section presents the results of the second matrix questionnaire (Matrix II) circulated among UEMWG representatives and their respective agencies. The purpose of this questionnaire was to build on Matrix I results, identifying the specific *attributes* that make a particular habitat function of high importance to assemblage species members. The top row lists assemblage species for a particular estuarine habitat, using the same code system used in Matrix I (see A-2 thru A-6 for key to codes). The left column lists the attributes Matrix II respondents listed for each habitat function. As in Matrix I, respondents were asked to rate the importance of attributes to assemblage species members using the following system:

0 = no relationship
1 = relationship of **low** importance
2 = relationship of **medium** importance
3 = relationship of **high** importance
4 = significant relationship suspected, but no data available

Many attributes were listed by more than one respondent, thus the results show several ranks for these attributes. Finally, it should be noted that for many "physical" habitat functions (i.e. salinity, temperature, bathymetric features, etc.) no specific attribute (e.g. salinity or temperature range, types of bathymetric features) were listed. A "n/a" in the attribute column indicates this situation were no specific attribute was identified, yet a rank of the importance of the habitat function was reported.

	amc	amg	amw	bfh	blb	cag	cks	cms	cog	csn	ctt	dej	gbh	gdw	gry	gwt	kld	lsp	mld
Feeding: General, Salinity																			
n/a							3	3			3								
Feeding: General, Carrion																			
n/a																			
Feeding: General, Detritus																			
n/a								3, 4								4			
Feeding: General, Temperature																			
n/a							-3, 3,	-3, 3, 3			-3, 3								
(cont'd)							3												
Feeding: General, Graveling																			
n/a					3														
Feeding: General, Light																			
day length																			
n/a		4	4		-3	4	1, 3,	1, 3, 4		4	3	4	4	4	4	4		4	4
(cont'd)							4												
Feeding: General, Sound																			
human disturbance																			
n/a		-3	-3		-3	4	-1, 2,	-1, 2, 4		-3	2	-3	-3,-3	-3	-3	-3	4	-3	-1
(cont'd)							4												
Feeding: General, Water/Sediment Quality																			
sediment quality							1	1											
water quality							2	2											
Feeding: General, Water/Sediment Quality																			
n/a			3	3	3	3	-3, 3	-3, 3	3	3	-3, 3		3	3		3		4	3
Feeding: General, Turbidity																			
n/a							-3,-2,	-3,-2, 2			-3, 3					4			
(cont'd)							2												
Feeding: Invertebrates, Benthic																			
Annelida (unid.)	4			4		4	4		4	4				4	4		3, 4	4	
Bivalvia (unid.)																			
Corbicula manilensis																			
Corophium salmonis															4			4	
Corophium spp.	4		4	4		4			4	4			4	4		4	4		4
Diptera (unid.)															4			4	
Hobsonia florida																			
Isopoda (unid.)																			
Manayunkia aestuarina	4		4	4		4	4		4	4	4		4	4		3	4		4
Neanthes limnicola																			
Nematoda (unid.)															4			4	
Oligochaeta (unid.)								1											
Polychaeta (unid.)							1												
Tanais spp.																			
Transennella tantilla										3					3				
Feeding: Invertebrates, Epibenthic																			
Anodonta spp.										4					4			4	
Balanus spp.	4		3	3		0	0		4	0, 3	0		4	0	3	0	0		0
Brachyrhyncha (unid.)	4		4	4		4	4		3	4	4		4	4		4	4		4
Calanoida (unid.)							2	2											
Cancer productus																			
Chironomidae (unid.)											4								
Chironomidae, larvae/pupae							2	3											
Corbicula manilensis										4					4			4	
Corophium salmonis							3												
Corophium spinicorne							3	3											
Corophium spp.							2, 3,	2		4	1								

MATRIX II RESULTS: EMERGENT MARSH

		amc	amg	amw	bfh	blb	cag	cks	cms	cog	csn	ctt	dej	gbh	gdw	gry	gwt	kld	lsp	mld
	(cont'd)							3												
	Crangon spp.										4	1				4			4	
	Cumella vulgaris																			
	Cyclopoida (unid.)							2	2											
	Cyclopoida (unid.)																			
	Decapoda (unid.)										4					4			4	
	Diptera (larvae)	4		4	4						4	4			4			4		4
	Diptera (unid.)							3	3			4								
	Eogammarus confervicolus	4		4	4		4	1, 4	2	4	4	3			4	4	3	4	4	4
	Eogammarus spp.																			
	Gammaridea (unid.)							2, 3	2, 3											
	Gastropoda (unid.)	4		4	4		4	4		4	4	4		4			4	4		3
	Gnorimosphaeroma oregonese											1								
	Harpacticoida (unid.)							1, 2	2, 3											
	Hemigrapsus spp.									3										
	Hemiptera (unid.)							2	2			4								
	Insecta (larvae)				3			3				4			3			3		3
	Insecta (unid.)	4		4	4		4	4		4	4	4		4	3		4	3		3
	Littorina spp.	4		4	4		4	4		3, 3	4	4		4	4		4	3		4
	Mytilus edulis	4		3	3		0	0		4	0	0		4	0		0	0		0
	Neomysis mercedis							2, 2	2			2, 4								
	Nereidae (unid.)																			
	Orchestia traskiana										3					4			4	
	Pacificastacus leniusculus																			
	Paramoera columbiana								1											
	Polychaeta (unid.)	4		4	4		4	4		4	4	4			4			4		4
	Saunderia spp.	4		4	4		4	4		4	4	4		4	4		3	4		4
									3											
Feeding: Invertebrates, Neustonic																				
	Araneae (unid.)							2												
	Chironomidae (unid.)							3	3			3								
	Diptera (unid.)							2	2											
	Ephydridae (unid.)							2												
	Heleidae (unid.)							2												
	Insecta, terrestrial (unid.)							4	4			4								
	n/a							2	3											
Feeding: Invertebrates, Pelagic																				
	Calanoida (unid.)							2	4											
	Cladocera (unid.)								4											
	Corycaeus spp.								1											
	Daphnia spp.							3												
	Mysidacea (unid.)				2															
	n/a																			
Feeding: Plants, Micro Algae																				
	epiphytic algae/animals								3											
	filamentous algae								4						3					
Feeding: Plants, Emergent Vascular																				
	Alnus rubra		3																	
	bentgrass/aster		4										4							
	Carex lyngbei	4		4	4		3			4					4					3
	Carex lyngbei (seeds)		4																	
	Carex spp.					3									3		3			3
	Deschampsia cespitosa		4																	
	Distichlis spp.	4		4	4		3			4					4		3			3
	Eleocharis palustris	4			4		4			4	4				3		3			3

MATRIX II RESULTS: EMERGENT MARSH

	amc	amg	amw	bfh	blb	cag	cks	cms	cog	csn	ctt	dej	gbh	gdw	gry	gwt	kld	lsp	mld
Eleocharis spp.																3			3
Grindelia integrifolia																			
Grindelia spp.		4																	
Juncus spp.		4																	
Phalaris arundinacea		3										4							
Polygonom spp.																3			2
Polygonum hydropiperoides	4				4	4			4	4				4		3			3
Potomogeton spp.																2			3
Rumex spp.																2			2
Salicornia spp.																3			
Scirpus acutis	4		4	4		4			4					3					
Scirpus americanus	4		4	4		3			4					4		3			3
Scirpus maritimus																			
Scirpus spp.									3							3			3
Scirpus validus	3			4		4			4	4				4		3			3
Scirpus validus (seeds)		4																	
Sium suave		4										4							
Spergularia marina	4	4	4	4		4			4					4					4
Triglochin maritimum	4	4	4	4		3			4					4		3			3
Triglochin palustris						3													
Typha spp.	3	4										4							4
Feeding: Plants, Macro Algae																			
Enteromorpha spp.	4		3, 3	4	2, 4	4		4	4	4				3, 4	4	4			4
Ulva spp.	4		3, 3,	4	2, 3	4		4	4	4				3, 4		4			4
(cont'd)			4																
Feeding: Plants, Submergent Vascular																			
Ruppia maritima	4		3	4	4	4			4					3		1			4
Zostera japonica	3		3	4	3	4			4					4		4			4
Zostera marina	3		3	4	3	4			4					4		4			4
Zostera spp.					3									3		2			
Feeding: Vertebrates, Demersal																			
Cottus spp.										4									
Gasterosteus aculeatus											3								
Leptocottus armatus									4	4	1, 4		3, 3						
Lumpenus sagitta										4									
Microgadus proximus										4									
Platichthys stellatus									4	4			3						
Feeding: Vertebrates, Terrestrial																			
Aves (unid.)																			
Chalidrae (unid.)																			
Microtus spp.													2, 3						
Microtus townsendii																			
Ondatra zibethicus																			
Peromyscus maniculatus																			
Sorex bendirii																			
Feeding: Vertebrates, Water Column																			
Allosmerus elongatus										4					4				
Cymatogaster aggregata				4						4	4		3	4					
Engraulis mordax										4					4				
Gasterosteus aculeatus													3						
Oncorhynchus gorbuscha (fry)				4						4	3		4	4					
Oncorhynchus keta (fry)				4						4	2, 3		4	4					
Oncorhynchus spp. (fry)													3						
Teleostei (unid.)										4	1				4				
Thaleichthys pacificus										4					4				

	amc	amg	amw	bfh	blb	cag	cks	cms	cog	csn	ctt	dej	gbh	gdw	gry	gwt	kld	lsp	mld
n/a																			
Refuge/Physiology: Biological Complexity, Emergent Vasc. Plants																			
Carex spp.							3	3											
loose soil																			
riparian buffer																			
Scirpus spp.	3		3	4	3	3	4	4	4	3	4		4	3		4			3
Typha spp.	3		3	4	3	3	4	4	4	3	4		4	3		4			3
n/a		4					2	2		3		4							
Refuge/Physiology: Biological Complexity, Submergent Vasc. Plants																			
n/a							2	2			4								
Refuge/Physiology: General, Light																			
n/a		4	4		4		-1, 4	-1, 4		4	4	4	4	4	4	4	4	4	4
Refuge/Physiology: General, Sound																			
n/a		4	-3		-3		-2,-1,	-2,-1,	4	-3	4	4	-3,-3	-3					-2
(cont'd)							4												
Refuge/Physiology: General, Water/Sediment Quality																			
sediment quality							1	1											
water quality							3	3											
n/a			3	3	3	3	-3, 3	-3, 3	3	4	3		4	3	3	3		3	3
Refuge/Physiology: General, Turbidity																			
n/a							-3,-3,	-3,-3,-2			-3		-3						
(cont'd)							2												
Refuge/Physiology: Physical Complexity, Bathymetric Features																			
area of refuge				3	3		2	2	3				3						
slope							2	2											
n/a	3		4	3	3	3	3, 3,	3, 3,	3		3, 3		3	4	3, 4	4		4	4
(cont'd)							3	3											
Refuge/Physiology: Physical Complexity, Horizontal Edges																			
n/a	3	4					2, 2	2		3	1	4	3, 4	3	4	3		4	3
Refuge/Physiology: Physical Complexity, Vertical Relief																			
Picea sitchensis		4										4			4			4	
Salix spp.		4										4			4			4	
n/a	4		4	3	4	3			4	3, 4	3		2	3		3			3
Reproduction: Elevation, Intertidal																			
n/a			3																
Reproduction: Elevation, Riparian																			
n/a	3	3	3, 4			3	3	2, 3, 3		3	3	3	3, 3	3, 3		3, 3	4		3, 3
Reproduction: Elevation, Subtidal																			
n/a																			
Reproduction: General, Light																			
n/a	4	4	4			4				4		4	4	4		4	4		4
Reproduction: General, Sound																			
n/a		4	-3			-2				-3		4	-3,-3	-3		-3			-3,-2
Reproduction: General, Water/Sediment Quality																			
n/a																			
Reproduction: General, Turbidity																			
n/a																			
Reproduction: Substrate, Emergent Vasc. Plants																			
Carex lyngbei																			
Scirpus americanus																			
Typha latifolia																			
Typha spp.	3		3			3				3				3		3			3
n/a			3																
Reproduction: Substrate, Macro Algae																			
Algae (unid.)																			

MATRIX II RESULTS: EMERGENT MARSH

	amc	amg	amw	bfh	blb	cag	cks	cms	cog	csn	ctt	dej	gbh	gdw	gry	gwt	kld	lsp	mld
n/a																			
Reproduction: Substrate, Riparian Vegetation																			
Picea sitchensis													3						2
Populus trichocarpa													3						2
Pseudotsuga menziesii																			
n/a	3	3	3			3				3		3	3	3		3	4		3
Reproduction: Substrate, Sediment																			
boulder/cobble																			
grain size apx. 1.00 um.																			
gravel							2	2											
mud							2	2											
sand							2	2											
sandy shallows																			

	mln	mrt	nor	osp	phs	prs	pss	rcc	rth	rvo	rwb	sbd	seo	sgs	sps	svs	tss	tsv	wgr	wsp
Feeding: General, Salinity																				
n/a																	3			
Feeding: General, Carrion																				
n/a					4															
Feeding: General, Detritus																				
n/a																				
Feeding: General, Temperature																				
n/a																	-3, 3			
(cont'd)																				
Feeding: General, Graveling																				
n/a																				
Feeding: General, Light																				
day length				3																
n/a	4	4	4	4	4			4	4			4		4	4	4		4		4
(cont'd)																				
Feeding: General, Sound																				
human disturbance				-3																
n/a	-3	-3	4	-3	-3				-3			-3		-3	-3	-3		-3		-3
(cont'd)																				
Feeding: General, Water/Sediment Quality																				
sediment quality																				
Fee water quality																				
Feeding: General, Water/Sediment Quality																				
n/a				3	4							4			4		-3			4
Feeding: General, Turbidity																				
n/a				-3	4															
(cont'd)																				
Feeding: Invertebrates, Benthic																				
Annelida (unid.)								4			4	3, 4			4	4	4			3
Bivalvia (unid.)							2													
Corbicula manilensis								3												
Corophium salmonis								4			4	4			4	4				4
Corophium spp.																				
Diptera (unid.)								4			4	4			4	4				4
Hobsonia florida							1													
Isopoda (unid.)							2													
Manayunkia aestuarina							1										4			
Neanthes limnicola							3													
Nematoda (unid.)								4			4	4			4	4				3
Oligochaeta (unid.)																				
Polychaeta (unid.)							1													
Tanais spp.							3													
Transennella tantilla															3,					
Feeding: Invertebrates, Epibenthic																				
Anodonta spp.								4			4	4			4					
Balanus spp.															3		0			
Brachyrhyncha (unid.)																	0			
Calanoida (unid.)																				
Cancer productus								3												
Chironomidae (unid.)																				
Chironomidae, larvae/pupae						2	2										3			
Corbicula manilensis											4	4			4					
Corophium salmonis						3	3										3			
Corophium spinicorne																				
Corophium spp.							3										3			

	mln	mrt	nor	osp	phs	prs	pss	rcc	rth	rvo	rwb	sbd	seo	sgs	sps	svs	tss	tsv	wgr	wsp
(cont'd)																				
Crangon spp.					3			3			4	4			4					
Cumella vulgaris							2													
Cyclopoida (unid.)																				
Cyclopoida (unid.)																				
Decapoda (unid.)					3		2	3			4	4			4					
Diptera (larvae)																	4			
Diptera (unid.)																				
Eogammarus confervicolus						1	3	4			4	4			4	4	3, 3			4
Eogammarus spp.																	3			
Gammaridea (unid.)							3	2				2					3			
Gastropoda (unid.)														2			0			
Gnorimosphaeroma oregonese						3	2													
Harpacticoida (unid.)							1										3			
Hemigrapsus spp.																				
Hemiptera (unid.)																				
Insecta (larvae)																	3			
Insecta (unid.)																	0			
Littorina spp.																	0			
Mytilus edulis																	0			
Neomysis mercedis						2, 3	2, 4										1			
Nereidae (unid.)														2						
Orchestia traskiana								4			4	3			4					
Pacificastacus leniusculus								3												
Paramoera columbiana																				
Polychaeta (unid.)							4										4			
Saunderia spp.																	4			
								2,												
Feeding: Invertebrates, Neustonic																				
Araneae (unid.)																				
Chironomidae (unid.)																				
Diptera (unid.)																				
Ephydridae (unid.)																				
Heleidae (unid.)																				
Insecta, terrestrial (unid.)																				
n/a																				
Feeding: Invertebrates, Pelagic																				
Calanoida (unid.)																	3			
Cladocera (unid.)																	3			
Corycaeus spp.																				
Daphnia spp.																				
Mysidacea (unid.)						2											3			
n/a																	3			
Feeding: Plants, Micro Algae																				
epiphytic algae/animals																				
filamentous algae																				
Feeding: Plants, Emergent Vascular																				
Alnus rubra																4				
bentgrass/aster		4	4					4						4		4		3		
Carex lyngbei		3																		
Carex lyngbei (seeds)		3														4		3		
Carex spp.																				
Deschampsia cespitosa		4										4				4				3
Distichlis spp.																				
Eleocharis palustris																				

	mln	mrt	nor	osp	phs	prs	pss	rcc	rth	rvo	rwb	sbd	seo	sgs	sps	svs	tss	tsv	wgr	wsp
Eleocharis spp.																				
Grindelia integrifolia														2						
Grindelia spp.		4												3		4				
Juncus spp.		4														4				
Phalaris arundinacea		3	4					4						4		4				
Polygonom spp.																				
Polygonum hydropiperoides																				
Potomogeton spp.																				
Rumex spp.																				
Salicornia spp.																		2		
Scirpus acutis																				
Scirpus americanus																				
Scirpus maritimus		3												2						
Scirpus spp.																				
Scirpus validus																				
Scirpus validus (seeds)		3														4				
Sium suave		3	4					4			4			4		4		4		
Spergularia marina		4										4				4				3
Triglochin maritimum		4														4				
Triglochin palustris																				
Typha spp.		3	4					4			3			4		4				
Feeding: Plants, Macro Algae																				
Enteromorpha spp.		4									4									
Ulva spp.																				
(cont'd)																				
Feeding: Plants, Submergent Vascular																				
Ruppia maritima																				
Zostera japonica																				
Zostera marina																				
Zostera spp.																				
Feeding: Vertebrates, Demersal																				
Cottus spp.				4	3			3												
Gasterosteus aculeatus																	4			
Leptocottus armatus																	4			
Lumpenus sagitta				4				4												
Microgadus proximus				4				4												
Platichthys stellatus				4	3			3									4			
Feeding: Vertebrates, Terrestrial																				
Aves (unid.)	3							3												
Chalidrae (unid.)	3							4	3											
Microtus spp.																				
Microtus townsendii									3											
Ondatra zibethicus									3											
Peromyscus maniculatus									3											
Sorex bendirii									3											
Feeding: Vertebrates, Water Column																				
Allosmerus elongatus				4				4							4					
Cymatogaster aggregata																	4			
Engraulis mordax				4				3							4					
Gasterosteus aculeatus																				
Oncorhynchus gorbuscha (fry)																	3			
Oncorhynchus keta (fry)																	3			
Oncorhynchus spp. (fry)																				
Teleostei (unid.)				3				3							4					
Thaleichthys pacificus				4				3							4					

	mln	mrt	nor	osp	phs	prs	pss	rcc	rth	rvo	rwb	sbd	seo	sgs	sps	svs	tss	tsv	wgr	wsp
n/a				3,																
Refuge/Physiology: Biological Complexity, Emergent Vasc. Plants																				
Carex spp.																	3			
loose soil																		3		
riparian buffer		3						3										2		
Scirpus spp.						4	4										4			
Typha spp.						4	4										4			
n/a		3	4					3			4			3, 4		3, 4		3, 3		
Refuge/Physiology: Biological Complexity, Submergent Vasc. Plants																				
n/a		4															4			
Refuge/Physiology: General, Light																				
n/a	4	4	4	4	4				4			4		4	4	4		4		4
Refuge/Physiology: General, Sound																				
n/a	4	4	4	4	3				3					4		4		4		
(cont'd)																				
Refuge/Physiology: General, Water/Sediment Quality																				
sediment quality																				
water quality																				
n/a					4							3			3		3			3
Refuge/Physiology: General, Turbidity																				
n/a					4												-3			
(cont'd)																				
Refuge/Physiology: Physical Complexity, Bathymetric Features																				
area of refuge																				
slope																				
n/a		4			3							4			4					4
(cont'd)																				
Refuge/Physiology: Physical Complexity, Horizontal Edges																				
n/a	4	4	4	4	4		1	4	4		4	4		4	4	4	2, 2	4		4
Refuge/Physiology: Physical Complexity, Vertical Relief																				
Picea sitchensis		4	4					3			4	4		4	4	4		4		4
Salix spp.		4	4					3			4	4		4	4	4		4		4
n/a				3		0					3			3			3	3,		
Reproduction: Elevation, Intertidal																				
n/a					4						4									
Reproduction: Elevation, Riparian																				
n/a	3	3	3	3, 3				3	3		4			3	4	3		4		4
Reproduction: Elevation, Subtidal																				
n/a																	3			
Reproduction: General, Light																				
n/a	4	4	4	4	4			4	4					4	4	4		4		4
Reproduction: General, Sound																				
n/a	-3	4	4	4	-3				-3					4	4	4		4		4
Reproduction: General, Water/Sediment Quality																				
n/a						3									3					3
Reproduction: General, Turbidity																				
n/a					4															
Reproduction: Substrate, Emergent Vasc. Plants																				
Carex lyngbei		3	4		4						4				4			3		4
Scirpus americanus		3	4		4						4				4			3		4
Typha latifolia											3				4					4
Typha spp.																				
n/a		3	4								3				4			3		4
Reproduction: Substrate, Macro Algae																				
Algae (unid.)																	3			

		mln	mrt	nor	osp	phs	prs	pss	rcc	rth	rvo	rwb	sbd	seo	sgs	sps	svs	tss	tsv	wgr	wsp
	n/a						4											3			
Reproduction: Substrate, Riparian Vegetation																					
	Picea sitchensis																				
	Populus trichocarpa																				
	Pseudotsuga menziesii				3																
	n/a	3	3	3	3				3	3		4			3	4	3		4		4
Reproduction: Substrate, Sediment																					
	boulder/cobble						3														
	grain size apx. 1.00 um.							2													
	gravel																				
	mud																				
	sand																				
	sandy shallows																	3,			

	bfh	bgb	cag	cms	cog	csn	dln	dnc	ens	gbh	grs	gry	lsp	phs	pss	rcc	sbd	sps	stf	wsp
Feeding: General, Carrion																				
n/a								3, 3												
Feeding: General, Detritus																				
n/a								2												
Feeding: General, Light																				
n/a			4		4	4	4			4		4	4	4		4	4	4		4
Feeding: General, Sound																				
n/a	4		-2		4	-3	-3			-3		-3	-3	-3		-3	-3	-3		-3
Feeding: General, Water/Sediment Quality																				
n/a	3		3		3	3	3					3	3	3			3	3		3
Feeding: General, Turbidity																				
n/a	4		4		4	4	4			-3		3	4	3		3	4	4		4
Feeding: Invertebrates, Benthic																				
Abarenicola pacifica									3											
Amphipoda (unid.)	4		4		4	4	4			4		4	4	4		4	4	4		3, 4
Annelida (unid.)	4					4	3			4		4	4	4		4	4	4		3
Bivalvia (unid.)									2						3				2	
Callianassa californiensis															3					
Cancer spp.														3						
Corbicula manilensis																3				
Corophium salmonis	4				4	4	3			4		4	4	4		4	4	4		4
Corophium spp.	4				4	4	3			4		4	3, 4	4			4	4		4
Decapoda (unid.)															1					
Macoma spp.	3				3			3	3											
Nematoda (unid.)	4				4	4	4			4		4	4	4		4	4	4		3
Polychaeta (unid.)									2, 2						1, 2				2	
Feeding: Invertebrates, Epibenthic																				
Archaeomysis grebnitzkii									3											
Atylus spp.																			2	
Corbicula manilensis	4				4					4		4		4			4			
Corophium salmonis									3											
Corophium spp.									3, 3										3	
Crangon spp.								3		3				3	3					
Cumella vulgaris									3										3	
Diptera (larvae)	3				4	3	3			4		4	4	4		4	4	4		3
Eogammarus confervicolus	4				4	4	3			4		4	4	4		4	4	4		3
Eogammarus spp.							3		3											
Eohaustorius washingtonius	4				4	4	4			4		4	4	4		4	4	4		3
Gammaridea (unid.)									2, 3						2				2	
Grapsidae (unid.)															1					
Harpacticoida (unid.)				3					3											
Harpacticus uniremis		3																		
Hemigrapsus spp.					3											3				
Mysidacea (unid.)	3								3											
Mysidacea (unid.)																				
Orchestoidea pugettensis	4				4	3	3			4		4	4	4			4	4		4
Ostrea lurida	3				3															
Pacificastacus leniusculus	4				4					4		4		4			4			
Pancolus californiensis	4				4	4	4			4		4	4	4		4	4			3
Pancolus californiensis																				
Tapes japonica	3				3															
Tisbe spp.		3																		
n/a									1, 3						3				3	
Feeding: Invertebrates, Neustonic																				
n/a	4						4													

	bfh	bgb	cag	cms	cog	csn	dln	dnc	ens	gbh	grs	gry	lsp	phs	pss	rcc	sbd	sps	stf	wsp
Feeding: Invertebrates, Pelagic																				
Callianassa californ. (larvae)				3																
Upogebia pugettensis (larvae)				3																
Feeding: Plants, Macro Algae																				
n/a	4		4		4	4						4								
Feeding: Vertebrates, Demersal																				
Cottidae (unid.)					4	4				3				3		3				
Lepidogobius lepidus	3									3										
Leptocottus armatus	2				3					3										
Platichthys stellatus					4	4				3, 3				3		3				
Pleuronichthys vetulus					4	4				3				4						
Feeding: Vertebrates, Terrestrial																				
Aves (unid.)										4						3				
Calidris alpina										4						4				
Feeding: Vertebrates, Water Column																				
Engraulis mordax	4				4	4				3		4				4		4		
Gasterosteus aculeatus															2					
Oncorhynchus spp. (fry)										3										
Teleostei (unid.)	4				4	4				3		3		3		3		4		
Refuge/Physiology: General, Salinity																				
n/a															2					
Refuge/Physiology: General, Light																				
n/a	4		4		4	4	4			4		4	4	4		4	4	4		4
Refuge/Physiology: General, Sound																				
n/a	-3		-2		-3	-3	-3			-3		-3	-3	-3			-3	-3		-3
Refuge/Physiology: General, Water/Sediment Quality																				
n/a	3		3		3									3						
Refuge/Physiology: Physical Complexity, Bathymetric Features																				
callianassid burrows		3																		
dendritic channels								3	3	3					3				3	
n/a	3				3		4			3, 4		3, 4		4			4			
Refuge/Physiology: Physical Complexity, Horizontal Edges																				
n/a	4	4	4		4	4	4	4	2, 4	3, 4		4	4	3	1	4		4	2, 4	4
Refuge/Physiology: Physical Complexity, Vertical Relief																				
shell hash								3												
n/a	3	4	3		3	3	3		3, 3,	3		3	3	3	1, 3	4	3	3	3, 4	3
cont'd									4											
Reproduction: Elevation, Riparian																				
n/a			3							3, 3										
Reproduction: Elevation, Subtidal																				
n/a									2, 3						1, 3				2, 3	
Reproduction: General, Salinity																				
n/a									-3										-3	
Reproduction: General, Temperature																				
n/a									-3										-3	
Reproduction: General, Light																				
n/a										4							4			
Reproduction: General, Sound																				
n/a										-3,-3							-3			
Reproduction: Substrate, Riparian Vegetation																				
n/a			3							3								4,		

	bgb	cks	cog	csn	dln	dnc	gbh	gry	hgb	lsp	phs	psd	psl	pss	sds	sps	ssd
Feeding: General, Salinity																	
n/a															2		
Feeding: General, Temperature																	
n/a								4									
Feeding: General, Light																	
n/a			4	4	4		4		4	4						4	
Feeding: General, Sound																	
n/a			4	-3	-3		-3		4	-3						-3	
Feeding: General, Water/Sediment Quality																	
n/a			3	3	3		3	3	3	3		3			3	3	3
Feeding: General, Turbidity																	
low							3										
n/a			-3	4	4		-3	-3	-3	4		-3			-3	4	-3
Feeding: Invertebrates, Benthic																	
Bivalvia (unid.)														3			
Callianassidae (unid.)														2			2
Clinocardium nutalli						2											
Corophium spp.			4	4	3		4	4	4	4						4	4
Decapoda (unid.)														1			
Mya arenaria			4	4		4	4	4		4		4		3	4	4	4
Oligochaeta (unid.)					3												
Polychaeta (unid.)					3									1, 2	1, 1		3
Feeding: Invertebrates, Epibenthic																	
Brachyrhyncha (unid.)			3	4		4	4	4		4						4	
Cancer magister														3			
Corophium spp.						4						4		4	4		
Crangon spp.			4	4		3, 4	3, 4	4		4		4		3, 3,	3, 4	4	4
(cont'd)														3			
Cumella vulgaris														3			
Eogammarus confervicolus			4	4	3	4	4	4	4	4		4		4	4	4	4
Gammaridea (unid.)		3															
Neomysis mercedis																	1
Orchestoidea pugettensis			4	4	3	4	4	4		4		4		4	4	4	4
Paraphoxus spp.			4	4	3	4	4	4	4	4		4		4	4	4	4
n/a												3		3	3		2
Feeding: Invertebrates, Neustonic																	
n/a					4	3											
Feeding: Vertebrates, Demersal																	
Citharichthys spp.							3										
Cottidae (unid.)			4	4			3	4	4								
Leptocottus armatus			3				3, 3		3								
Platichthys stellatus			4	4			3	4	4								
Feeding: Vertebrates, Water Column																	
Cottidae (unid.)							3										
Engraulis mordax			4	4		4	3	4	4						3		
n/a															3		
Refuge/Physiology: Biological Complexity, Submergent Vasc. Plants																	
refuge from wave action			4				4	4	4								
Refuge/Physiology: General, Light																	
n/a			4	4	4		4	4	4	4						4	
Refuge/Physiology: General, Sound																	
n/a			4	-3	-3		-3	-3	4	-3						-3	
Refuge/Physiology: General, Water/Sediment Quality																	
n/a			3	3	3			3	3	3		3			3	3	3
Refuge/Physiology: Physical Complexity, Bathymetric Features																	

		bgb	cks	cog	csn	dln	dnc	gbh	gry	hgb	lsp	phs	psd	psl	pss	sds	sps	ssd
	dendritic channels						3											
	depressions, pools		3															
	shallow depressions							2										
	tidepools			3				3	3									
	n/a			4	4	4		4	4	4	4						4	
Refuge/Physiology: Physical Complexity, Horizontal Edges																		
	n/a				4	4	4	3	4		4				1		4	
Refuge/Physiology: Physical Complexity, Vertical Relief																		
	shell hash						3											
	n/a			4	3	3		3	3		3						3	
Refuge/Physiology: Physical Complexity, Water Movement																		
	n/a			4				4		4								
Reproduction: Elevation, Riparian																		
	n/a							3, 3, 4									4	
Reproduction: General, Sound																		
	n/a							-3										
Reproduction: General, Water/Sediment Quality																		
	n/a					3			3		3						3	
Reproduction: Substrate, Riparian Vegetation																		
	n/a							3									3, 4	

		bfh	bfs	blb	blt	chs	cog	cpr	ctt	dcc	dvt	grs	hgb	lsp	mwg	pah	plp	psc	ptc	rcc
Feeding: General, Salinity																				
	n/a					2														
Feeding: General, Detritus																				
	n/a														4					4
Feeding: General, Temperature																				
	n/a					3, 3			3, 3		3									
Feeding: General, Light																				
	n/a	4				4			4	4	4		4	4	4					
Feeding: General, Sound																				
	n/a	4				4			4	4	4		4	-3	4					
Feeding: General, Water/Sediment Quality																				
	n/a	3							-3, 3	3	3		3	3	3					
Feeding: General, Turbidity																				
	30-60 NTU					-3														
	n/a	-3				-3, 3			-3, 3	-3	-3		-3		-3					-3
Feeding: Invertebrates, Benthic																				
	Bivalvia (unid.)								1											
	Corbicula manilensis																			3
	Corophium spp.	4											4	4	4					
	Dendraster excentricus																			
	Mya arenaria	4							4	4	4		4		4					4
	Nucella spp.																			2
	Polychaeta (unid.)		3						2											
	Tellina nuculoides																			
	n/a		2																	
Feeding: Invertebrates, Epibenthic																				
	Amphipoda (unid.)	4							4	4	4		4	3, 4	4					3
	Ampithoe spp.																			
	Anisogammarus pugettensis					3														
	Balanus spp.				3															
	Cancer magister																			3
	Cancer spp.							1												
	Copepoda (unid.)	4							4	4	4		4	4	4					4
	Corbicula manilensis	4							4	4	4		4	4	4					
	Corophium spp.					3, 3			3	4	4								2, 3	
	Crangon spp.	4							3	4	3	3	4		4			1	3	4
	Cumella vulgaris								2											
	Eogammarus spp.	4							4	4	4		4	4	4				3	
	Eusiroides spp.																			
	Gammaridea (unid.)		3			2, 3			3										3	
	Gnorimosphaeroma oregonese					2												1		
	Harpacticoida (unid.)																			
	Hemigrapsus spp.	2																		
	Heptacarpus spp.																			
	Hippolytidae (unid.)																	3		
	Mysidacea (unid.)					1														
	Mytilus edulis				3															
	Neomysis mercedis					3														
	Pacificastacus leniusculus	4							4	4	4		4	4	4					3
	Pugettia gracilis																			
	Tanaidacea (unid.)																			
	n/a		2			3		3	3			2, 3						3		

MATRIX II RESULTS: GRAVEL/COBBLE

	bfh	bfs	blb	blt	chs	cog	cpr	ctt	dcc	dvt	grs	hgb	lsp	mwg	pah	plp	psc	ptc	rcc
Feeding: Invertebrates, Neustonic																			
Insecta, terrestrial (unid.)					2														
Feeding: Invertebrates, Neustonic																			
n/a	4									4									
Feeding: Invertebrates, Pelagic																			
Calanoida (unid.)					1														
Decapoda (larvae)					1, 2, 3			1, 2											
Euphausiacea (unid.)					2			2, 2											
Hyperiidea (unid.)					3														
Mysidacea (unid.)	2																		
n/a							1	4		4			4						
Feeding: Plants, Macro Algae																			
Ulva spp.		3, 3																	
n/a	4	3																	
Feeding: Vertebrates, Demersal																			
Ammodytes hexapterus					2				3										
Apodichthys flavidus									3			3							
Clupea harengus pallasi (eggs)			3											3					
Cottidae (unid.)									3, 3	3		4							3
Gasterosteus aculeatus								3	3, 4	3		4							
Pholis laeta									3			3							
Platichthys stellatus									3			3							
Feeding: Vertebrates, Terrestrial																			
n/a								4	3	4									
Feeding: Vertebrates, Water Column																			
Ammodytes hexapterus					2			2		2									
Clupea harengus pallasi	4							2, 4	4	2, 4		4		4					
Cymatogaster aggregata	4							4	3	4		4		4					
Gasterosteus aculeatus									3			3							
Oncorhynchus spp. (fry)	4							1, 3	3, 4	4		3, 4		4					
Sebastes caurinus									3			3							
Thaleichthys pacificus	4							4	3	4		4		4					
Feeding: Vertebrates, Water Column																			
n/a								2											
Refuge/Physiology: Biological Complexity, Macro Algae																			
Laminaria spp.																2			
Ulva spp.																2			
n/a		3																	
Refuge/Physiology: Biological Complexity, Submergent Vasc. Plants																			
Macrocystis pyrifera							3									3			
Zostera spp.																			
Refuge/Physiology: General, Salinity																			
mesohaline					2														
polyhaline																			
n/a					3		-3	3											
Refuge/Physiology: General, Temperature																			
n/a					-3, 3			-3, 3		3									
Refuge/Physiology: General, Light																			
n/a	4				4			4	4	4		4	4	4					
Refuge/Physiology: General, Sound																			
n/a					-3, 4			-3, 4		4									
Refuge/Physiology: General, Water/Sediment Quality																			
n/a	3							-2, 3		3		3	4	3					
Refuge/Physiology: General, Turbidity																			
n/a					3, 4			3, 4		4									

		bfh	bfs	blb	blt	chs	cog	cpr	ctt	dcc	dvt	grs	hgb	lsp	mwg	pah	plp	psc	ptc	rcc
Refuge/Physiology: Physical Complexity, Bathymetric Features																				
	n/a	4	3			2, 3, 3		3	1, 3		1, 3	3	4	4				3		
Refuge/Physiology: Physical Complexity, Horizontal Edges																				
	n/a					2, 3, 4			1, 4		1, 4			4						4
Refuge/Physiology: Physical Complexity, Vertical Relief																				
	n/a	4							3	3	3			3	3					
Refuge/Physiology: Physical Complexity, Water Movement																				
	< 40 cm/sec					3														
Reproduction: Elevation, Intertidal																				
	+7 ft to + 11 ft																			
	n/a															3				
Reproduction: Elevation, Subtidal																				
	n/a							3								3	2		2	
Reproduction: General, Salinity																				
	freshwater seepage																			
Reproduction: Substrate, Macro Algae																				
	n/a															3				
Reproduction: Substrate, Sediment																				
	1-7 mm diameter																			
	n/a							3												

		rcr	rks	rvl	rvo	sfs	sps	stf	wgr	wsg
Feeding: General, Salinity										
	n/a					3				
Feeding: General, Detritus										
	n/a									
Feeding: General, Temperature										
	n/a					3, 3				
Feeding: General, Light										
	n/a	4					4		4	
Feeding: General, Sound										
	n/a	4					-3		4	
Feeding: General, Water/Sediment Quality										
	n/a	3	3			-3, 3	3	3	3	
Feeding: General, Turbidity										
	30-60 NTU									
	n/a					-3, 3			-3	
Feeding: Invertebrates, Benthic										
	Bivalvia (unid.)									
	Corbicula manilensis									
	Corophium spp.						4		4	
	Dendraster excentricus							2		
	Mya arenaria							3	4	
	Nucella spp.									
	Polychaeta (unid.)							2		
	Tellina nuculoides							3		
	n/a		3							
Feeding: Invertebrates, Epibenthic										
	Amphipoda (unid.)						3, 4	3	4	
	Ampithoe spp.									2
	Anisogammarus pugettensis									
	Balanus spp.	3								
	Cancer magister									
	Cancer spp.									2
	Copepoda (unid.)						4	3	4	
	Corbicula manilensis						4		4	
	Corophium spp.							3, 3		
	Crangon spp.							3	4	
	Cumella vulgaris							2		
	Eogammarus spp.						4	3	4	
	Eusiroides spp.									2
	Gammaridea (unid.)					3		3		
	Gnorimosphaeroma oregonese		1							
	Harpacticoida (unid.)					3				
	Hemigrapsus spp.									
	Heptacarpus spp.							1		3
	Hippolytidae (unid.)									2
	Mysidacea (unid.)							1		
	Mytilus edulis									
	Neomysis mercedis									
	Pacificastacus leniusculus								4	
	Pugettia gracilis									2
	Tanaidacea (unid.)		1							
	n/a		3							2, 3

		rcr	rks	rvl	rvo	sfs	sps	stf	wgr	wsg
Feeding: Invertebrates, Neustonic										
	Insecta, terrestrial (unid.)									
Feeding: Invertebrates, Neustonic										
	n/a									
Feeding: Invertebrates, Pelagic										
	Calanoida (unid.)					3				
	Decapoda (larvae)					1				
	Euphausiacea (unid.)					2				
	Hyperiidea (unid.)					1				
	Mysidacea (unid.)									
	n/a						4			
Feeding: Plants, Macro Algae										
	Ulva spp.									
	n/a									
Feeding: Vertebrates, Demersal										
	Ammodytes hexapterus	4								
	Apodichthys flavidus									
	Clupea harengus pallasi (eggs)									
	Cottidae (unid.)								3, 4	
	Gasterosteus aculeatus						4		4	
	Pholis laeta									
	Platichthys stellatus	3							3	
Feeding: Vertebrates, Terrestrial										
	n/a									
Feeding: Vertebrates, Water Column										
	Ammodytes hexapterus									
	Clupea harengus pallasi	4							3	
	Cymatogaster aggregata	4							3	
	Gasterosteus aculeatus									
	Oncorhynchus spp. (fry)	4							4	
	Sebastes caurinus									
	Thaleichthys pacificus	4							3, 3	
Feeding: Vertebrates, Water Column										
	n/a									3
Refuge/Physiology: Biological Complexity, Macro Algae										
	Laminaria spp.									3
	Ulva spp.	3								3
	n/a									2
Refuge/Physiology: Biological Complexity, Submergent Vasc. Plants										
	Macrocystis pyrifera									
	Zostera spp.					2				
Refuge/Physiology: General, Salinity										
	mesohaline									
	polyhaline					3				
	n/a					3				
Refuge/Physiology: General, Temperature										
	n/a					-3				
Refuge/Physiology: General, Light										
	n/a						4		4	
Refuge/Physiology: General, Sound										
	n/a									
Refuge/Physiology: General, Water/Sediment Quality										
	n/a					-3, 3	4		3	
Refuge/Physiology: General, Turbidity										
	n/a					3, 4				

		rcr	rks	rvl	rvo	sfs	sps	stf	wgr	wsg
Refuge/Physiology: Physical Complexity, Bathymetric Features										
	n/a	4	3			3	4	3	4	
Refuge/Physiology: Physical Complexity, Horizontal Edges										
	n/a	4					4			
Refuge/Physiology: Physical Complexity, Vertical Relief										
	n/a		3				3	3		
Refuge/Physiology: Physical Complexity, Water Movement										
	< 40 cm/sec									
Reproduction: Elevation, Intertidal										
	+7 ft to + 11 ft					3				
	n/a					3				
Reproduction: Elevation, Subtidal										
	n/a									3
Reproduction: General, Salinity										
	freshwater seepage					2				
Reproduction: Substrate, Macro Algae										
	n/a									
Reproduction: Substrate, Sediment										
	1-7 mm diameter					3				
	n/a					3,				

	bfh	blb	bpf	cag	cms	crg	csn	dnc	gbh	gry	gwg	kpp	lgc	lsp	osp	pah	phs
Feeding: General, Salinity																	
n/a			4	4	2, 4	4		2, 4				4					
Feeding: General, Carrion																	
n/a								3, 3			3						
Feeding: General, Detritus																	
n/a					2, 3			3			4						
Feeding: General, Temperature																	
n/a					-3, 2			4									
Feeding: General, Graveling																	
n/a		3						-2									
Feeding: General, Light																	
n/a	4	4		4	-2				4	4				4	4		4
Feeding: General, Sound																	
n/a	-3	-3		-3	-2				-3	-3				-3	-3		4
Feeding: General, Water/Sediment Quality																	
n/a	3	3		3	2, 3					3	3				3		1
Feeding: General, Turbidity																	
n/a	3	3		4	-2, 3			4	3	3					3		1
Feeding: Invertebrates, Benthic																	
Bivalvia (unid.)								2									
Callianassa californiensis								3									
Capitellidae (unid.)								3									
Corophium spp.	4									4	4			4			
Cryptomya californica								3									
Invertebrates, benthic (unid.)	4			4					4	4	4			4			
Macoma spp.								3									
Mya arenaria								3									
Polychaeta (unid.)																	
Tellina spp.								3									
n/a																	
Feeding: Invertebrates, Epibenthic																	
Alienacanthomysis macropsis																	
Aoroides inermis						1											
Bivalvia (unid.)					4				4		3	4					3
Calanoida (unid.)					2												
Cancer magister					4			2	4		4						3
Caprella laeviuscula						3											
Caprellidea (unid.)																	
Corophium spp. (males)					3												
Crangon spp.					4			3	4	4	4	4		4			3
Cumella vulgaris					2, 2							2					
Cyclopoida (unid.)					2												
Decapoda (unid.)												2					
Eogammarus confervicolus			4		4	4				4	4	4		4			
Eogammarus spp.					3												
Gammaridea (unid.)					2, 3	3						2					
Harpacticoida (unid.)					2, 3							2					
Harpacticus spinulosus																	
Harpacticus spp.					3			3									
Harpacticus uniremis					3												
Hemigrapsus nudis																	
Hippolytidae (unid.)																	
Ischyrocerus spp.						3											
Metacaprella kennerlyi						1											
Mysidacea (unid.)			4		4	4				4	4	4		4			

		bfh	blb	bpf	cag	cms	crg	csn	dnc	gbh	gry	gwg	kpp	lgc	lsp	osp	pah	phs
	Pontogeneia rostrata																	
	Scutellidium arthuri																	
	Tanaidacea (unid.)										4	4			4			
	Tisbe spp.					2												
	Zaus spp.					3												
	n/a			1, 2, 3			1, 3											
Feeding: Invertebrates, Neustonic																		
	n/a																	
Feeding: Invertebrates, Pelagic																		
	Aetidius spp.																	
	Corycaeus anglicus																	
	Decapoda (larvae)																	
	Paracalanus spp.																	
	Tortanus discandatus																	
	n/a																	
Feeding: Plants, Emergent Vascular																		
	Spartina spp.		-3															
	n/a	4	4		3													
Feeding: Plants, Macro Algae																		
	Ulva spp.	1	3															
	n/a	4	3		3						4	4						
Feeding: Plants, Submergent Vascular																		
	Zostera japonica	3	3		3													
	Zostera marina	3	3		3													
	Zostera spp.				2				2									
Feeding: Vertebrates, Demersal																		
	Clupea harengus pallasi (eggs)		3															
	Leptocottus armatus								3	3, 3,	4				4	4		4
	cont'd									4								
	Lumpenus sagitta																	3
	Platichthys stellatus									3								
	Porichthys notatus																	3
	Psettichthys melanostictus								3									
	Teleostei, benthic (unid.)									3, 4	3				4	4		3
Feeding: Vertebrates, Terrestrial																		
	Aves (unid.)									4		3						
Feeding: Vertebrates, Water Column																		
	Clupea harengus pallasi								3	2, 4	4	2				4		3
	Cymatogaster aggregata									3								
	Embiotocidae (unid.)								3	3								
	Oncorhynchus spp. (fry)									4	4	4				3		1
	Thaleichthys pacificus								3	4	4	3				3		3
Refuge/Physiology: Biological Complexity, Emergent Vasc. Plants																		
	n/a	4	3		3	4			4	4	3	4			3	4		4
Refuge/Physiology: Biological Complexity, Macro Algae																		
	epiphytic algae/animals			3			2											
	Ulva spp.												2					
	n/a								3			4						
Refuge/Physiology: Biological Complexity, Submergent Vasc. Plants																		
	substrate/gravel		3															
	Zostera spp.			3		3							3					
	n/a	4	3		4	4			3	4		4						
Refuge/Physiology: General, Salinity																		
	n/a					2, 3, 4							-3					

	bfh	blb	bpf	cag	cms	crg	csn	dnc	gbh	gry	gwg	kpp	lgc	lsp	osp	pah	phs
Refuge/Physiology: General, Temperature																	
n/a					-3, 2, 3												
Refuge/Physiology: General, Sound																	
n/a	4	4		-1, 4	-2, 4				-3, 4	-3, 4				-3, 4	4		-3, 4
Refuge/Physiology: General, Water/Sediment Quality																	
n/a	3	3		3	-3, 2				3		3						1
Refuge/Physiology: General, Turbidity																	
n/a					-3,-2			4									
Refuge/Physiology: Physical Complexity, Bathymetric Features																	
n/a	3								3	4				4			3
Refuge/Physiology: Physical Complexity, Horizontal Edges																	
n/a	4	4		4	3, 4				4	4				4			3
Refuge/Physiology: Physical Complexity, Vertical Relief																	
n/a	4	3		3	3, 4				3	3	3			3	3, 4		3
Refuge/Physiology: Physical Complexity, Water Movement																	
n/a					1, 4												
Reproduction: Elevation, Riparian																	
n/a				4					3						3		1
Reproduction: General, Salinity																	
n/a								2									
Reproduction: General, Water/Sediment Quality																	
n/a								3									
Reproduction: Substrate, Macro Algae																	
n/a																	
Reproduction: Substrate, Riparian Vegetation																	
n/a				3					3						3		

		ppg	rvo	shp	spb	sps	ssp	tbs
Feeding: General, Salinity								
	n/a	4		4	4		4	4
Feeding: General, Carrion								
	n/a							
Feeding: General, Detritus								
	n/a							
Feeding: General, Temperature								
	n/a							
Feeding: General, Graveling								
	n/a							
Feeding: General, Light								
	n/a					4		
Feeding: General, Sound								
	n/a					-3		
Feeding: General, Water/Sediment Quality								
	n/a							
Feeding: General, Turbidity								
	n/a							
Feeding: Invertebrates, Benthic								
	Bivalvia (unid.)				2			
	Callianassa californiensis							
	Capitellidae (unid.)			3				
	Corophium spp.			3		4	4	
	Cryptomya californica							
	Invertebrates, benthic (unid.)			4		4	4	
	Macoma spp.							
	Mya arenaria							
	Polychaeta (unid.)				2			
	Tellina spp.							
	n/a						2	
Feeding: Invertebrates, Epibenthic								
	Alienacanthomysis macropsis							2
	Aoroides inermis	1		1			1	
	Bivalvia (unid.)			4			4	
	Calanoida (unid.)							
	Cancer magister			4			4	
	Caprella laeviuscula			1			1	
	Caprellidea (unid.)							3
	Corophium spp. (males)			3				
	Crangon spp.			4	4		4	
	Cumella vulgaris			2			2	
	Cyclopoida (unid.)							
	Decapoda (unid.)							
	Eogammarus confervicolus	4			4		2	4
	Eogammarus spp.			3				
	Gammaridea (unid.)	3		3	1		3, 3	
	Harpacticoida (unid.)			3			3	
	Harpacticus spinulosus	2					1	2
	Harpacticus spp.			3			3	
	Harpacticus uniremis			1				1
	Hemigrapsus nudis						2	
	Hippolytidae (unid.)			2			2	
	Ischyrocerus spp.	3		2			3	1
	Metacaprella kennerlyi			1				
	Mysidacea (unid.)	4		3	4		4	4

		ppg	rvo	shp	spb	sps	ssp	tbs
	Pontogeneia rostrata			2				
	Scutellidium arthuri			1				
	Tanaidacea (unid.)			3			4	
	Tisbe spp.	1		3			1	3
	Zaus spp.	1		1				1
	n/a	1, 2, 3		1, 2, 3			2, 3	3
Feeding: Invertebrates, Neustonic								
	n/a			3				
Feeding: Invertebrates, Pelagic								
	Aetidius spp.							1
	Corycaeus anglicus							3
	Decapoda (larvae)						3	
	Paracalanus spp.							2
	Tortanus discandatus							1
	n/a							2
Feeding: Plants, Emergent Vascular								
	Spartina spp.							
	n/a							
Feeding: Plants, Macro Algae								
	Ulva spp.							
	n/a							
Feeding: Plants, Submergent Vascular								
	Zostera japonica							
	Zostera marina							
	Zostera spp.							
Feeding: Vertebrates, Demersal								
	Clupea harengus pallasi (eggs)							
	Leptocottus armatus					4		
	cont'd							
	Lumpenus sagitta							
	Platichthys stellatus							
	Porichthys notatus							
	Psettichthys melanostictus							
	Teleostei, benthic (unid.)					4		
Feeding: Vertebrates, Terrestrial								
	Aves (unid.)							
Feeding: Vertebrates, Water Column								
	Clupea harengus pallasi							
	Cymatogaster aggregata							
	Embiotocidae (unid.)							
	Oncorhynchus spp. (fry)							
	Thaleichthys pacificus							
Refuge/Physiology: Biological Complexity, Emergent Vasc. Plants								
	n/a					3		
Refuge/Physiology: Biological Complexity, Macro Algae								
	epiphytic algae/animals	2						
	Ulva spp.			3			2	
	n/a							
Refuge/Physiology: Biological Complexity, Submergent Vasc. Plants								
	substrate/gravel							
	Zostera spp.			3			3	3
	n/a							
Refuge/Physiology: General, Salinity								
	n/a			-3			-3	

		ppg	rvo	shp	spb	sps	ssp	tbs
Refuge/Physiology: General, Temperature								
	n/a							
Refuge/Physiology: General, Sound								
	n/a			4		-3, 4	-3, 4	4
Refuge/Physiology: General, Water/Sediment Quality								
	n/a							
Refuge/Physiology: General, Turbidity								
	n/a							
Refuge/Physiology: Physical Complexity, Bathymetric Features								
	n/a					4		
Refuge/Physiology: Physical Complexity, Horizontal Edges								
	n/a					4		
Refuge/Physiology: Physical Complexity, Vertical Relief								
	n/a			3		3		
Refuge/Physiology: Physical Complexity, Water Movement								
	n/a							
Reproduction: Elevation, Riparian								
	n/a					4		
Reproduction: General, Salinity								
	n/a							
Reproduction: General, Water/Sediment Quality								
	n/a							
Reproduction: Substrate, Macro Algae								
	n/a							3
Reproduction: Substrate, Riparian Vegetation								
	n/a							

MATRIX II RESULTS: NEARSHORE SUBTIDAL SOFT BOTTOM

	cmr	cos	dnc	dvs	grw	hys	lss	mwf	nos	pac	ptc	rsc	rtf	stp	wep
Feeding: General, Salinity															
mesohaline							2								
n/a		-3		-3		-3		-3	-3	-3			-3		-3
Feeding: General, Water/Sediment Quality															
n/a		3		3		3				-3,3	-3,3	3	3	3	-3,3
Feeding: General, Turbidity															
n/a										-3,3	-3,3		3	-3	-3,3
Feeding: Invertebrates, Benthic															
Ampelisca agassizi					3										
Ampelisca careyi					2										
Bivalvia (unid.)						3									
Callianassa californiensis			3												
Clinocardium nutalli			2												
Macoma spp.			3												
Mya arenaria			3												
Orchomene minuta					2										
Photis lacia					2										
Polychaeta (unid.)				3							2				
Protomedeia penates					2										
Sarsia spp.													1		
Tellina spp.			3												
Veneropsis japonica			2												
Yoldia spp.													3		
n/a		2,3		2,3									3		
Feeding: Invertebrates, Epibenthic															
Cancer spp.													1		
Crangon spp.			3								3			2	
Gammaridea (unid.)										3	3				
Hemigrapsus spp.													2		
Mysidacea (unid.)										3	2				
Neomysis mercedis										3	3				
n/a		1		2							1,2,3		2,3	3	1,2,3
Feeding: Invertebrates, Pelagic															
Calanoida (unid.)															2
Decapoda (larvae)										3					2
Euphausiacea (unid.)										2					
n/a															2
Feeding: Vertebrates, Demersal															
Ammodytes hexapterus			3												
Leptocottus armatus			3												
Microgadus proximus			3												
Feeding: Vertebrates, Water Column															
Clupea harengus pallasi			3							3,3					3,3
Thaleichthys pacificus			3												
Refuge/Physiology: Biological Complexity, Macro Algae															
n/a			3												
Refuge/Physiology: Biological Complexity, Submergent Vasc. Plants															
n/a			3												
Refuge/Physiology: General, Salinity															
n/a										3					
Refuge/Physiology: General, Water/Sediment Quality															
n/a		3		3		3				-3,3	-3,3	3	3	3	-3,3
Refuge/Physiology: General, Turbidity															
n/a										3	3				3

MATRIX II RESULTS: NEARSHORE SUBTIDAL SOFT BOTTOM

		cmr	cos	dnc	dvs	grw	hys	lss	mwf	nos	pac	ptc	rsc	rtf	stp	wep
Refuge/Physiology: Physical Complexity, Horizontal Edges																
	n/a			-1												
Refuge/Physiology: Physical Complexity, Vertical Relief																
	n/a			-1												
Reproduction: Elevation, Subtidal																
	n/a			3,3												
Reproduction: Elevation, Subtidal																
	n/a										3					
Reproduction: General, Salinity																
	n/a									-3	-3	-3		-3		-3
Reproduction: Substrate, Sediment																
	mud			1												

		blr	brr	cbz	cpr	klg	lgc	plp	qbr	ssp
Feeding: Invertebrates, Benthic										
	Transennella tantilla							3		
Feeding: Invertebrates, Epibenthic										
	Balanus crenatus							3		
	Balanus glandula							3		
	Eualus spp.	3	3		3	3			3	
	Gammaridea (unid.)				3					3
	Heptacarpus spp.	3	3		3	3			3	
	Lebbeus spp.	3	3		3	3			3	
	Pandalus danae				3				3	
	Spirontocaris spp.	3	3		3	3			3	
Feeding: Invertebrates, Pelagic										
	Calanoida (unid.)				3				3	
	Cancer spp. (zoea)				3				3	3
Feeding: Vertebrates, Water Column										
	Ammodytes hexapterus						3			
	Clupea harengus pallasi						3			
	Phanerodon furcatus				3					

	bfh	chs	cks	cms	cog	com	csa	dcc	gdw	lfs	mwg	noa	osp	pah	phk	phs	psa	psl	rbm
Feeding: General, Detritus																			
n/a											3								
Feeding: General, Temperature																			
n/a		3, 3,	2, 3,	3, 3, 3													3, 3, 3		
(cont'd)		3	3																
Feeding: General, Light																			
n/a	4	4	4	4	4	4		4	4		4		4			4	4		4
Feeding: General, Sound																			
n/a	4	4	4	4	4	4		4	4		4		4			4	4		4
Feeding: General, Water/Sediment Quality																			
n/a	3	-3, 3	-3, 3	-3, 3	3	3		3	3		3		3			3	-3, 3		3
Feeding: General, Turbidity																			
low		3	3	3													3		
n/a	4	-3,-2	-3,-2	-3,-2	-3	-3		-3	-3				4			-3	-3,-2		-3
Feeding: Invertebrates, Epibenthic																			
Calanoida (unid.)			2	2													2		
Cancer magister																2			
Corophium spp.		3	3	3						3									
Crangon franciscorum																2			
Decapoda (unid.)																			
Eogammarus spp.										3									
Gammaridea (unid.)		3	3	3															
Harpacticoida (unid.)				3															
Cancer spp. (larvae)		2		3															
Cancer spp. (larvae)																			
Epilabidocera amphitrites		3		2													1		
Epilabidocera spp.				3															
Insecta (drift)		3																	
Insecta, terrestrial (unid.)		2	3																
Scoloidea (unid.)																			
Feeding: Invertebrates, Neustonic																			
n/a			2	1															
Feeding: Invertebrates, Pelagic																			
Acartia californiensis										4		3		4					
Acartia clausi				3						3, 3		3		3, 3			3		
Calanoida (unid.)			2	3										3			3	3	
Callianassa californ. (larvae)		1, 3	3	3, 3, 3								1		1			2		
Cancer spp. (megalops)											3								
Copepoda (unid.)				3						3		4		3				3	
Corycaeus anglicus				2								2		2					
Corycaeus spp.				3															
Daphnia spp.			3, 3	2										2					
Decapoda (larvae)			3	2, 2										3			1		
Euphausia pacifica		3	2	3													3		
Euphausiacea (unid.)		3	2, 2,	2, 2, 3										2			2, 3		
(cont'd)			3																
Eurytemora affinis		3								4		3		4					
Hyperiidea (unid.)		3	3	1										2			1		
Insecta (larvae)			1	2, 3										2			3, 3		
Loligo opalescens																3			
Mysidacea (unid.)	2									3, 3		4		3, 3					
Natantia (unid.)																		3	
Octopus spp.																			
Oikopleura spp.				2													2		
Oithona similis																	3		

	bfh	chs	cks	cms	cog	com	csa	dcc	gdw	lfs	mwg	noa	osp	pah	phk	phs	psa	psl	rbm
Parathemisto pacifica		1		2													2		
Pseudocalanus minutus																	3		
Pseudocalanus spp.												4		4					
n/a		2, 3	3	3, 3						2, 3		2		1, 3			2, 3		
Feeding: Vertebrates, Demersal																			
Cottidae (unid.)	3				3	3		3, 3	3		3		3			3			3
Gadus macrocephalus																3			
Leptocottus armatus																2			
Lumpenus sagitta																2			
Microgadus proximus																2, 3			
Platichthys stellatus																2			
Pleuronectidea (unid.)																3			
Porichthys notatus																3			
Teleostei, benthic (unid.)	4				4	3		3	4		4		4			3			4
Theragra chalcogramma																3			
Feeding: Vertebrates, Water Column																			
Allosmerus elongatus																4			
Ammodytes hexapterus		1, 3,	1, 2, 3													3			
(cont'd)		3																	
Clupea harengus pallasi	4	2, 3,	2, 3,	1	4	3		4	4		4		4			2, 4	3		4
(cont'd)		4	4																
Cottidae (unid.)																			
Cymatogaster aggregata	4	4	4		4	3		3	4		4		4			3			4
Engraulis mordax		3														2, 3, 3			
Gasterosteus aculeatus						3													3
Gonatidae (unid.)																			
Hypomesus pretiosus		3																	
Lampetra tridentatus																2			
Lycodopsis pacifica																3			
Mallotus villosus																			
Merluccius productus																3			
Oncorhynchus gorbuscha (fry)		3	3																
Oncorhynchus keta (fry)		3	3																
Oncorhynchus spp.																1			
Oncorhynchus spp. (fry)	4	4	4		4	3, 3		4	4		4		4						3
Parophyrs vetulus																2			
Scorpaenidae (unid.)																			
Sebastes spp.																			
Spirinchus thaleichthys																2			
Teleostei (larvae)		3	3																
Thaleichthys pacificus	4	4	4		4	3		3	4		4		3			3, 3, 4			4
Thaleichthys pacificus																			
n/a		2	2									2							
Refuge/Physiology: Biological Complexity, Emergent Vasc. Plants																			
Phragmites spp.																			
Scirpus spp.																			
Typha spp.																			
Refuge/Physiology: General, Salinity																			
n/a		-2	-2	-2										-2			-2	-2	
Refuge/Physiology: General, Temperature																			
n/a		-3, 3	-3, 3	-3, 3													-3, 3		
Refuge/Physiology: General, Light																			
<2-13				2													2		
n/a	4	4	4	4	4	4		4	4		4		4			4	4		4

		bfh	chs	cks	cms	cog	com	csa	dcc	gdw	lfs	mwg	noa	osp	pah	phk	phs	psa	psl	rbm
Refuge/Physiology: General, Sound																				
	n/a	4	4	4	4	4	4		4	4		4		4			-3	4		4
Refuge/Physiology: General, Water/Sediment Quality																				
	n/a	3	-3, 3	-3, 3	-3, 3	3	3		3	3		3		3			3	-3, 3		3
Refuge/Physiology: General, Turbidity																				
	n/a		3, 4	3, 4	3, 4													3, 4		
Refuge/Physiology: Physical Complexity, Bathymetric Features																				
	n/a								3											
Refuge/Physiology: Physical Complexity, Horizontal Edges																				
	n/a																			
Refuge/Physiology: Physical Complexity, Vertical Relief																				
	n/a								3					3			3			
Refuge/Physiology: Physical Complexity, Water Movement																				
	n/a																			
Reproduction: Elevation, Intertidal																				
	n/a														3					
Reproduction: Elevation, Riparian																				
	n/a									3				3, 3						
Reproduction: Elevation, Subtidal																				
	n/a														3, 3					
Reproduction: General, Salinity																				
	polyhaline														3					
	n/a														2					
Reproduction: General, Water/Sediment Quality																				
	n/a														3					
Reproduction: Substrate, Emergent Vasc. Plants																				
	Distichlis spp.																			
	Scirpus spp.																			
	Typha spp.																			
Reproduction: Substrate, Macro Algae																				
	Ulva spp.														3					
	Zostera marina														3					
	Zostera spp.														3					
	n/a														4					
Reproduction: Substrate, Riparian Vegetation																				
	n/a									3				3						
Reproduction: Substrate, Sediment																				
	gravel																			
	Zostera marina														3					

		rvl	sfs	sht	ssc	ssl	tss	wbl	wgr
Feeding: General, Detritus									
	n/a								
Feeding: General, Temperature									
	n/a			3, 3, 3					
	(cont'd)								
Feeding: General, Light									
	n/a			4		4			4
Feeding: General, Sound									
	n/a			4		4			4
Feeding: General, Water/Sediment Quality									
	n/a			-3, 3		3			3
Feeding: General, Turbidity									
	low			3					
	n/a			-3,-2		4			-3
Feeding: Invertebrates, Epibenthic									
	Calanoida (unid.)								
	Cancer magister								
	Corophium spp.			3					
	Crangon franciscorum								
	Decapoda (unid.)								3
	Eogammarus spp.								
	Gammaridea (unid.)								
	Harpacticoida (unid.)								
	Cancer spp. (larvae)								
	Cancer spp. (larvae)								
	Epilabidocera amphitrites								
	Epilabidocera spp.								
	Insecta (drift)								
	Insecta, terrestrial (unid.)								
	Scoloidea (unid.)			2					
Feeding: Invertebrates, Neustonic									
	n/a			2					
Feeding: Invertebrates, Pelagic									
	Acartia californiensis		3						
	Acartia clausi		3						
	Calanoida (unid.)		3	1					
	Callianassa californ. (larvae)			1, 3					
	Cancer spp. (megalops)								
	Copepoda (unid.)								
	Corycaeus anglicus								
	Corycaeus spp.								
	Daphnia spp.		3						
	Decapoda (larvae)		2	2, 3					
	Euphausia pacifica								
	Euphausiacea (unid.)		2	3					
	(cont'd)								
	Eurytemora affinis		3						
	Hyperiidea (unid.)		2						
	Insecta (larvae)		2	1					
	Loligo opalescens								
	Mysidacea (unid.)								
	Natantia (unid.)								3
	Octopus spp.					2			
	Oikopleura spp.		2						
	Oithona similis								

		rvl	sfs	sht	ssc	ssl	tss	wbl	wgr
	Parathemisto pacifica								
	Pseudocalanus minutus								
	Pseudocalanus spp.								
	n/a		3	3					
Feeding: Vertebrates, Demersal									
	Cottidae (unid.)					3			3, 3
	Gadus macrocephalus					2			
	Leptocottus armatus								
	Lumpenus sagitta								
	Microgadus proximus								
	Platichthys stellatus								
	Pleuronectidea (unid.)					3			
	Porichthys notatus								
	Teleostei, benthic (unid.)					4			4
	Theragra chalcogramma					3			
Feeding: Vertebrates, Water Column									
	Allosmerus elongatus								
	Ammodytes hexapterus	1		3				1	
	(cont'd)								
	Clupea harengus pallasi	3, 4		3, 4		2, 4		3	3, 3
	(cont'd)								
	Cottidae (unid.)					2			
	Cymatogaster aggregata	4		4		4		4	3, 4
	Engraulis mordax								
	Gasterosteus aculeatus								
	Gonatidae (unid.)					3			
	Hypomesus pretiosus								
	Lampetra tridentatus								
	Lycodopsis pacifica								
	Mallotus villosus					2			
	Merluccius productus					3			
	Oncorhynchus gorbuscha (fry)								
	Oncorhynchus keta (fry)								
	Oncorhynchus spp.					2, 4			
	Oncorhynchus spp. (fry)	4		4					4
	Parophyrs vetulus								
	Scorpaenidae (unid.)					2, 3			
	Sebastes spp.					3			
	Spirinchus thaleichthys								
	Teleostei (larvae)								
	Thaleichthys pacificus	4		4		4			4
	Thaleichthys pacificus								
	n/a								
Refuge/Physiology: Biological Complexity, Emergent Vasc. Plants									
	Phragmites spp.								3
	Scirpus spp.								3
	Typha spp.								3
Refuge/Physiology: General, Salinity									
	n/a								
Refuge/Physiology: General, Temperature									
	n/a			-3, 3					
Refuge/Physiology: General, Light									
	<2-13								
	n/a			4		4			4

		rvl	sfs	sht	ssc	ssl	tss	wbl	wgr
Refuge/Physiology: General, Sound									
	n/a			4		4			4
Refuge/Physiology: General, Water/Sediment Quality									
	n/a			-3, 3		3			3
Refuge/Physiology: General, Turbidity									
	n/a			3, 4					
Refuge/Physiology: Physical Complexity, Bathymetric Features									
	n/a								
Refuge/Physiology: Physical Complexity, Horizontal Edges									
	n/a								4
Refuge/Physiology: Physical Complexity, Vertical Relief									
	n/a					3			4
Refuge/Physiology: Physical Complexity, Water Movement									
	n/a	3						3	
Reproduction: Elevation, Intertidal									
	n/a		3						
Reproduction: Elevation, Riparian									
	n/a								4
Reproduction: Elevation, Subtidal									
	n/a		1						
Reproduction: General, Salinity									
	polyhaline								
	n/a		3						
Reproduction: General, Water/Sediment Quality									
	n/a								
Reproduction: Substrate, Emergent Vasc. Plants									
	Distichlis spp.								3
	Scirpus spp.								3
	Typha spp.								3
Reproduction: Substrate, Macro Algae									
	Ulva spp.								
	Zostera marina								
	Zostera spp.								
	n/a								
Reproduction: Substrate, Riparian Vegetation									
	n/a								4
Reproduction: Substrate, Sediment									
	gravel		3						
	Zostera marina								

APPENDIX C: SUPPLEMENTAL BIBLIOGRAPHY

The following bibliographic references are the results of a literature search designed to compliment and enhance the results of Matrix II. References were obtained primarily through the use of a computerized technical literature data base system (Compact Cambridge Aquatic Sciences and Fisheries Abstracts and Life Science Collection) using common and Latin names of assemblage species as search items. The Compact Cambridge systems do not list references published prior to 1975. Abstracts of papers were read to determine relevance to the project. Those references that reported on fish and wildlife relationships to estuarine habitats were added to the Protocol Data Base and used to supplement the list of attributes obtained in the Matrix II process.

These results are reported in this appendix, sorted by the common name of the assemblage species to which the reference pertains. Furthermore, the habitat function associated with the paper is also listed following the reference. Format of the computerized retrieval did not allow for use of the standardized bibliographic style utilized in the rest of the Protocol.

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Feeding: Vertebrates, Water Column.

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Feeding: Invertebrates, Epibenthic.

SURF SMELT

Hawkes-JW; Stehr-CM. Cytopathology of the Brain and Retina of Embryonic Surf Smelt (Hypomesus pretisus) Exposed to Crude Oil. ENVIRON. RES., 1982., vol. 27, no. 1, pp. 164-178.
Refuge/Physiology: General, Water/Sediment Quality.

Lichatowich-J; Bottom-DL; Jones-KK; Herring-MJ.. Fishes of the Columbia River Estuary. Columbia River Estuary Data Development Program. 1984.
Feeding: Invertebrates, Pelagic.

Malins-DC; Hidgins-HO; McCain-BB; Weber-DD; Varanasi-U; Brown-DW. Sublethal effects of petroleum hydrocarbons and trace metals, including biotransformations, as reflected by morphological, chemical, physiological, pathological, and behavioral indices. ENVIRONMENTAL ASSESSMENT OF THE ALASKAN CONTINENTAL SHELF. ANNUAL REPORTS OF PRINCIPAL INVESTIGATORS FOR THE YEAR ENDING MARCH 1980. VOLUME 3: EFFECTS, CONTAMINANT BASELINES., NOAA/OMPA, BOULDER, CO (
Reproduction: General, Water/Sediment Quality.

Penttila-D.. Studies of the surf smelt (Hypomesus pretiosus) in Puget Sound. Wash. Dept. Fish. Tech. Rept. 42: 47 pp.
Reproduction: Substrate, Sediment; Reproduction: General, Temperature; Reproduction: Elevation, Intertidal.

Simenstad-CA; Cordell-JR; Wissmar-RC; Fresh-KL; Schroder-SL Carr-M; Sanborn-G; Burg-ME. Assemblage structure, microhabitat distribution, and food web linkages of epibenthic crustaceans in Padilla Bay National Estuarine Research Reserve, Washington. Rep. FRI-UW-8813, Fish. Res. Inst., Sch
Feeding: Invertebrates, Epibenthic.

Simenstad-CA; Miller-BS; Nyblade-CF; Thornburgh-K; Bledsoe-LJ. Food web relationships of northern Puget Sound and the Strait of Juan de Fuca: A synthesis of the available knowledge EPA DOC Research Report EPA-600/7-79-259 (Also Fish. Res. Inst., Univ. Wash., Seattle, WA. FRI-UW-7914). 1979. 335 pp.
Feeding: Invertebrates, Epibenthic; Feeding: Invertebrates, Pelagic.

THREESPINE STICKLEBACK

Allen-JA; Barnett-PRO; Boyd-JM; Mackay-DW; Smyth-JC(eds). The status of fish populations in the Clyde Estuary. THE ENVIRONMENT OF THE ESTUARY AND FIRTH OF CLYDE., PROC. R. SOC. EDINB., SECT. B., vol. 90, 1986., pp. 157-170.
Refuge/Physiology: General, Water/Sediment Quality.

Audet-C; FitzGerald-GJ; Guderley-H. Environmental control of salinity preferences in four sympatric species of sticklebacks: Gasterosteus aculeatus, Gasterosteus wheatlandi, Pungitius pungitius and Apeltes quadracus . J. FISH BIOL., 1986., vol. 28, no. 6, pp. 725-739.
Refuge/Physiology: General, Salinity; Refuge/Physiology: General, Temperature; Refuge/Physiology: General, Light.

Audet-C; FitzGerald-GJ; Guderley-H. Salinity preferences of four sympatric species of sticklebacks (Pisces: Gasterosteidae) during their reproductive season. COPEIA., 1985., no. 1, pp. 209-213.
Refuge/Physiology: General, Salinity.

Birtwell-LK; Wood-M; Gordon-DK. Fish diets and benthic invertebrates in the estuary of the Somass River, Port Alberni, British Columbia. CAN. MANUSCR. REP. FISH. AQUAT. SCI., no. 1799, 1984., 58 pp.
Feeding: Invertebrates, Benthic.

Cardwell-RD; Purdy-R; Bahner-RC(eds). An overview of biological effects testing in Puget Sound, Washington: Methods, results, and implications. AQUATIC TOXICOLOGY AND HAZARD ASSESSMENT: SEVENTH SYMPOSIUM. A SYMPOSIUM SPONSORED BY ASTM COMMITTEE E-47 ON BIOLOGICAL EFFECTS AND ENVIRONMENTAL FATE, MILWAUKEE, WISC., 17-19 APRIL 1983., ASTM SPEC.
Refuge/Physiology: General, Water/Sediment Quality.

Henning-R; Zander-CD. On the Biology and Food of Small-Sized Fish From the North and Baltic Sea Area. 3. The Colonization of a Freshwater Mud Flat of the Elbe River by Euryhaline Fish. ARCH. HYDROBIOL. (SUPPL.)., 1981., vol. 43, no. 4, pp. 487-505.
Feeding: Invertebrates, Epibenthic.

Hutcheson-MS. Toxicological effects of potash brine on Bay of Fundy marine organisms. MAR. ENVIRON. RES., 1983., vol. 9, no. 4, pp. 237-255.
Refuge/Physiology: General, Water/Sediment Quality.

Lachance-S; Magnan-P; FitzGerald-GJ. Temperature preferences of three sympatric sticklebacks (Gasterosteidae). CAN. J. ZOOL./J. CAN. ZOOL., 1987., vol. 65, no. 6, pp. 1573-1576.
Refuge/Physiology: General, Temperature.

Lacroix-G; Bourget-E; Therriault-J-C(eds). The activity budget and behavior patterns of female threespine sticklebacks Gasterosteus aculeatus (L.), in a Quebec tidal salt marsh. ST. LAWRENCE ESTUARY: OCEANOGRAPHIC AND ECOLOGICAL PROCESSES., NAT. CAN., vol. 112, no. 1, 1985., pp. 113-118.
Refuge/Physiology: General, Temperature; Refuge/Physiology: General, Water/Sediment Quality.

Levy-DA; Northcote-TG; Birch-GJ. Juvenile salmon utilization of tidal channels in the Fraser River estuary, British Columbia. Tech. Rep. 23, Westwat. Res. Cent., Univ. Brit. Columbia, Vancouver, B. C., Canada. 1979. 70 pp.
Feeding: Invertebrates, Epibenthic.

Lichatowich-J; Bottom-DL; Jones-KK; Herring-MJ.. Fishes of the Columbia River Estuary. Columbia River Estuary Data Development Program. 1984.
Feeding: Invertebrates, Pelagic; Feeding: Invertebrates, Epibenthic.

Schreier-H; Northcote-TG; Hall-K. Trace metals in fish exposed to asbestos rich sediments. WATER AIR SOIL POLLUT., 1987., vol. 35, no. 3-4, pp. 279-291.
Refuge/Physiology: General, Water/Sediment Quality.

Simenstad-CA; Cordell-JR; Wissmar-RC; Fresh-KL; Schroder-SL Carr-M; Sanborn-G; Burg-ME. Assemblage structure, microhabitat distribution, and food web linkages of epibenthic crustaceans in Padilla Bay National Estuarine Research Reserve, Washington. Rep. FRI-UW-8813, Fish. Res. Inst., Sch
Feeding: Invertebrates, Epibenthic.

Simenstad-CA; Miller-BS; Nyblade-CF; Thornburgh-K; Bledsoe-LJ. Food web relationships of northern Puget Sound and the Strait of Juan de Fuca: A synthesis of the available knowledge EPA DOC Research Report EPA-600/7-79-259 (Also Fish. Res. Inst., Univ. Wash., Seattle, WA. FRI-UW-7914). 1979. 335 pp.
Feeding: Invertebrates, Epibenthic; Feeding: Invertebrates, Benthic.

Snyder-RJ. Seasonal variation in the diet of the three-spine stickleback, Gasterosteus aculeatus , in Contra Costa County, California. CALIF. FISH GAME., 1984., vol. 70, no. 3, pp. 167-172.
Feeding: Invertebrates, Pelagic; Feeding: Invertebrates, Neustonic.

Soin-SG; Danil'chenko-OP; Khandal'-AS. Combined effect of salinity and triethyl stannic chloride on the development of the marine forms of three-spine stickleback, Gasterosteus aculeatus (Gasterosteidae). J. ICHTHYOL., 1984., vol. 24, no. 4, pp. 26-34.
Reproduction: General, Salinity.

Visser-M. Prey selection by the three-spined stickleback Gasterosteus aculeatus L.). OECOLOGIA., 1982., vol. 55, no. 3, pp. 395-402.
Feeding: Invertebrates, Neustonic.

TOWNSEND VOLE

Taitt-MJ; Krebs-CJ. Predation, cover, and food manipulations during a spring decline of Microtus townsendii . J. ANIM. ECOL., 1983., vol. 52, no. 3, pp. 837-848.
Refuge/Physiology: Biological Complexity, Emergent Vasc. Plants.

Howerton-J. Key Mammals of the Columbia River Estuary. Columbia River Estuary Data Development Program. 1984.
Feeding: Plants, Emergent Vascular; Refuge/Physiology: Biological Complexity, Emergent Vasc. Plants; Reproduction: Substrate, Riparian Vegetation.

Taitt-MJ; Gipps-JHW; Krebs-CJ; Dundjerski-Z. The Effect of Extra Food and Cover on Declining Populations of Microtus townsendii . CAN. J. ZOOL., 1981., vol. 59, no. 8, pp. 1593-1599.
Refuge/Physiology: Biological Complexity, Emergent Vasc. Plants.

TUBE-SNOUT

Simenstad-CA; Miller-BS; Nyblade-CF; Thornburgh-K; Bledsoe-LJ. Food web relationships of northern Puget Sound and the Strait of Juan de Fuca: A synthesis of the available knowledge EPA DOC Research Report EPA-600/7-79-259 (Also Fish. Res. Inst., Univ. Wash., Seattle, WA. FRI-UW-7914). 1979. 335 pp.
Feeding: Invertebrates, Epibenthic; Feeding: Invertebrates, Pelagic.

Thom-R; Albright-R; Simenstad-CA; Hampel-J; Cordell-JR; Chew-K. Intertidal and shallow subtidal benthic ecology. Vol. IV, Sect. 5 in K. K. Chew and Q. J. Stober (Prin. Invest.), Renton Sewage Treatment Plant Project: Seahurst Baseline Study, Fin. Rep. FRI-UW- 8413, Fish. Res. Inst., School Fish., Univ. Wash., Se
Feeding: Invertebrates, Epibenthic.

WALLEYE POLLOCK

Maeda-T; Takahashi-T; Ueno-M. Ecological studies on the Alaska pollack in the adjacent waters of the Funka Bay. Hokkaido. 4. Seasonal variations of zooplankton distribution in food for the Alaska pollack. BULL. JAP. SOC. SCI. FISH./NISSUISHI., 1980., vol. 46, no. 6, pp. 671-674.
Feeding: Invertebrates, Pelagic.

Nakatani-T; Maeda-T. Distribution of walleye pollock larvae and their food supply in Funka Bay and the adjacent waters, Hokkaido. BULL. JAP. SOC. SCI. FISH./NISSUISHI., 1983., vol. 49, no. 2, pp. 183-187.
Feeding: Invertebrates, Pelagic.

Nishiyama-T; Hirano-K. Prey size and weight relations in larval walleye pollock (Theragra chalcogramma). BULL. PLANKTON SOC. JAPAN/NIHON PURANKUTON GAKKAIHO., 1985., vol. 32, no. 1, pp. 45-59.
Feeding: Invertebrates, Pelagic.

Paul-AJ. Light, temperature, nauplii concentrations, and prey capture by first feeding pollock larvae Theragra chalcogramma . MAR ECOL. (PROGR. SER.)., 1983., vol. 13, no. 2/3, pp. 175-179.
Feeding: Invertebrates, Pelagic; Feeding: General, Light.

Simenstad-CA; Miller-BS; Nyblade-CF; Thornburgh-K; Bledsoe-LJ. Food web relationships of northern Puget Sound and the Strait of Juan de Fuca: A synthesis of the available knowledge EPA DOC Research Report EPA-600/7-79-259 (Also Fish. Res. Inst., Univ. Wash., Seattle, WA. FRI-UW-7914). 1979. 335 pp.
Feeding: Invertebrates, Epibenthic; Feeding: Invertebrates, Benthic.

Zver'kova-LM; Sapronova-RK. Some morphological and ecologo-physiological characteristics of young Alaska pollock Theragra chalcogramma (Pallas) (Gadidae). VOPR. IKHTIOL., 1986., vol. 26, no. 2, pp. 232-238.
Refuge/Physiology: General, Temperature.

WESTERN GREBE

Hazel-CR. Avifauna of the Columbia River Estuary. Columbia River Estuary Development Program. 1984.
Feeding: Vertebrates, Water Column.

White-DH; Mitchell-CA; Kaiser-TE. Temporal accumulation of organochlorine pesticides in shorebirds wintering on the south Texas coast, 1979-80. ARCH. ENVIRON. CONTAM. TOXICOL., 1983., vol. 12, no. 2, pp. 241-245.
Refuge/Physiology: General, Water/Sediment Quality.

WESTERN SANDPIPER

Couch. Feeding Ecology of Four Species of Sandpipers in Western Washington MS Thesis, University of Washington. 1966.
Feeding: Invertebrates, Benthic; Feeding: Invertebrates, Epibenthic.

Quammen-ML. Influence of subtle substrate differences on feeding by shorebirds on intertidal mudflats. MAR. BIOL., 1982., vol. 71, no. 3, pp. 339-343.
Feeding: Invertebrates, Epibenthic; Feeding: General, Water/Sediment Quality.

White-DH; Mitchell-CA; Kaiser-TE. Temporal accumulation of organochlorine pesticides in shorebirds wintering on the south Texas coast, 1979-80. ARCH. ENVIRON. CONTAM. TOXICOL., 1983., vol. 12, no. 2, pp. 241-245.
Refuge/Physiology: General, Water/Sediment Quality.

WHITESPOTTED GREENLING

Simenstad-CA; Miller-BS; Nyblade-CF; Thornburgh-K; Bledsoe-LJ. Food web relationships of northern Puget Sound and the Strait of Juan de Fuca: A synthesis of the available knowledge EPA DOC Research Report EPA-600/7-79-259 (Also Fish. Res. Inst., Univ. Wash., Seattle, WA. FRI-UW-7914). 1979. 335 pp.
Feeding: Invertebrates, Epibenthic; Feeding: Invertebrates, Pelagic; Feeding: Invertebrates, Benthic.

APPENDIX D: ATTRIBUTE DATA QUESTIONAIRE RESULTS

Following the Matrix II survey which identified specific attributes of estuarine wetland habitats important to fish and wildlife, a questionaire was circulated to regional experts on these attributes. Respondents were selected for their experience in field research of these attributes and questionaires were specific to their respective areas of expertise. Data on attributes was collected relative to sampling methodolgy and data handling, occurence, habitat characteristics and ecology, as well as technical literature references where this data was published. The following section reports the responses to this questionaire, sorted by attribute name.

Alnus rubra

GROUP: rooted vascular plants

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: variable

TEMPERATURE: variable

SALINITY: variable

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: variable (characteristic of estuarine marshes along the northern Pacific coast of North America)

BIOMASS LEVELS: variable (characteristic of estuarine marshes along the northern Pacific coast of North America)

SEASONALITY: variable (characteristic of estuarine marshes along the northern Pacific coast of North America)

SAMPLING METHODOLOGY

TECHNIQUES: 0.25 m2 quadrats systematically located (5-10m intervals) along transects; % cover of all vascular plants estimated; leveling survey of quadrat elevation (w.r.t. chart datum); soil samples collected

DESIGN: transects located subjectivly to represent total vegetation variation in marsh; soil samples randomly collected within plant communities

REPLICATION: a function of vegetation variation (5-20 transectsper marsh); 75-300 quadrats per marsh; 3-5 soil samples per community

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: disk files & magnetic tapes used on University of British Columbia mainframe AMDAHL (=IBM) computer

STATISTICAL ANALYSIS: exploratory data analysis using multivariate methods in MIDAS & SAS

GRAPHS AND FIGURES: scatter diagrams (PCA,CVA,CANCOR); box plots (medians & interquartile ranges) for selected variables; cluster analysis dendograms; 95% confidence ellipses

SOURCES

LOCATION: estuarine marshes along British Columbia coast

REFERENCES:

Bradfield, G.E. and A. Campbell. 1986. Vegetation-elevation correlation in two dyked marshes of northeastern Vancouver Island: A multivariate analysis. Can. J. Bot. 64:2487-2494.

Bradfield, G.E. and G.L. Porter. 1982. Vegetation structure and diversity components of a Fraser estuary tidal marsh. Can. J. Bot. 60:440-451.

Campbell, A., and G.E. Bradfield. 1988. Short-term vegetation change after dyke breaching at the Kokish marsh, northeastern Vancouver Island. Northwest Science 62:28-35.

Campbell, A., and G.E. Bradfield. 1989. Comparison of plant community-environment relations in two estuarine marshes of northern British Columbia. Can. J. Bot. (in press).

Hutchinson, I., A. Campbell-Prentice, and G.E. Bradfield. 1989. Aquatic plant resources of the Strait of Georgia. in: The status and ecology of marine and shoreline birds in the Strait of Georgia. edited by K. Vermeer and R.W. Butler. Can. Wildl. Serv. Special Publ. No. 4. Ottawa. In press.

RESPONDENT: Bradfield; Botany Department

Ammodytes hexapterus

GROUP: motile fish

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: gravel/cobble

TEMPERATURE:

SALINITY:

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: all fish 0+; mean CPUE = 2-4 fish/haul; range of CPUE 1-36 fish/haul

BIOMASS LEVELS:

SEASONALITY: most abundant in April-June in all

SAMPLING METHODOLOGY

TECHNIQUES: 10 ft. x 20 ft. tow net; 10 min. tows

DESIGN: monthly hauls made at each of 3 sites; 1974-1976; all nighttime samples

REPLICATION: 2 samples per site

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC/MESA

STATISTICAL ANALYSIS: none

GRAPHS AND FIGURES: time series

SOURCES

LOCATION: northern Puget Sound

REFERENCES:

Fresh, K.L. 1979. Distribution and abundance of fishes occuring in the nearshore surface waters of northern Puget Sound, Washington. M.S. thesis, University of Washington. 120 pp.

RESPONDENT: Fresh; Washington Department of Fisheries

Amphipoda (unid.)

GROUP:

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: cobble with Fucus

TEMPERATURE:

SALINITY: >25 ppt

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: mean = 9,705 +/- 6,484 (study area); mean = 8,678 +/- 4,174 (control); range 3,036 to 19,249 m-2; included in total epibenthos

BIOMASS LEVELS:

SEASONALITY: sampled once only, August 24, 1983

SAMPLING METHODOLOGY

TECHNIQUES: 0.164 m2 underwater suction (benthic/epibenthic) sampler modified from Gale & Thompson (1975); powered by submerged bilge pump run by battery from boat; samples retained in 295 um Nitex mesh

DESIGN: lower intertidal for control and for development area along 1 transect (=tidal elevation); water depths 0.5 to 2.0 m; 1 min. suction/sample

REPLICATION: n=3 for each station; subsamples obtained by pooling replicates and elutriation process undertaken & 10 subsamples obtained using method from H. Muncie (PBS, Nanaimo)

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: data tables; figures (histogram)

STATISTICAL ANALYSIS: standardized to m-2; mean +/- std. deviation

GRAPHS AND FIGURES: abundance (m-2) vs. substrate

SOURCES

LOCATION: Duncan Bay barge terminal site, apx. 6.5 km north of Campbell River on Vancouver Island

REFERENCES:

Gale, W.F. and J.D. Thompson. 1975. A suction sampler for quantitatively sampling benthos on rocky substrate in rivers. Trans. Am. Fish. Soc. 104:398-405.

Waddell, B. and S. Markowski. 1983. Campbell River foreshore biophysical inventory. Water Use Unit, Habitat Management Division, Dept. of Fish and Oceans, Vancouver, B.C. 53 pp.

Williams, G.L. 1983. A survey of the marine benthic invertebrates and vegetation at the proposed Transp. Can. barge loading facility at Campbell River (Middle Pt.), B.C. unpublished report to Public Works, Canada. 30 pp.

RESPONDENT: Williams; G.L. WIlliams and Associates, Ltd.

Amphipoda (unid.)

GROUP:

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: under cobble, at 0 m MLLW

TEMPERATURE: unknown

SALINITY: apx. 28-30 ppt

FOOD: unknown

OTHER: Amphipodia spp.

OCCURENCE

ABUNDANCE LEVELS: apx. 100 m-2; patchy

BIOMASS LEVELS:

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: 100 cm2 quadrats; all organisms identified

DESIGN: stratified random samples by habitat type and tide height (0, +0.9, +1.8 m above MLLW)

REPLICATION: 8 reps per station

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: hard copy; species abundance and distribution by tide height, season, habitat

STATISTICAL ANALYSIS: species area curves; cluster analysis; regression; "T" tests; discriminant analysis

GRAPHS AND FIGURES:

SOURCES

LOCATION: 5 central Puget Sound beaches: Alki; Carkeek; Lincoln Park; Richmond; West Point

REFERENCES:

Armstrong, J. 1977. The impact of subtidal sewage outfalls on the intertidal macrofauna of several central Puget Sound beaches. PhD Dissertation, University of Washington. 183 pp. and Appendices.

RESPONDENT: Armstrong,; Environmental Protection Agency

Ampithoe spp.

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: 1/4-3/4 in. gravel spread out over natural mudflat

TEMPERATURE:

SALINITY:

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: adult: mean = 1.1 +/- 1 s.d. = 7.9 m-2; range: 0-55.6 m-2

BIOMASS LEVELS: adult: mean = less than 1 +/- 1 s.d. = less than 10 mg m-2; range: 0-6 mg m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: random samples along transect line established at same tidal elevation, parallel to shoreline; one collection, early April

REPLICATION: n = 50

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; "jacknife" procedure used to determine optimal replication according to stabilization of standard error

GRAPHS AND FIGURES: plots of mean and standard error of density as function of number of replicates

SOURCES

LOCATION: Oakland Bay, southern Puget Sound, Washington; mid-intertidal beach graveling experimental site in upper Bay

REFERENCES:
C. A. Simenstad and J. R. Cordell (in prep.) (unpubl.) Fish. Res. Inst., Univ. Wash., Seattle, WA

RESPONDENT: Simenstad; Fisheries Research Institute

Ampithoe spp.

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: cobble with Fucus

TEMPERATURE:

SALINITY: >25 ppt

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: mean = 9,705 +/- 6,484 (study area); mean = 8,678 +/- 4,174 (control); range 3,036 to 19,249 m-2; included in total epibenthos

BIOMASS LEVELS:

SEASONALITY: sampled once only, August 24, 1983

SAMPLING METHODOLOGY

TECHNIQUES: 0.164 m2 underwater suction (benthic/epibenthic) sampler modified from Gale & Thompson (1975); powered by submerged bilge pump run by battery from boat; samples retained in 295 um Nitex mesh

DESIGN: lower intertidal for control and for development area along 1 transect (=tidal elevation); water depths 0.5 to 2.0 m; 1 min. suction/sample

REPLICATION: n=3 for each station; subsamples obtained by pooling replicates and elutriation process undertaken & 10 subsamples obtained using method from H. Muncie (PBS, Nanaimo)

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: data tables; figures (histogram)

STATISTICAL ANALYSIS: standardized to m-2; mean +/- std. deviation

GRAPHS AND FIGURES: abundance (m-2) vs. substrate

SOURCES

LOCATION: Duncan Bay barge terminal site, apx. 6.5 km north of Campbell River on Vancouver Island

REFERENCES:

Gale, W.F. and J.D. Thompson. 1975. A suction sampler for quantitatively sampling benthos on rocky substrate in rivers. Trans. Am. Fish. Soc. 104:398-405.

Waddell, B. and S. Markowski. 1983. Campbell River foreshore biophysical inventory. Water Use Unit, Habitat Management Division, Dept. of Fish and Oceans, Vancouver, B.C. 53 pp.

Williams, G.L. 1983. A survey of the marine benthic invertebrates and vegetation at the proposed Transp. Can. barge loading facility at Campbell River (Middle Pt.), B.C. unpublished report to Public Works, Canada. 30 pp.

RESPONDENT: Williams; G.L. WIlliams and Associates, Ltd.

Anisogammarus pugettensis

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silt-sand w/ some gravel beneath surface

TEMPERATURE: 8.0 degrees C (March) to 24 degrees C (July)

SALINITY: greater than 25 ppt

FOOD:

OTHER: dense Zostera marina

OCCURENCE

ABUNDANCE LEVELS: juveniles:mean=15.4 +/- 1 s.d.=41.8 m-2; range: 55.6-166.7 m-2

BIOMASS LEVELS: juveniles:mean=80 +/- 1 s.d.=210 mg m-2; range: 200-778 mg m-2

SEASONALITY: maxima in late April

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: permanent sampling points established randomly along transect line through eelgrass meadow at same tidal elevation

REPLICATION: n=5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Drayton Harbor, Washington; mid-intertidal (0.6 m MLLW) eelgrass meadow east of Blaine Marina

REFERENCES:

Thom, R. M., C. A. Simenstad, J. R. Cordell, and E. O. Salo 1989. Fish and their epibenthic prey in a marine and adjacent mudflats and eelgrass meadow in a small estuarine bay FRI-UW-8901, Final Rep. prep. for The Port of Bellingham, Fish. Res. Inst., Univ. Wash., Seattle, WA. 27 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Anisogammarus pugettensis

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: mid-intertidal (+0.3 ft. MLLW) brown mud

TEMPERATURE: not available

SALINITY: not available

FOOD:

OTHER: high marsh; Salicornia dominant vegetation

OCCURENCE

ABUNDANCE LEVELS: juveniles: mean=111.1 +/- 1 s.d.=111.1 m-2; range: 111.1-222.2 m-2

BIOMASS LEVELS: juveniles: mean=24 +/- 1 s.d.=2 mg m-2; range: 33-39 m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: random samples from similar tidal height within five distinct habitat strata along established transect line (perpendicular to elevation gradient); sampled once, late May 1987

REPLICATION: n=3

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); using NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Day Island, central Puget Sound, southern reach of The (Tacoma) Narrows; adjacent to Days Island Channel

REFERENCES:

Thom, R. M., C. A. Simenstad, and J. R. Cordell. 1987. Benthic productivity and epibenthic crustacean community structure at the Day Island Marina expansion site, Tacoma, Washington. Unpubl. rep. to Day Island Community Club.

RESPONDENT: Simenstad; Fisheries Research Institute

Anisogammarus pugettensis

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: mid-intertidal (+2.3 ft. MLLW) mud; Enteromorpha on surface

TEMPERATURE: not available

SALINITY: not available

FOOD:

OTHER: high marsh; Salicornia dominant vegetation

OCCURENCE

ABUNDANCE LEVELS: juveniles: mean=18.5 +/- 1 s.d.=32.1 m-2; range: 0-55.6 m-2

BIOMASS LEVELS: juveniles: mean=489 +/- 1 s.d.=850 mg m-2; range: 0-1467 m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: random samples from similar tidal height within five distinct habitat strata along established transect line (perpendicular to elevation gradient); sampled once, late May 1987

REPLICATION: n=3

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); using NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Day Island, central Puget Sound, southern reach of The (Tacoma) Narrows; adjacent to Days Island Channel

REFERENCES:

Thom, R. M., C. A. Simenstad, and J. R. Cordell. 1987. Benthic productivity and epibenthic crustacean community structure at the Day Island Marina expansion site, Tacoma, Washington. Unpubl. rep. to Day Island Community Club.

RESPONDENT: Simenstad; Fisheries Research Institute

Anisogammarus pugettensis

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: mid-intertidal (-0.1 ft. MLLW) gravel-cobble

TEMPERATURE: not available

SALINITY: not available

FOOD:

OTHER: high marsh; Salicornia dominant vegetation

OCCURENCE

ABUNDANCE LEVELS: juveniles: mean = 1351.9 +\- 1 s.d. = 2151.9 m-2; range: 222.2-3833.3 m-2

BIOMASS LEVELS: juveniles: mean = 163 +/- 1 s.d. = 27 mg m-2; range: 11-487 m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: random samples from similar tidal height within five distinct habitat strata along established transect line (perpendicular to elevation gradient); sampled once, late May 1987

REPLICATION: n=3

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); using NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Day Island, central Puget Sound, southern reach of The (Tacoma) Narrows; adjacent to Days Island Channel

REFERENCES:

Thom, R. M., C. A. Simenstad, and J. R. Cordell. 1987. Benthic productivity and epibnthic crustacean community structure at the Day Island Marina expansion site, Tacoma, Washington. Unpubl. rep. to Day Island Community Club.

RESPONDENT: Simenstad; Fisheries Research Institute

Anisogammarus pugettensis

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: coarse sand

TEMPERATURE:

SALINITY:

FOOD:

OTHER: adjacent Zostera marina meadow

OCCURENCE

ABUNDANCE LEVELS: juveniles: mean = 16.0 +/- 1. s.d. = 21.9 m-2; range: 0.0-40.0 m-2

BIOMASS LEVELS: juveniles: mean = 7 +/- 1 s.d. = 10 mg m-2; range: 12-24 mg m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.10-m2 epibenthic suction pump (FRI macropump); gas engine powered; w/ 130-um mesh on ports; organisms filtered through nested 500-um, 253-um, and 130-um mesh nets; pumped for 45 sec.

DESIGN: random samples from discrete substrate and tidal elevation; sampled on one occasion (early July)

REPLICATION: n = 5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archieved on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2

GRAPHS AND FIGURES: (data not processed beyond tabulation)

SOURCES

LOCATION: Alki Point (Seattle), central Puget Sound

REFERENCES:
Simenstad, C. A., and J. R. Cordell. 1984. n.a. Unpubl. data.

RESPONDENT: Simenstad; Fisheries Research Institute

Anisogammarus pugettensis

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: coarse sand w/ gravel, some silt patches; thick Zostera marina growth; +0.5 ft. MLLW tidal elevation

TEMPERATURE: 23.0 degrees C

SALINITY: 28-29 ppt

FOOD:

OTHER: weather sunny, no wave disturbance

OCCURENCE

ABUNDANCE LEVELS: adults: mean=1.6 +/- 1 s.d.=4.4 100-cm2; juveniles: mean=1.5 +/- 1 s.d.=4.1 100-cm2, for high epiphyte plant

BIOMASS LEVELS: adults: mean=0.01 +/- 1 s.d.=0.02 mg 100-cm2; juveniles: mean=1.1 +/- 1 s.d.=3.3, for high epiphyte plant

SEASONALITY: no data other than for early May

SAMPLING METHODOLOGY

TECHNIQUES: Zostera marina plants collected intact, or as 10-cm segments, without disturbance of epiphytes (e.g., in situ); in laboratory, animals washed out of epiphytes and sieved to 253 um

DESIGN: randomly selected plants within same tidal elevation along "established" research transect in PBNERR;sampled with 0.5 to 1.5 m water depth

REPLICATION: n=2 plants

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5 as modified by FRI; archived on 9-tract tape at UW ACC (Cyber); all NODC codes used

STATISTICAL ANALYSIS: standardized to density and standing crop 100-cm2 surface area of blade; log transformed for statistical comparisons; ANOVA used if uniform variance dist., otherwise Kruskal-Wallis non-parametri

GRAPHS AND FIGURES: line plots, histograms, etc. using Statgraphics

SOURCES

LOCATION: Padilla Bay National Estuarine Research Reserve; established littoral flat gradient research transect; flat just off "Gun Club marsh"

REFERENCES:

Simenstad, C. A., J. R. Cordell, R. C. Wissmar, K. L. Fresh, S. L. Schroder, M. Carr, G. Sanborn, and M. E. Burg 1988. Assemblage structure, microhabitat distribution, and food web linkages of epibenthic crustaceans in Padilla Bay National Estuarine Research Reserve, Washington FRI-UW-8813, Fish. Res. Inst., Univ. Wash., Seattle, WA. 60 pp. (also NOAA Tech. Rep. Series OCRM/MEMD)

RESPONDENT: Simenstad; Fisheries Research Institute

Aves (unid.)

GROUP: avifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: 1) beach; 2) revetment; 3) dune (=Elymus mollis); 4) grass-herb meadow (=Festuca spp.); and 5) storm tide plain

TEMPERATURE:

SALINITY:

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: 850 gulls on 44 hectares

BIOMASS LEVELS: # of nests & territory size varies by habitat; habitats include: 1) beach; 2) revetment; 3) dune; 4) grass-herb meadow; and 5) storm tide plain

SEASONALITY: breeding and nesting from March through August

SAMPLING METHODOLOGY

TECHNIQUES: beach & upland habitats beyond emmergent marsh for Larus occidentalis surveyed; nests counted, territories measured, % cover measured, nesting chronology recorded, attendance & behavior established

DESIGN: four year study with behavioral observations

REPLICATION: four year study with replications as required for specialized studies

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: field data forms with summary tables & floppy diskinfo; some data on computer cards

STATISTICAL ANALYSIS: varied, parametric & non-parametric using SPSS contingency tables

GRAPHS AND FIGURES: rough hand drawn graphs at present

SOURCES

LOCATION: East Sand Island, Baker Bay (46o16' lat. 124o30' long.)

REFERENCES:
Richter, K.O. (in prep.) Habitat and nest site selection in a mixed colony of Western & Glaucous-winged gulls

RESPONDENT: Richter;

Aves (unid.)

GROUP: avifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: beaches, dunes, drift wood plains

TEMPERATURE:

SALINITY:

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: varied by island, species, etc.

BIOMASS LEVELS:

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: beach & upland habitats beyond emmergent marsh surveyed; June-September 1977 study of island use by nesting seabirds; Larus occidentallis, L. Glaucescens, Sterna caspia, sterna spp., & Ardea herodias

DESIGN: 1 year study; counted number of nests and identified habitat

REPLICATION: none; descriptive

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: data in published tables

STATISTICAL ANALYSIS: none

GRAPHS AND FIGURES: published in reports

SOURCES

LOCATION: Columbia River, Baker Bay, Willapa Bay, Grays Harbor, Duwamish River, Port Gardner Bay

REFERENCES:

Peters, C.F., K.O. Richter, D.A. Manuwal, and S.G. Herman. 1978. Colinal nestin sea and wading bird use of estuarine islands in the Pacific Northwest. Final Rpt. U.S. Army Engineer Waterways Experiment Station. D-78-17. 200 pp.

RESPONDENT: Richter;

Aves (unid.)

GROUP: avifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE:

TEMPERATURE:

SALINITY:

FOOD:

OTHER: primary bird spp. of eelgrass habitat: amw, blb, gbh, gwg; secondary: bfh, dcc, hgb, mld, and common loon, n. pintail, others

OCCURENCE

ABUNDANCE LEVELS:

BIOMASS LEVELS:

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: surface scan using telescope, binoculars; aircraft transect censuses of offshore area

DESIGN: predetermined location of transpect of mapped census areas; (see MESA report, Wahl et al. 1981)

REPLICATION: 2-4 wks for surface census; apx. 6 wks by aircraft, in 1978-79

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC 041

STATISTICAL ANALYSIS: see MESA report

GRAPHS AND FIGURES: see MESA report

SOURCES

LOCATION: Drayton Harbor (n=53); Padilla Bay (n=35); Jamestown (n=29); aerial surveys (n=21)

REFERENCES:

Wahl, T.R., and S.M. Speich. 1980. Marine bird populations in Washington waters. Impact documentation and long-term monitoring. Washington Department of Ecology report.

Wahl, T.R., S.M. Speich, D.A. Manuwal, K.V. Hirsch, and C. Miller. 1981. Marine bird populations of the Strait of Jaun de Fuca, Strait of Georgia, and adjacent waters in 1978 and 1979. EPA-600/7-81-156.

RESPONDENT: Wahl;

Balanus spp.

GROUP: surface epifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: firm, rough

TEMPERATURE: 7+ C

SALINITY:

FOOD: plankton

OTHER: these species of barnacles (Balanus crenatus, B. Glandula) will occur most abundantly between 0-10 ft. below MLLW; abundant on deeper hard substrata during spring-summer, and during early succession

OCCURENCE

ABUNDANCE LEVELS: 0-100% cover on hard substrata; 0-11,500 m-2; mean=4230 m-2; SD=4133 m-2

BIOMASS LEVELS: 0-3710 gm m-2; mean=2281 g m-2; SD=2367 g m-2

SEASONALITY: peaks from April-September

SAMPLING METHODOLOGY

TECHNIQUES: airlift (using SCUBA) by scraping the barnacles from the substrata to sample individual organisms for counting and weighing; percent cover estimated using 0.25 m2 grid

DESIGN: randomly selected sites at similar depths; see Benson 1989 re. design

REPLICATION: n=3-5 at each depth interval

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: no specific format

STATISTICAL ANALYSIS: standardized to per square meter

GRAPHS AND FIGURES: chronological line plots or bar charts

SOURCES

LOCATION: artificial reefs off Edmonds; Gedney Island, Onamanc Point, Possession Point, Misery Point, Point Heyer, Toliva Shoal, Itsami Ledge, and Boeing Creek

REFERENCES:

Benson, B.L. 1989. Air-lift sampler: Applications for sampling hard substrat. Bull. Mar. Sci. (in press).

Hueckel, G.J. 1980. Foraging on an artificial reef by three Puget Sound fish species. Wash. Dept. Fish. Tech. Rept. 53. 110pp.

Hueckel, G.J., and R.M. Buckley. 1987. The influence of prey communities on fish species assemblages on artificial reefs in Puget Sound, Washington. Wnv. Biol. Fish. 19(3):195-214.

RESPONDENT: Hueckel; Washington Department of Fisheries

Bivalvia (unid.)

GROUP:

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: sand, some Enteromorpha

TEMPERATURE:

SALINITY: >25 ppt

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: mean = 33,209 +/- 2,092 (study area); mean = 33,822 +/- 19,071 (control); range 21,529 to 61,883 m-2; included in total epibenthos

BIOMASS LEVELS:

SEASONALITY: sampled once only, August 25, 1983

SAMPLING METHODOLOGY

TECHNIQUES: 0.164 m2 underwater suction (benthic/epibenthic) sampler modified from Gale & Thompson (1975); powered by submerged bilge pump run by battery from boat; samples retained in 295 um Nitex mesh

DESIGN: lower intertidal for control and for development area along 1 transect (= tidal elevation); water depths 0.5 to 2.0m

REPLICATION: n=3 for each station; subsamples obtained by pooling replicates and elutriation process undertaken & 10 subsamples obtained using method from H. Muncie (PBS, Nanaimo)

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: data tables; figures (histogram)

STATISTICAL ANALYSIS: standardized to m-2; mean +/- std. deviation

GRAPHS AND FIGURES: abundance (m-2) vs. substrate

SOURCES

LOCATION: Duncan Bay barge terminal site, apx. 6.5 km north of Campbell River on Vancouver Island

REFERENCES:

Gale, W.F. and J.D. Thompson. 1975. A suction sampler for quantatively sampling benthos on rocky substrate in rivers. Trans. Am. Fish. Soc. 104:398-405.

Waddell, B. and S. Markowski. 1983. Campbell River foreshore biophysical inventory. Water Use Unit, Habitat Management Division, Dept. of Fish and Oceans, Vancouver, B.C. 53 pp.

Williams, G.L. 1983. A survey of the marine benthic invertebrates and vegetation at the proposed Transp. Can. barge loading facility at Campbell River (Middle Pt.) B.C. unpublished report to Public Works Candada. 30 pp.

RESPONDENT: Williams; G.L. WIlliams and Associates, Ltd.

Bivalvia (unid.)

GROUP:

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: sand

TEMPERATURE: unknown

SALINITY: apx. 28-30 ppt

FOOD: unknown

OTHER: epifauna abundance at 0.9 m > > 0 m or 1.8 m MLLW

OCCURENCE

ABUNDANCE LEVELS:

BIOMASS LEVELS: 0 m MLLW: 60-500 gm m-2; +0.9 m MLLW: 60-400 gm m-2

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: 100 cm2 quadrats; all organisms identified

DESIGN: stratified random samples by habitat type and tide height (0, +0.9, +1.8 m above MLLW)

REPLICATION: 8 reps per station

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: hard copy; species abundance and distribution by tide height, season, habitat

STATISTICAL ANALYSIS: species area curves; cluster analysis; regression; "T" tests; discriminant analysis

GRAPHS AND FIGURES:

SOURCES

LOCATION: 5 central Puget Sound beaches: Alki; Carkeek; Lincoln Park; Richmond; West Point

REFERENCES:

Armstrong, J. 1977. The impact of subtidal sewage outfalls on the intertidal macrofauna of several central Puget Sound beaches. PhD Dissertation, University of Washington. 183 pp. and Appendices.

RESPONDENT: Armstrong,; Environmental Protection Agency

Bivalvia (unid.)

GROUP:

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silty sand with occassional rocks and cobble; clayey silts with common wood dibris

TEMPERATURE:

SALINITY:

FOOD:

OTHER: water currents 50-290 ft hr-1 during ebb and flood tides

OCCURENCE

ABUNDANCE LEVELS: 40-2240 m-2

BIOMASS LEVELS:

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: hydraulic lift; Ventari suction device; sampling 0.05 m2 x 100 mm core; sieved through a 0.5 mm mesh bag

DESIGN: five stations sampled withinn project area, one in a nearby dredged area; elevations were +0.4 to -10.7 ft; all sampled on 19 October 1983 (1320-1430)

REPLICATION: none

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: simple numerical summaries

STATISTICAL ANALYSIS: none

GRAPHS AND FIGURES: none

SOURCES

LOCATION: Gig Harbor near Donkey Creek, at site of now constructed 'Murphy's Landing', a 90 slip marina where 5 acres of intertidal/subtidal bottom area were developed

REFERENCES:

Cheney, D., C. Cheney, M. Jordan, and M. Kyte. 1983. Turner Marina, Gig Harbor, Washington. Supplemental Environmental Information.

RESPONDENT: Cheney; BioAquatics International

Callianassidae (unid.)

GROUP: active infauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: in mixed cobble sediments; in sand at 0 m MLLW

TEMPERATURE: unknown

SALINITY: apx. 28-30 ppt

FOOD: unknown

OTHER: epifauna abundance at 0.9 m > > 0 m or 1.8 m MLLW

OCCURENCE

ABUNDANCE LEVELS: 2-< 100 m-2; patchy

BIOMASS LEVELS:

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: 100 cm2 quadrats; all organisms identified

DESIGN: stratified random samples by habitat type and tide height (0, +0.9, +1.8 m above MLLW)

REPLICATION: 8 reps per station

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: hard copy; species abundance and distribution by tide height, season, habitat

STATISTICAL ANALYSIS: species area curves; cluster analysis; regression; "T" tests; discriminant analysis

GRAPHS AND FIGURES:

SOURCES

LOCATION: 5 central Puget Sound beaches: Alki; Carkeek; Lincoln Park; Richmond; West Point

REFERENCES:

Armstrong, J. 1977. The impact of subtidal sewage outfalls on the intertidal macrofauna of several central Puget Sound beaches. PhD Dissertation, University of Washington. 183 pp. and Appendices.

RESPONDENT: Armstrong,; Environmental Protection Agency

Cancer magister

GROUP: evasive macroepifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: sand, silty sand, gravel, shell, wood debris, eelgrass, macroalgae covers

TEMPERATURE: 0-25 C

SALINITY: generally >15 ppt

FOOD: any live or freshly dead animal tissue

OTHER:

OCCURENCE

ABUNDANCE LEVELS: trawls/diver transect: typically 0-100 crab/hectare; can range as high as 5,000 crab/hectare in areas of crab aggregation; intertidal quadrats: typically 1-10 m-2 but up to 300 m-2

BIOMASS LEVELS:

SEASONALITY: all seasons

SAMPLING METHODOLOGY

TECHNIQUES: 3m beam trawl; 2.5-5 min. tows; generally with bottom coverage of 0.1 to 0.05 hectares/tow; also diver transects; 0.25 m2 quadrats dug & screened at ow tide; see Miller et al. 1988 for trawl protocol

DESIGN: trawls along transects or at specific stations, diver transects at specific stations, intertidal quadrat samples along transects or random within selected plots

REPLICATION: replication within strata (generally depth or habitat type) for trawls and diver transects; within habitat or within plot for quadrat samples (n= up to 30)

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: UW/Cyber or pc spreadsheet (Excel)

STATISTICAL ANALYSIS: catches standardized to crab/hectare; generally non-parametric statistical procedures or log-transformation with parametric statistics

GRAPHS AND FIGURES: line charts, bar charts, histograms

SOURCES

LOCATION: various locations throughout Puget Sound, Grays Harbor (complete list of sampling sites available)

REFERENCES:

Armstrong, D.A., J.L. Armstrong, and P.A. Dinnel. 1987. Ecology and population dynamics of Dungeness crab, Cancer magister, in Ship Harbor, Anacortes, Washington. Final Rpt. for Leeward Development Company and Washington Department of Fisheries. FRI-UW-8701.

Armstrong, D.A., T.C. Wainwright, J. Orensanz, P.A. Dinnel, and B.R. Dumbauld. 1987. Model of dredging impact on Dungeness crab in Grays Harbor, Washington. Final Rpt. to Battelle Northwest Laboratories and U.S. Army Corp of Engineers. FRI-UW-8701. 67 pp.

Dinnel, P.A. R.R. Lauth, D.A. Armstrong, J.L. Armstrong, K. Larsen, and S.D. Sulkin. 1989. Marine fish predation on juvenile Dungeness crab, Cancer magister, in Padilla Bay, Washington. Final Rpt. to NOAA/NOS/OCRM, Marine and Estuarine Management Division by School of Fisheries, University of Washington, Seattle. In preparation.

Dinnel, P.A., D.A. Armstrong, and B.R. Dumbauld, and T.C. Wainwright. 1986. Impact of dredging on Dungeness crab, Cancer magister, in Grays Harbor, Washington during August 1986. Final Rpt. for U.S. Army Corps of Engineers by Fisheries Research Institute, University of Washington, Seattle. FRI-UW-8611. 34 pp.

Dinnel, P.A., D.A. Armstrong, and B.R. Dumbauld, T.C. Wainwright, A.J. Whiley, R. Burge, and R. Bumgarner. 1987. Padilla Bay Dungeness crab, Cancer magister, habitat study. Final Rpt. to NOAA/OCRM/DMEM and the Washington State Department of Ecology by Fisheries Research Institute, University of Washington, Seattle. FRI-UW-8704. 78 pp.

Dinnel, P.A., D.A. Armstrong, and B.R. Dumbauld. 1986. Impact of dredging and dredged material disposal on Dungeness crab, Cancer magister, in Grays Harbor, Washington during October 1985. Final Rpt. for U.S. Army Corps of Engineers by Fisheries Research Institute, University of Washington, Seattle. FRI-UW-8606. 30 pp.

Dinnel, P.A., D.A. Armstrong, and C. Dungan. 1985. Initiation of a Dungeness crab (Cancer magister) habitat study in North Puget Sound. pages 327-337 in: Proceedings of the Symposium on Dungeness Crab BIology and Management. Alaska Sea Grant Rpt. No. 85-3, University of Alaska, Fairbanks.

Dinnel, P.A., D.A. Armstrong, and R.O. McMillan. (in prep.) Settlement patterns, timing, and early post-larval growth of Dungeness crab, Cancer magister, in Puget Sound, Washington. Manuscript in preparation for J. Marine Biology.

Dinnel, P.A., D.A. Armstrong, and R.O. McMillan. 1985. Survey of Dungeness crab, Cancer magister, resources in Oak Harbor, Washington. Final Rpt. for the Seattle District, U.S. Army Corp of Engineers by School of Fisheries, University of Washington, Seattle. 23 pp.

Dinnel, P.A., D.A. Armstrong, and R.O. McMillan. 1986. Dungeness crab, Cancer magister, distribution, recruitment, growth, and habitat use in Lummi Bay, Washington. Final Rpt. for the Lummi Indian Tribe by Fisheries Research Institute, University of Washington, Seattle. FRI-UW-8612. 61 pp.

Dinnel, P.A., D.A. Armstrong, and R.R. Lauth 1988. Invertebrate resource assessments in and around proposed dredged materials disposal sites in Puget Sound. in: Proceedings of the First Annual Conference on Puget Sound Research. Vol 1:337-343. Puget Sound Water Quality Authority, Seattle, Washington.

Dinnel, P.A., D.A. Armstrong, B.S. Miller, and R.F. Donnelly. 1986. Puget Sound Dredge Disposal Analysis (PSDDA) disposal site investigations: Phase I trawl studies in Saratoga Passage, Port Gardner, Elliott Bay, and Commencement Bay, Washington. Final Rpt. for U.S. Army Corps of Engineers by Fisheries Research Institute, University of Washington, Seattle. FRI-UW-8615. 208 pp.

Dinnel, P.A., D.A. Armstrong, R.R. Lauth, and K. Larsen. 1988. Puget Sound Dredge Disposal Analysis (PSDDA) disposal site investigations: Phase II trawl studies in north and south Puget Sound. Invertebrate resource assessments. Final Rpt. for Washington Sea Grant and Seattle District, U.S. Army Corp of Engineers by School of Fisheries, University of Washington, Seattle. FRI-UW-8818. 92 pp.

Dinnel, P.A., D.A. Armstrong, R.R. Lauth, T.C. Wainwright, J.L. Armstrong, and K. Larsen. 1988. U.S. Navy Homeport disposal site investigations in Port Gardner, Washington. Invertebrate resource assessments. Two-year Final Rpt. for Washington Sea Grant, U.S. Navy, and U.S. Army Corps of Engineers by School of Fisheries, University of Washington, Seattle. FRI-UW-8820. 25 pp.

Dinnel, P.A., G. Jamieson, B.S. Miller, D.A. Armstrong, and R.R. Lauth. 1987. Use of Pisces IV submersible for determining the distribution of Dungenss crab, shrimp, and bottomfish in Port Gardner, Washington. Final Rpt. for Washington Sea Grant, U.S. Army Corp of Engineers, and U.S. Navy by Fisheries Research Institute, University of Washington, Seattle. FRI-UW-8709. 16 pp.

Dumbauld, B.R., D.A. Armstrong, T.C. Wainwright, and P.A. Dinnel 1988. Impact of dredging on Dungeness crab, Cancer magister, in Grays Harbor, Washington during August 1987. Final Rpt. for Seattle District, U.S. Army Corps of Engineers by School of Fisheries, University of Washington, Seattle. FRI-UW-8820. 25 pp.

McGraw, K.A., L.L. Conquest, J.O. Waller, P.A. Dinnel, and D.A. Armstrong. 1988. Entrainment of Dungeness crabs, Cancer magister Dana, by hopper dredge in Grays Harbor, Washington. J. Shellfish Res. 7(2):219-231. Paper also presented by K.A. Chew at the National Shellfisheries Association Annual Meeting, New Orleans, Louisiana, June 1988.

Miller, B.S., D.R. Gunderson, D.A. Armstrong, P.A. Dinnel, and R.F. Donnelly. 1988. Recommended protocols for standardized collections of Puget Sound bottomfish. Final Rpt. to Tetra Tech, Inc. and Office of Puget Sound, U.S. Environmental Protection Agency, Region 10, Seattle, Washington. 42 pp.

RESPONDENT: Dinnel; School of Fisheries

Cancer magister

GROUP: evasive macroepifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: sand or silty sand often with detrital cover

TEMPERATURE: 7-14 C

SALINITY: >25 ppt

FOOD: any live or freshly dead animal tissue

OTHER:

OCCURENCE

ABUNDANCE LEVELS: typically in range of 0-100 crab/hectare; can range as high as 5,000 crab/hectare in areas of crab aggregation

BIOMASS LEVELS:

SEASONALITY: all seasons, but esp. summer/fall for deepest areas and winter for shallow subtidal

SAMPLING METHODOLOGY

TECHNIQUES: 3m beam trawl; 2.5-5 min. tows; generally with bottom coverage of 0.1 to 0.05 hectares/tow; also diver transects; see Miller et al. 1988 for trawl protocol

DESIGN: 1) samples along multiple transects at preset depths; 2) random samples; or 3) stratified random sampling by depth; also Pisces IV submersible in Pt. Gardner

REPLICATION: replication within strata (generally depth strata) but not within station

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: UW/Cyber or pc spreadsheet (Excel)

STATISTICAL ANALYSIS: catches standardized to crab/hectare; generally non-parametric statistical procedures or log-transformation with parametric statistics

GRAPHS AND FIGURES: line charts, bar charts, histograms

SOURCES

LOCATION: various locations throughout Puget Sound, Grays Harbor (complete list of sampling sites available)

REFERENCES:

Armstrong, D.A., J.L. Armstrong, and P.A. Dinnel. 1987. Ecology and population dynamics of Dungeness crab, Cancer magister, in Ship Harbor, Anacortes, Washington. Final Rpt. for Leeward Development Company and Washington Department of Fisheries. FRI-UW-8701.

Armstrong, D.A., T.C. Wainwright, J. Orensanz, P.A. Dinnel, and B.R. Dumbauld. 1987. Model of dredging impact on Dungeness crab in Grays Harbor, Washington. Final Rpt. to Battelle Northwest Laboratories and U.S. Army Corp of Engineers. FRI-UW-8701. 67 pp.

Dinnel, P.A. R.R. Lauth, D.A. Armstrong, J.L. Armstrong, K. Larsen, and S.D. Sulkin. 1989. Marine fish predation on juvenile Dungeness crab, Cancer magister, in Padilla Bay, Washington. Final Rpt. to NOAA/NOS/OCRM, Marine and Estuarine Management Division by School of Fisheries, University of Washington, Seattle. In preparation.

Dinnel, P.A., D.A. Armstrong, and B.R. Dumbauld, and T.C. Wainwright. 1986. Impact of dredging on Dungeness crab, Cancer magister, in Grays Harbor, Washington during August 1986. Final Rpt. for U.S. Army Corps of Engineers by Fisheries Research Institute, University of Washington, Seattle. FRI-UW-8611. 34 pp.

Dinnel, P.A., D.A. Armstrong, and B.R. Dumbauld, T.C. Wainwright, A.J. Whiley, R. Burge, and R. Bumgarner. 1987. Padilla Bay Dungeness crab, Cancer magister, habitat study. Final Rpt. to NOAA/OCRM/DMEM and the Washington State Department of Ecology by Fisheries Research Institute, University of Washington, Seattle. FRI-UW-8704. 78 pp.

Dinnel, P.A., D.A. Armstrong, and B.R. Dumbauld. 1986. Impact of dredging and dredged material disposal on Dungeness crab, Cancer magister, in Grays Harbor, Washington during October 1985. Final Rpt. for U.S. Army Corps of Engineers by Fisheries Research Institute, University of Washington, Seattle. FRI-UW-8606. 30 pp.

Dinnel, P.A., D.A. Armstrong, and C. Dungan. 1985. Initiation of a Dungeness crab (Cancer magister) habitat study in North Puget Sound. pages 327-337 in: Proceedings of the Symposium on Dungeness Crab BIology and Management. Alaska Sea Grant Rpt. No. 85-3, University of Alaska, Fairbanks.

Dinnel, P.A., D.A. Armstrong, and R.O. McMillan. (in prep.) Settlement patterns, timing, and early post-larval growth of Dungeness crab, Cancer magister, in Puget Sound, Washington. Manuscript in preparation for J. Marine Biology.

Dinnel, P.A., D.A. Armstrong, and R.O. McMillan. 1985. Survey of Dungeness crab, Cancer magister, resources in Oak Harbor, Washington. Final Rpt. for the Seattle District, U.S. Army Corp of Engineers by School of Fisheries, University of Washington, Seattle. 23 pp.

Dinnel, P.A., D.A. Armstrong, and R.O. McMillan. 1986. Dungeness crab, Cancer magister, distribution, recruitment, growth, and habitat use in Lummi Bay, Washington. Final Rpt. for the Lummi Indian Tribe by Fisheries Research Institute, University of Washington, Seattle. FRI-UW-8612. 61 pp.

Dinnel, P.A., D.A. Armstrong, and R.R. Lauth 1988. Invertebrate resource assessments in and around proposed dredged materials disposal sites in Puget Sound. in: Proceedings of the First Annual Conference on Puget Sound Research. Vol 1:337-343. Puget Sound Water Quality Authority, Seattle, Washington.

Dinnel, P.A., D.A. Armstrong, B.S. Miller, and R.F. Donnelly. 1986. Puget Sound Dredge Disposal Analysis (PSDDA) disposal site investigations: Phase I trawl studies in Saratoga Passage, Port Gardner, Elliott Bay, and Commencement Bay, Washington. Final Rpt. for U.S. Army Corps of Engineers by Fisheries Research Institute, University of Washington, Seattle. FRI-UW-8615. 208 pp.

Dinnel, P.A., D.A. Armstrong, R.R. Lauth, and K. Larsen. 1988. Puget Sound Dredge Disposal Analysis (PSDDA) disposal site investigations: Phase II trawl studies in north and south Puget Sound. Invertebrate resource assessments. Final Rpt. for Washington Sea Grant and Seattle District, U.S. Army Corp of Engineers by School of Fisheries, University of Washington, Seattle. FRI-UW-8818. 92 pp.

Dinnel, P.A., D.A. Armstrong, R.R. Lauth, T.C. Wainwright, J.L. Armstrong, and K. Larsen. 1988. U.S. Navy Homeport disposal site investigations in Port Gardner, Washington. Invertebrate resource assessments. Two-year Final Rpt. for Washington Sea Grant, U.S. Navy, and U.S. Army Corps of Engineers by School of Fisheries, University of Washington, Seattle. FRI-UW-8820. 25 pp.

Dinnel, P.A., G. Jamieson, B.S. Miller, D.A. Armstrong, and R.R. Lauth. 1987. Use of Pisces IV submersible for determining the distribution of Dungenss crab, shrimp, and bottomfish in Port Gardner, Washington. Final Rpt. for Washington Sea Grant, U.S. Army Corp of Engineers, and U.S. Navy by Fisheries Research Institute, University of Washington, Seattle. FRI-UW-8709. 16 pp.

Dumbauld, B.R., D.A. Armstrong, T.C. Wainwright, and P.A. Dinnel 1988. Impact of dredging on Dungeness crab, Cancer magister, in Grays Harbor, Washington during August 1987. Final Rpt. for Seattle District, U.S. Army Corps of Engineers by School of Fisheries, University of Washington, Seattle. FRI-UW-8820. 25 pp.

McGraw, K.A., L.L. Conquest, J.O. Waller, P.A. Dinnel, and D.A. Armstrong. 1988. Entrainment of Dungeness crabs, Cancer magister Dana, by hopper dredge in Grays Harbor, Washington. J. Shellfish Res. 7(2):219-231. Paper also presented by K.A. Chew at the National Shellfisheries Association Annual Meeting, New Orleans, Louisiana, June 1988.

Miller, B.S., D.R. Gunderson, D.A. Armstrong, P.A. Dinnel, and R.F. Donnelly. 1988. Recommended protocols for standardized collections of Puget Sound bottomfish. Final Rpt. to Tetra Tech, Inc. and Office of Puget Sound, U.S. Environmental Protection Agency, Region 10, Seattle, Washington. 42 pp.

RESPONDENT: Dinnel; School of Fisheries

Cancer magister

GROUP: evasive macroepifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: clean sands to fine clay/mud

TEMPERATURE: 0-25 C

SALINITY: 0-32 ppt

FOOD: amphipods (Corophium spp.), Macoma spp., polychaetes, harpacticoid copepods, Crangon franciscosum, Neomysis spp., Archaemysis, cumacea, etc.

OTHER:

OCCURENCE

ABUNDANCE LEVELS: 0-100,000 hectare

BIOMASS LEVELS: available from NMFS, Hammond, Oregon

SEASONALITY: young of year in May-August; 1+,2+ in October-December

SAMPLING METHODOLOGY

TECHNIQUES: 8 m MacInovitch trawl; 5 min. tows; distance measured; 8.5 m vessel; trawl with liner in cod-end; crabs, shrimp, and fish were identified, measured (mm), and weighed

DESIGN: once or twice monthly for 1 year, multiple stations

REPLICATION: none

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: ASCii NMFS format; stored on NWAFC Burroughs computer; archived on tape

STATISTICAL ANALYSIS: number/hectare; length frequency analysis; annual variations; Kruski-Wallace non-parametric test, length/weight (log.log) relationships

GRAPHS AND FIGURES: bar graphs of catches, lengths

SOURCES

LOCATION: Columbia River estuary, Oregon-Washington; specific locations available from NMFS

REFERENCES:

McCabe, G.T., and R.J. McConnell. 1989. Abundance and size-class structure of Dungeness crabs in or near frequently-dredged areas in the Columbia River estuary. Unpubl. rep., NOAA-NMFS to U.S. Army Corps of Engineers, Northwest Alaska Fish. Cent., Seattle, WA. 22 pp.

RESPONDENT: Emmett; National Marine Fisheries Service

Cancer spp.

GROUP: evasive macroepifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: gravel/cobble over sand or silty sand, often with some plant cover

TEMPERATURE: 0-25 C

SALINITY: >15 ppt

FOOD: any live or freshly dead animal tissue

OTHER:

OCCURENCE

ABUNDANCE LEVELS: typically 1-10 m-2; highs of 100-200 m-2

BIOMASS LEVELS:

SEASONALITY: all year

SAMPLING METHODOLOGY

TECHNIQUES: 0.25 m2 quadrats dug & screend from intertidal areas; see Miller et al. 1988 for trawl protocol

DESIGN: random with habitat type along transects or within sampling plots

REPLICATION: up to 30 reps within plots; usually 3 reps/habitat type for transects

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: UW/Cyber or pc spreadsheet (Excel)

STATISTICAL ANALYSIS: catches standardized to crab/hectare; generally non-parametric statistical procedures or log-transformation with parametric statistics

GRAPHS AND FIGURES: line charts, bar charts, histograms

SOURCES

LOCATION: various locations throughout Puget Sound, Grays Harbor (complete list of sampling sites available)

REFERENCES:

Armstrong, D.A., J.L. Armstrong, and P.A. Dinnel. 1987. Ecology and population dynamics of Dungeness crab, Cancer magister, in Ship Harbor, Anacortes, Washington. Final Rpt. for Leeward Development Company and Washington Department of Fisheries. FRI-UW-8701.

Armstrong, D.A., T.C. Wainwright, J. Orensanz, P.A. Dinnel, and B.R. Dumbauld. 1987. Model of dredging impact on Dungeness crab in Grays Harbor, Washington. Final Rpt. to Battelle Northwest Laboratories and U.S. Army Corp of Engineers. FRI-UW-8701. 67 pp.

Dinnel, P.A. R.R. Lauth, D.A. Armstrong, J.L. Armstrong, K. Larsen, and S.D. Sulkin. 1989. Marine fish predation on juvenile Dungeness crab, Cancer magister, in Padilla Bay, Washington. Final Rpt. to NOAA/NOS/OCRM, Marine and Estuarine Management Division by School of Fisheries, University of Washington, Seattle. In preparation.

Dinnel, P.A., D.A. Armstrong, and B.R. Dumbauld, and T.C. Wainwright. 1986. Impact of dredging on Dungeness crab, Cancer magister, in Grays Harbor, Washington during August 1986. Final Rpt. for U.S. Army Corps of Engineers by Fisheries Research Institute, University of Washington, Seattle. FRI-UW-8611. 34 pp.

Dinnel, P.A., D.A. Armstrong, and B.R. Dumbauld, T.C. Wainwright, A.J. Whiley, R. Burge, and R. Bumgarner. 1987. Padilla Bay Dungeness crab, Cancer magister, habitat study. Final Rpt. to NOAA/OCRM/DMEM and the Washington State Department of Ecology by Fisheries Research Institute, University of Washington, Seattle. FRI-UW-8704. 78 pp.

Dinnel, P.A., D.A. Armstrong, and B.R. Dumbauld. 1986. Impact of dredging and dredged material disposal on Dungeness crab, Cancer magister, in Grays Harbor, Washington during October 1985. Final Rpt. for U.S. Army Corps of Engineers by Fisheries Research Institute, University of Washington, Seattle. FRI-UW-8606. 30 pp.

Dinnel, P.A., D.A. Armstrong, and C. Dungan. 1985. Initiation of a Dungeness crab (Cancer magister) habitat study in North Puget Sound. pages 327-337 in: Proceedings of the Symposium on Dungeness Crab BIology and Management. Alaska Sea Grant Rpt. No. 85-3, University of Alaska, Fairbanks.

Dinnel, P.A., D.A. Armstrong, and R.O. McMillan. (in prep.) Settlement patterns, timing, and early post-larval growth of Dungeness crab, Cancer magister, in Puget Sound, Washington. Manuscript in preparation for J. Marine Biology.

Dinnel, P.A., D.A. Armstrong, and R.O. McMillan. 1985. Survey of Dungeness crab, Cancer magister, resources in Oak Harbor, Washington. Final Rpt. for the Seattle District, U.S. Army Corp of Engineers by School of Fisheries, University of Washington, Seattle. 23 pp.

Dinnel, P.A., D.A. Armstrong, and R.O. McMillan. 1986. Dungeness crab, Cancer magister, distribution, recruitment, growth, and habitat use in Lummi Bay, Washington. Final Rpt. for the Lummi Indian Tribe by Fisheries Research Institute, University of Washington, Seattle. FRI-UW-8612. 61 pp.

Dinnel, P.A., D.A. Armstrong, and R.R. Lauth 1988. Invertebrate resource assessments in and around proposed dredged materials disposal sites in Puget Sound. in: Proceedings of the First Annual Conference on Puget Sound Research. Vol 1:337-343. Puget Sound Water Quality Authority, Seattle, Washington.

Dinnel, P.A., D.A. Armstrong, B.S. Miller, and R.F. Donnelly. 1986. Puget Sound Dredge Disposal Analysis (PSDDA) disposal site investigations: Phase I trawl studies in Saratoga Passage, Port Gardner, Elliott Bay, and Commencement Bay, Washington. Final Rpt. for U.S. Army Corps of Engineers by Fisheries Research Institute, University of Washington, Seattle. FRI-UW-8615. 208 pp.

Dinnel, P.A., D.A. Armstrong, R.R. Lauth, and K. Larsen. 1988. Puget Sound Dredge Disposal Analysis (PSDDA) disposal site investigations: Phase II trawl studies in north and south Puget Sound. Invertebrate resource assessments. Final Rpt. for Washington Sea Grant and Seattle District, U.S. Army Corp of Engineers by School of Fisheries, University of Washington, Seattle. FRI-UW-8818. 92 pp.

Dinnel, P.A., D.A. Armstrong, R.R. Lauth, T.C. Wainwright, J.L. Armstrong, and K. Larsen. 1988. U.S. Navy Homeport disposal site investigations in Port Gardner, Washington. Invertebrate resource assessments. Two-year Final Rpt. for Washington Sea Grant, U.S. Navy, and U.S. Army Corps of Engineers by School of Fisheries, University of Washington, Seattle. FRI-UW-8820. 25 pp.

Dinnel, P.A., G. Jamieson, B.S. Miller, D.A. Armstrong, and R.R. Lauth. 1987. Use of Pisces IV submersible for determining the distribution of Dungenss crab, shrimp, and bottomfish in Port Gardner, Washington. Final Rpt. for Washington Sea Grant, U.S. Army Corp of Engineers, and U.S. Navy by Fisheries Research Institute, University of Washington, Seattle. FRI-UW-8709. 16 pp.

Dumbauld, B.R., D.A. Armstrong, T.C. Wainwright, and P.A. Dinnel 1988. Impact of dredging on Dungeness crab, Cancer magister, in Grays Harbor, Washington during August 1987. Final Rpt. for Seattle District, U.S. Army Corps of Engineers by School of Fisheries, University of Washington, Seattle. FRI-UW-8820. 25 pp.

McGraw, K.A., L.L. Conquest, J.O. Waller, P.A. Dinnel, and D.A. Armstrong. 1988. Entrainment of Dungeness crabs, Cancer magister Dana, by hopper dredge in Grays Harbor, Washington. J. Shellfish Res. 7(2):219-231. Paper also presented by K.A. Chew at the National Shellfisheries Association Annual Meeting, New Orleans, Louisiana, June 1988.

Miller, B.S., D.R. Gunderson, D.A. Armstrong, P.A. Dinnel, and R.F. Donnelly. 1988. Recommended protocols for standardized collections of Puget Sound bottomfish. Final Rpt. to Tetra Tech, Inc. and Office of Puget Sound, U.S. Environmental Protection Agency, Region 10, Seattle, Washington. 42 pp.

RESPONDENT: Dinnel; School of Fisheries

Cancer spp.

GROUP: evasive macroepifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: on boulders, under cobble, in mixed sediments, 0-+0.9 m MLLW

TEMPERATURE: unknown

SALINITY: apx. 28-30 ppt

FOOD: unknown

OTHER:

OCCURENCE

ABUNDANCE LEVELS: 2-100 m-2

BIOMASS LEVELS:

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: 100 cm2 quadrats; all organisms identified

DESIGN: stratified random samples by habitat type and tide height (0, +0.9, +1.8 m above MLLW)

REPLICATION: 8 reps per station

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: hard copy; species abundance and distribution by tide height, season, habitat

STATISTICAL ANALYSIS: species area curves; cluster analysis; regression; "T" tests; discriminant analysis

GRAPHS AND FIGURES:

SOURCES

LOCATION: 5 central Puget Sound beaches: Alki; Carkeek; Lincoln Park; Richmond; West Point

REFERENCES:

Armstrong, J. 1977. The impact of subtidal sewage outfalls on the intertidal macrofauna of several central Puget Sound beaches. PhD Dissertation, University of Washington. 183 pp. and Appendices.

RESPONDENT: Armstrong,; Environmental Protection Agency

Caprella laeviuscula

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silt-sand w/ some gravel beneath surface

TEMPERATURE: 8.0 degrees C (March) to 24 degrees C (July)

SALINITY: greater than 25 ppt

FOOD:

OTHER: dense Zostera marina

OCCURENCE

ABUNDANCE LEVELS: adults:mean=298.9 +/- 1 s.d.=774.7 m-2; range: 0-5111.1 m-2

BIOMASS LEVELS: adults:mean=150.7 +/- 1 s.d.=345.2 mg m-2; range: 0-2600 mg m-2

SEASONALITY: maxima in mid-June

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: permanent sampling points established randomly along transect line through eelgrass meadow at same tidal elevation

REPLICATION: n=5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Drayton Harbor, Washington; mid-intertidal (0.6 m MLLW) eelgrass meadow east of Blaine Marina

REFERENCES:

Thom, R. M., C. A. Simenstad, J. R. Cordell, and E. O. Salo 1989. Fish and their epibenthic prey in a marine and adjacent mudflats and eelgrass meadow in a small estuarine bay FRI-UW-8901, Final Rep. prep. for The Port of Bellingham, Fish. Res. Inst., Univ. Wash., Seattle, WA. 27 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Caprella laeviuscula

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: coarse sand

TEMPERATURE:

SALINITY:

FOOD:

OTHER: dense Zostera marina meadow

OCCURENCE

ABUNDANCE LEVELS: juveniles: mean=816.0 +/- 1. s.d.=881.2 m-2; range: 600-1840 m-2; combined adults: mean=848.0 +/- 1 s.d.=1058.0 m-2; range: 1440-2200 m-2

BIOMASS LEVELS: juveniles: mean=494 +/- 1 s.d.=880 mg m-2; range: 60-2036 mg m-2; combined adults: mean=1956 +/- 1 s.d.=2570 mg m-2; range: 2024-5900 mg m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.10-m2 epibenthic suction pump (FRI macropump); gas engine powered; w/ 130-um mesh on ports; organisms filtered through nested 500-um, 253-um, and 130-um mesh nets; pumped for 45 sec.

DESIGN: random samples from discrete substrate and tidal elevation; sampled on one occasion (early July)

REPLICATION: n=5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archieved on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2

GRAPHS AND FIGURES: (data not processed beyond tabulation)

SOURCES

LOCATION: Alki Point (Seattle), central Puget Sound

REFERENCES:
Simenstad, C. A., and J. R. Cordell. 1984. n.a. Unpubl. data.

RESPONDENT: Simenstad; Fisheries Research Institute

Carex lyngbei

GROUP: rooted vascular plants

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: sand silt

TEMPERATURE:

SALINITY: 0 ppt (freshwater)

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS:

BIOMASS LEVELS:

SEASONALITY: one sampling only; Sept. 1987

SAMPLING METHODOLOGY

TECHNIQUES: Braun-Blonquet sociability classes (1 to 5); abundance & coverage (+,1-6)

DESIGN: 10 plots; 1 m2 plots; to obtain natural marsh coverage data at marina development site prior to construction; compensation site monitoring: species i.d.; 1 m2 plots (n=15); aerial color photographs

REPLICATION: n=10-15

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: raw data; not processed; compensation monitoring on going

STATISTICAL ANALYSIS: data will be processed this fall

GRAPHS AND FIGURES: data will be processed this fall

SOURCES

LOCATION: Bridge Pont Harbour Market site North Arm (immediately below Oak St. Bridge in Richmond); compensation site on south side of Mitchell Island (immediately downstream of Arrow Transfer)

REFERENCES:

Williams, G.L. 1985. Outline of habitat compensation for proposed Bridge Point Harbour Market development, Richmond, B.C. unpubl. report for North Fraser Harbour Commission, Richmond. 35 pp.
Williams, G.L. 1989. Final report on marsh construction.

RESPONDENT: Williams; G.L. WIlliams and Associates, Ltd.

Carex lyngbei

GROUP: rooted vascular plants

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: sand-mud

TEMPERATURE:

SALINITY: 0.0 ppt

FOOD: N/A

OTHER:

OCCURENCE

ABUNDANCE LEVELS:

BIOMASS LEVELS: 1392 g m2; net primary productivity 529 g C m-2 yr-1

SEASONALITY: spring-fall

SAMPLING METHODOLOGY

TECHNIQUES: standing stock: 0.25 or 1.0 m2 quadrats

DESIGN: random samples within strata

REPLICATION: 2-30

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: "Statgraphics" data files; "Lotus" files

STATISTICAL ANALYSIS: summary statistics per unit area (usually m2)

GRAPHS AND FIGURES: line plots of spatial-temporal variation

SOURCES

LOCATION: Grays Harbor, Putallup River estuary

REFERENCES:

Thom, R.M, C.A. Simenstad, and E.O. Salo. 1987. The Lincoln Street wetland system in the Puyallup River estuary, Washington. Phase I report: Construction and initial monitoring, July 1985-December 1986. Fisheries Research Institute, University of Washington, FRI-UW-8706. 85 pp.

Thom, R.M, C.A. Simenstad, D.K. shreffler, J.R. Cordell, and E.O. Salo. 1988. The Lincoln Street wetland system in the Puyallup River estuary, Washington. Phase II report: Year two monitoring, January-December 1987. Fisheries Research Institute, University of Washington, FRI-UW-8812.

Thom, R.M. 1981. Primary productivity and carbon input to Grays Harbor estuary. Seattle District, U.S. Army Corps of Engineers, Seattle, Washington.

Thom, R.M. 1984. Primary production in Grays Harbor estuary, Washington. Bull. Southern California Acad. Sciences 83:99-105.

RESPONDENT: Thom; Fisheries Research Institute

Carex lyngbei

GROUP: rooted vascular plants

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: sand to clay

TEMPERATURE: soil temp = 12-16 C in May

SALINITY: 0-12 ppt

FOOD:

OTHER: redox. (+)155-(-)435 mV

OCCURENCE

ABUNDANCE LEVELS:

BIOMASS LEVELS: 1500 g dry weight m-2

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: vegetation transects; continuous presence/absence data; added to 16 environmental stations; sampled weekly at environmental plots for phenology, growth, salinity, temperature

DESIGN: sampled production at end of season

REPLICATION: n=5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: only reduced data available

STATISTICAL ANALYSIS: multivariate techniques: regression, binary discriminate analysis, PCA, decorana

GRAPHS AND FIGURES: numerous, in dissertation and journals

SOURCES

LOCATION: Skagit Bay, intertidal marsh between Freshwater Slough and North Fork

REFERENCES:

Ewing, K. 1982. Plant response to environmental variation in the Skagit marsh. PhD dissertation, University of Washington.
Ewing, K. 1983. Environmental controls in Pacific Northwest intertidal plant communities. Can. J. Bot. 61:1105-1116.
Ewing, K. 1986. Plant growth and productivity along complex gradients in a Pacific northwest brackish intertidal marsh. Estuaries 9:49-62.
Ewing, K. 1989. (manuscript)

RESPONDENT: Ewing; Range Science Department

Chironomidae, larvae/pupae

GROUP: surface epifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silt and detritus; decaying marsh litter and trapped eelgrass and other debris

TEMPERATURE: 8.0 degrees C (March) to 24 degrees C (July)

SALINITY: greater than 25 ppt

FOOD:

OTHER: marsh vegetation dominated by Scirpus, Triglochin, and Distichlis

OCCURENCE

ABUNDANCE LEVELS: juveniles and adults combined: mean = 305.6 +/- 1 s.d. = 354.0 m-2; range = 111.1-1000.0 m-2

BIOMASS LEVELS: juveniles and adults combined: mean = 26 +/- 1 s.d. = 30 mg m-2; range = 6-78 mg m-2

SEASONALITY: most abundant in early-March (only sampled twice, in March)

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: permanent sampling points established randomly along transect line bisecting marsh vegetation along same tidal elevation

REPLICATION: n = 5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-tract mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Drayton Harbor, Washington; high intertidal emergent marsh within Blaine Marina

REFERENCES:

Thom, R. M., C. A. Simenstad, J. R. Cordell, and E. O. Salo 1989. Fish and their epibenthic prey in a marina and adjacent mudflats and eelgrass meadow in a small estuarine bay FRI-UW-8901, Final Rep. prep. for The Port of Bellingham, Fish. Res. Inst., Univ. Wash., Seattle, WA. 27 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Chironomidae, larvae/pupae

GROUP: surface epifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silt-clay on flats; silt to medium sand in channels

TEMPERATURE: 8 degrees C (February) to 20 degrees C (June)

SALINITY: 0 to 7 ppt

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: mean=397.6 +/- 1 s.d.=401.9 m-2; range: 12.5-888.9 m-2

BIOMASS LEVELS: mean=182.3 +/- 1 s.d.=352.6 mg m-2; range: 1-711 mg m-2

SEASONALITY: maxima in mid-April

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: permanent sampling points established randomly along transect lines transecting tidal flats and channels; epibenthos sampled monthly, March-June 1987

REPLICATION: n=5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise, Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Lincoln Avenue restored wetland system, Puyallup river estuary, Washington; surface of unvegetated (non-planted, few recruited marsh vascular plants)

REFERENCES:

Thom, R. M., C. A. Simenstad, D. K. Shreffler, J. R. Cordell, and E. O. Salo 1988. The Lincoln Avenue wetland system in the Puyallup River estuary, Washington: Phase II report; year two monitoring, January-December 1987 FRI-UW-8812, Ann. Rep. to Port of Tacoma, Fish. Res. Inst., Univ. Wash., Seattle, WA. 80 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Chironomidae, larvae/pupae

GROUP: surface epifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silt-clay on flats; silt to medium sand in channels

TEMPERATURE: 8 degrees C (February) to 20 degrees C (June)

SALINITY: 0 to 7 ppt

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: mean = 149.7 +/- 1 s.d. = 117.9 m-2; range: 0-287.5 m-2

BIOMASS LEVELS: mean = 8.5 +/- 1 s.d. = 6.0 mg m-2; range: 0-14 mg m-2

SEASONALITY: maxima in March

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: permanent sampling points established randomly along transect lines transecting tidal flats and channels; epibenthos sampled monthly, March-June 1987

REPLICATION: n = 5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise, Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Lincoln Avenue restored wetland system, Puyallup river estuary, Washington; surface of vegetated (planted Carex, endemic Typha) flat

REFERENCES:

Thom, R. M., C. A. Simenstad, D. K. Shreffler, J. R. Cordell, and E. O. Salo 1988. The Lincoln Avenue wetland system in the Puyallup River estuary, Washington: Phase II report; year two monitoring, January-December 1987 FRI-UW-8812, Ann. Rep. to Port of Tacoma, Fish. Res. Inst., Univ. Wash., Seattle, WA. 80 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Chironomidae, larvae/pupae

GROUP: surface epifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silt-clay on flats; silt to medium sand in channels

TEMPERATURE: 8 degrees C (February) to 20 degrees C (June)

SALINITY: 0 to 7 ppt

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: mean=314.8 +/- 1 s.d.=308.8 m-2; range: 0-648.19 m-2

BIOMASS LEVELS: mean=21.8 +/- 1 s.d.=21.6 mg m-2; range: 0-50 mg m-2

SEASONALITY: maxima in May

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: permanent sampling points established randomly along transect lines transecting tidal flats and channels; epibenthos sampled monthly, March-June 1987

REPLICATION: n=5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise, Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Lincoln Avenue restored wetland system, Puyallup river estuary, Washington; tidal channel draining vegetated flat

REFERENCES:

Thom, R. M., C. A. Simenstad, D. K. Shreffler, J. R. Cordell, and E. O. Salo 1988. The Lincoln Avenue wetland system in the Puyallup River estuary, Washington: Phase II report; year two monitoring, January-December 1987 FRI-UW-8812, Ann. Rep. to Port of Tacoma, Fish. Res. Inst., Univ. Wash., Seattle, WA. 80 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Clinocardium nutalli

GROUP: surface epifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: sand

TEMPERATURE: unknown

SALINITY: apx. 28-30 ppt

FOOD: unknown

OTHER: epifauna abundance at 0.9 m > > 0 m or 1.8 m MLLW

OCCURENCE

ABUNDANCE LEVELS: 0 m MLLW: 30-160 m-2; +0.9 m MLLW 60-125 m-2

BIOMASS LEVELS: 0 m MLLW: 40-740 gm m-2; +0.9 m MLLW: 10-625 gm m-2

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: 100 cm2 quadrats; all organisms identified; 6 mm mesh screen

DESIGN: stratified random samples by habitat type and tide height (0, +0.9, +1.8 m above MLLW)

REPLICATION: 8 reps per station

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: hard copy; species abundance and distribution by tide height, season, habitat

STATISTICAL ANALYSIS: species area curves; cluster analysis; regression; "T" tests; discriminant analysis

GRAPHS AND FIGURES:

SOURCES

LOCATION: 5 central Puget Sound beaches: Alki; Carkeek; Lincoln Park; Richmond; West Point

REFERENCES:

Armstrong, J. 1977. The impact of subtidal sewage outfalls on the intertidal macrofauna of several central Puget Sound beaches. PhD Dissertation, University of Washington. 183 pp. and Appendices.

RESPONDENT: Armstrong,; Environmental Protection Agency

Clinocardium nutalli

GROUP: surface epifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: fine to medium sand to clay hardpan; shell debris abundant on unconsolidated substrate; nearly all clams (96%) were in sand to cobble sediments at 0 to -8 ft

TEMPERATURE:

SALINITY:

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: 0 to -5 ft: 24.5 m-2; -5 to -8 ft: 2.0 m-2; -8 to -15 ft: 0.0 m-2; -15 to -25 ft: 0.7 m-2; below -25 ft: 0.0; mean=9.3 m-2

BIOMASS LEVELS: mean=76.5 g m-2

SEASONALITY: none; not measured

SAMPLING METHODOLOGY

TECHNIQUES: venturi dredge; 6 in (i.d.) hydraulic suction dredge; clams were collected in a 0.75 in mesh vexar bag; substrate vacuumed with in a 0.25 m2 quadrat to a depth of 50 cm

DESIGN: samples from stations fixed by a predetermined transect perpendicular to shore at depths of -0.4 to -48.0 ft (MLLW); all sampled on August 15, 1986

REPLICATION: none, 22 samples overall

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: simple spreadsheets

STATISTICAL ANALYSIS: none; basic data summary only

GRAPHS AND FIGURES: none

SOURCES

LOCATION: Elliott Bay immediately west of piers 90-91

REFERENCES:

BioAquatics International (D. Cheney). 1986. Distribution and abundance of subtidal hardshell clams at the Elliott Bay Marina project site. Elliott Bay Marina Group. Project Rpt. 11 pp.

RESPONDENT: Cheney; BioAquatics International

Clupea harengus pallasi

GROUP: motile fish

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: sand to mud

TEMPERATURE: seasonally variable; range 5-18 C

SALINITY: seasonally variable; range 15-30 ppt

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: mean (per site) - 12-3557 fish/haul; range of 1 to 29,350 fish/haul

BIOMASS LEVELS: available, not analyzed

SEASONALITY: most fish were 0+ herring; most abundant in June-September

SAMPLING METHODOLOGY

TECHNIQUES: 3.1m x 6.1m tow net; 10 minute tow; 2 boat surface trawl

DESIGN: monthly samples collected at 6 eelgrass sites from July 1974-August 1976

REPLICATION: 2 samples

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC/MESA; hard copy

STATISTICAL ANALYSIS: none

GRAPHS AND FIGURES: none

SOURCES

LOCATION: nothern Puget Sound

REFERENCES:

Fresh, K.L. 1979. Distribution and abundance of fishes occuring in the nearshore surface waters of northern Puget Sound, Washington. M.S. thesis, University of Washington, Seattle. 120 pp.

RESPONDENT: Fresh; Washington Department of Fisheries

Clupea harengus pallasi

GROUP: motile fish

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: steep rocky slopes; some attached kelp; very exposed

TEMPERATURE: 5-13 C; mean = 8.3 to 9.6

SALINITY: 21-31 ppt.; mean = 27.5 to 28.1

FOOD: available

OTHER:

OCCURENCE

ABUNDANCE LEVELS: mean CPUE/site apx. 31-2312; range of monthly CPUE = 1 to 20,269

BIOMASS LEVELS:

SEASONALITY: primarily age 0+ herring; most abundant June-August

SAMPLING METHODOLOGY

TECHNIQUES: 3.1m x 6.1m tow net; 2 boat surface trawl

DESIGN: 10 min. tows; all night sets; 3 rocky deep sites in northern Puget Sound; monthly between July 1974-August 1976

REPLICATION: 2 samples

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC/MESA; hard copy

STATISTICAL ANALYSIS: none

GRAPHS AND FIGURES: time series

SOURCES

LOCATION: nothern Puget Sound

REFERENCES:

Fresh, K.L. 1979. Distribution and abundance of fishes occuring in the nearshore surface waters of northern Puget Sound, Washington. M.S. thesis, University of Washington, Seattle. 120 pp.

RESPONDENT: Fresh; Washington Department of Fisheries

Clupea harengus pallasi

GROUP: motile fish

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: gravel/cobble

TEMPERATURE: available

SALINITY: available

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: mean CPUE = 1.4 fish/haul

BIOMASS LEVELS:

SEASONALITY: no consistent pattern

SAMPLING METHODOLOGY

TECHNIQUES: 3.1m x 6.1m tow net; two boat surface trawl

DESIGN: areas were sampled from April-June 1978 in Nisqually Reach; day & night time hauls; 10 min. tows

REPLICATION: multiple tows in the area on each sampling trip

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC/MESA

STATISTICAL ANALYSIS: none

GRAPHS AND FIGURES: none

SOURCES

LOCATION: Nisqually Reach

REFERENCES:

Fresh, K.L., D. Rabin, C.A. Simenstad, E.O. Salo, K. Garrison, and L. Matheson. 1979. Fish ecology studies in the Nisqually Reach area of southern Puget Sound, Washington. Final report to Weyerhauser Company. Fisheries Research Institute, FRI-UW-7904. University of Washington, 229 pp.

RESPONDENT: Fresh; Washington Department of Fisheries

Clupea harengus pallasi

GROUP: motile fish

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: variable

TEMPERATURE:

SALINITY:

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: CPUE = 0 to 14,066; highest catches in August

BIOMASS LEVELS: not known

SEASONALITY: not sufficiently sampled

SAMPLING METHODOLOGY

TECHNIQUES: 3.1m x 6.1m tow net; two boat surface trawl; 10 min.

DESIGN: hauls made June-September 1977,1978; all night time

REPLICATION: no consistent replication

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: data sheets & computer

STATISTICAL ANALYSIS: none

GRAPHS AND FIGURES: none

SOURCES

LOCATION: Nisqually Reach

REFERENCES:

Fresh, K.L., D. Rabin, C.A. Simenstad, E.O. Salo, K. Garrison, and L. Matheson. 1979. Fish ecology studies in the Nisqually Reach area of southern Puget Sound, Washington. Final report to Weyerhauser Company. Fisheries Research Institute, FRI-UW-7904. University of Washington, 229 pp.

RESPONDENT: Fresh; Washington Department of Fisheries

Clupea harengus pallasi

GROUP: motile fish

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: variable

TEMPERATURE:

SALINITY:

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: CPUE = 51 fish/haul

BIOMASS LEVELS: not known

SEASONALITY: not sufficiently sampled

SAMPLING METHODOLOGY

TECHNIQUES: 3.1m x 6.1m tow net; two boat surface trawl; 10 min.

DESIGN: samples collected April-June 1978; samples pooled by area

REPLICATION: multiple hauls per area

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC/MESA

STATISTICAL ANALYSIS: none

GRAPHS AND FIGURES: none

SOURCES

LOCATION: Nisqually Reach

REFERENCES:

Fresh, K.L., D. Rabin, C.A. Simenstad, E.O. Salo, K. Garrison, and L. Matheson. 1979. Fish ecology studies in the Nisqually Reach area of southern Puget Sound, Washington. Final report to Weyerhauser Company. Fisheries Research Institute, FRI-UW-7904. University of Washington, 229 pp.

RESPONDENT: Fresh; Washington Department of Fisheries

Clupea harengus pallasi

GROUP: motile fish

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: gravel/cobble; some small amounts of kelp, eelgrass, other submergent plants at some sites

TEMPERATURE: 6-16 C; mean = 8.8-10.2 C

SALINITY: 20-30 ppt; mean = 26.6-30.2 ppt

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: mean CPUE per site = 10-484; range 1-2,903 fish/haul

BIOMASS LEVELS:

SEASONALITY: most abundant June-September; most fish 0+ herring; length frequencies available

SAMPLING METHODOLOGY

TECHNIQUES: 3.1m x 6.1m tow net; two boat surface trawl; 10 min. tows

DESIGN: monthly sampling July 1974-August 1976; night time samples; 6 gravel/cobble sites in northern Puget Sound (San Jaun Island area); Cherry Point; Padilla area

REPLICATION:

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC/MESA; hard copy also

STATISTICAL ANALYSIS: none

GRAPHS AND FIGURES: time series

SOURCES

LOCATION: San Jaun Island area; Cherry Point area; Padilla area

REFERENCES:

Fresh, K.L. 1979. Distribution and abundance of fishes occuring in the nearshore surface water of northern Puget Sound, Washington. M.S. thesis, University of Washington. 120 pp.

RESPONDENT: Fresh; Washington Department of Fisheries

Clupea harengus pallasi

GROUP: motile fish

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silt-sand w/ some gravel beneath surface

TEMPERATURE: 8.0 degrees C (March) to 24 degrees C (July)

SALINITY: greater than 25 ppt

FOOD:

OTHER: dense Zostera marina

OCCURENCE

ABUNDANCE LEVELS: juveniles and adults combined: mean=45.4 +/- 1 s.d. =116.8 m-2; range: 0-388.7 m-2

BIOMASS LEVELS: (standing crop data not summarized)

SEASONALITY: maxima in late May

SAMPLING METHODOLOGY

TECHNIQUES: 37-m long beach seine (UW School of Fisheries research seine) w/ 7-mm mesh bag, set 30-m from and parallel to shore; retrieved to sample 520 m2

DESIGN: adjacent, consecutive sets made in identical shallow subtidal habitats; small catches retained, large catches subsampled; sorted to spp. and life history stage; enumerated and weighed (damp wet wt.)

REPLICATION: n=3

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 3; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Drayton Harbor, Washington; mid-intertidal (0.6 m MLLW) eelgrass meadow east of Blaine Marina

REFERENCES:

Thom, R. M., C. A. Simenstad, J. R. Cordell, and E. O. Salo 1989. Fish and their epibenthic prey in a marine and adjacent mudflats and eelgrass meadow in a small estuarine bay FRI-UW-8901, Final Rep. prep. for The Port of Bellingham, Fish. Res. Inst., Univ. Wash., Seattle, WA. 27 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Clupea harengus pallasi

GROUP: motile fish

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: predominately sand to mud with some eelgrass

TEMPERATURE: 5-20 C

SALINITY: 15-30 ppt.

FOOD: detailed diet data available

OTHER:

OCCURENCE

ABUNDANCE LEVELS: 0-20,000

BIOMASS LEVELS: unknown

SEASONALITY: consistently present,; most abundant in summer & early fall; primarily young of year

SAMPLING METHODOLOGY

TECHNIQUES: 37m beach seine; 30m set; floating

DESIGN: monthly hauls made at 6 sites throughout Puget Sound by beach seine; 1979-1981

REPLICATION: 2 samples per site

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC/MESA

STATISTICAL ANALYSIS: none

GRAPHS AND FIGURES: time series

SOURCES

LOCATION: Nisqually Reach, Bainbridge Island

REFERENCES:

Fresh, K.L., R.D. Cardwell, and R.R. Koons. 1981. Food habits of pacific salmon, baitfish, and their potential predators and competitors in the marine waters of Washington, August 1978 to September 1979. Washington Department of Fisheries Progress Report No. 145.

RESPONDENT: Fresh; Washington Department of Fisheries

Clupea harengus pallasi

GROUP: motile fish

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: sand to mud

TEMPERATURE: available but not summarized

SALINITY: avaliable but not summarized

FOOD: available

OTHER:

OCCURENCE

ABUNDANCE LEVELS: mean = 51; mostly young of the year; most abundant late spring

BIOMASS LEVELS:

SEASONALITY: most abundant in late spring

SAMPLING METHODOLOGY

TECHNIQUES: 37m beach seine; floating

DESIGN: weekly or twice weekly samples collected February-July 1978; both day & night hauls made; 3 eelgrass sites sampled; 30m hauls

REPLICATION: 2 samples per site

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC/MESA; computerized & soft copy

STATISTICAL ANALYSIS: none

GRAPHS AND FIGURES: none

SOURCES

LOCATION: Nisqually Reach

REFERENCES:

Fresh, K.L., D. Rabin, C.A. Simenstad, E.O. Salo, K. Garrison, and L. Matheson. 1979. Fish ecology studies in Nisqually Reach area of southern Puget Sound, Washington. Final report to Weyerhauser Company. Fisheries Research Institute, FRI-UW-7904. University of Washington, 229 pp.

RESPONDENT: Fresh; Washington Department of Fisheries

Clupea harengus pallasi

GROUP: motile fish

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: unknown

TEMPERATURE: available

SALINITY: available

FOOD: see Fresh et al. (1981)

OTHER:

OCCURENCE

ABUNDANCE LEVELS: all size classes captured; data available but not summarized

BIOMASS LEVELS:

SEASONALITY: insufficient data

SAMPLING METHODOLOGY

TECHNIQUES: 500m x 55m purse seine (2 cm mesh)

DESIGN: 3 sampling trips made in 1979 in Puget Sound; various sites were sampled; both day & night hauls

REPLICATION: same sites

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC/MESA

STATISTICAL ANALYSIS: N/A

GRAPHS AND FIGURES: N/A

SOURCES

LOCATION: Puget Sound (south of Possession Point)

REFERENCES:

Fresh, K.L., R.D. Cardwell, and R.R. Koons. 1981. Food habits of pacific salmon, baitfish, and their potential predators and competitors in the marine waters of Washington, August 1978 to September 1979. Washington Department of Fisheries Progress Report No. 145.

RESPONDENT: Fresh; Washington Department of Fisheries

Clupea harengus pallasi

GROUP: motile fish

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: unknown

TEMPERATURE: unknown

SALINITY: unknown

FOOD: detailed food habits data available

OTHER:

OCCURENCE

ABUNDANCE LEVELS: 0-apx. 60 tons (mostly 1+ herring)

BIOMASS LEVELS: unknown

SEASONALITY: not sufficiently sampled

SAMPLING METHODOLOGY

TECHNIQUES: 500m x 55m purse seine (2cm mesh)

DESIGN: 3 sampling trips made 1979-80 in south & central Puget Sound; numerous sites sampled; day & night trawls made

REPLICATION: varied

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODL/MESA

STATISTICAL ANALYSIS: none

GRAPHS AND FIGURES: none

SOURCES

LOCATION: south & central Puget Sound

REFERENCES:

Fresh, K.L., R.D. Cardwell, and R.R. Koons. 1981. Food habits of pacific salmon, baitfish, and their potential predators and competitors in the marine waters of Washington, August 1978 to September 1979. Washington Department of Fisheries Progress Report No. 145.

RESPONDENT: Fresh; Washington Department of Fisheries

Clupea harengus pallasi

GROUP: motile fish

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: various

TEMPERATURE: 0-25 C

SALINITY: 0-32 ppt

FOOD: Corophium spp., calanoid copepods, insects, mysids, Daphnia spp., etc.

OTHER: tidal stage, time of day, tidal height

OCCURENCE

ABUNDANCE LEVELS: 0-40,000/set; depends on schooling fish and hatchery releases

BIOMASS LEVELS:

SEASONALITY: highest numbers in summer/fall depending on species of concern and area in estuary

SAMPLING METHODOLOGY

TECHNIQUES: purse seine; collect, identify, measure, and weigh fish species; sample once/month depending on study; sometimes more intensive during salmonid migration

DESIGN: 10-200 m deep; 0.5 in. stretch mesh; knotless bunt; 2 vessels used; seining done all at flood, high slack tide

REPLICATION: none

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: ASCii NMFS format, species code; transformed to CPUE

STATISTICAL ANALYSIS: ANOVA on logged (x+1) data; chi-square

GRAPHS AND FIGURES: length-frequency distribution; numbers/month; # species/month

SOURCES

LOCATION: Columbia River estuary

REFERENCES:

McCabe, G.T., R.L. Emmett, and R.J. McConnell. 1987. Abundance and size-class structure of Dungeness crabs in or near frequently-dredged areas in the Columbia River estuary. Unpubl. rep., NOAA-NMFS to U.S. Army Corps of Engineers, Northwest Alaska Fish. Cent., Seattle, WA. 31 pp.

McCabe, G.T., R.L. Emmett, T.C. Colby, and R.J. McConnell. 1986. Distribution, abundance, and size-class structure of Dungeness crabs in the Columbia River estuary. Unpubl. rep., NOAA-NMFS to U.S. Army Corps of Engineers, Northwest Alaska Fish. Cent., Seattle, WA. 57 pp.

RESPONDENT: Emmett; National Marine Fisheries Service

Corbicula manilensis

GROUP: surface epifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: fine sand; silt clay with high organics (wood chips)

TEMPERATURE: 0-25 C

SALINITY: 0-32 ppt

FOOD: algal, micro flora on detritus particles

OTHER: currents, wave action on flats

OCCURENCE

ABUNDANCE LEVELS: 0-60,000 m-2 depending on species

BIOMASS LEVELS: available at NMFS

SEASONALITY: peaks in spring of fall-winter depending on species and station location

SAMPLING METHODOLOGY

TECHNIQUES: 0.05 Powan dredge; samples were collected during high tide from vessel, washed through .595 (#30) mesh siz, preserved in formalin (10%) and then identified in lab

DESIGN: quarterly samples of many (non-random) selected sites throughout the estuary

REPLICATION: n=2 per station for invertebrates; n=1 for sediment structure

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: on paper, never archived properly

STATISTICAL ANALYSIS: standardized to m-2

GRAPHS AND FIGURES: number m-2 at each station/season; sediment grain size

SOURCES

LOCATION: Columbia River estuary

REFERENCES:

Durkin, J.T., and R.L. Emmett. 1978. Benthic invertebrates of Baker Bay, Young's Bay, and adjacent areas in the Columbia River estuary. Unpubl. rep., NOAA-NMFS, Northwest Alaska Fish. Cent., Seattle, WA.

RESPONDENT: Emmett; National Marine Fisheries Service

Corophium salmonis

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silt, fine sand; some depressions and shallow drainage channels

TEMPERATURE: 8.0 degrees C (March) to 24 degrees C (July)

SALINITY: greater than 25 ppt

FOOD:

OTHER: Enteromorpha abundant during much of spring

OCCURENCE

ABUNDANCE LEVELS: adults: mean=1.5 +/- 1 s.d.=9.3 m-2; range=0-55.6 m-2

BIOMASS LEVELS: adults: mean=3 mg +/- 1 s.d.=2 mg m-2; range=0-111 mg m-2

SEASONALITY: maxima observed in late March

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: two points, corresponding to two microhabitats, sampled along each of five transects across littoral flat; transects positioned randomly along perpendicular baseline; sampled biweekly March-May (1988)

REPLICATION: n=10 at habitat level; n=5 at microhabitat level

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-tract mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Drayton Harbor, Washington; exposed, high intertidal mudflat (+1.8 m MLLW) in Harbor immediately east of marina breakwater

REFERENCES:

Thom, R. M., C. A. Simenstad, J. R. Cordell, and E. O. Salo 1989. Fish and their epibenthic prey in a marina and adjacent mudflats and eelgrass meadow in a small estuarine bay FRI-UW-8901, Final Rep. prep. for The Port of Bellingham, Fish. Res. Inst., Univ. Wash., Seattle, WA. 27 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Corophium spinicorne

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: upper 15 cm of water column

TEMPERATURE: 11-22 C

SALINITY: 0-7 ppt

FOOD:

OTHER: water discharge (cfs)

OCCURENCE

ABUNDANCE LEVELS: adults: 0.2 m-3; nymphs: 0.1 m-3

BIOMASS LEVELS: 0.17% of total biomass

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: Neuston net (253 um mesh)

DESIGN: Bi-weekly sampling; 5 min. tows; volume sampled quantified using flow meter; sample sieved through 150 um mesh sieve

REPLICATION: n=1

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT:

STATISTICAL ANALYSIS:

GRAPHS AND FIGURES:

SOURCES

LOCATION: Lincoln Ave. wetland, Puyallup River, Tacoma WA

REFERENCES:

Shreffler, D.K. 1989. Temporary residence and foraging by juvenile salmon in a restored estuarine wetland. M.S. thesis, Univ. of Washington. 100 pp.

RESPONDENT: Shreffler; Fisheries Research Institute

Corophium spp.

GROUP: surface epifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: fine-sand, mud; scattered, sparse eelgrass, Ulva and Enteromorpha

TEMPERATURE: 16 to 17 degrees C

SALINITY:

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: juveniles: mean=27.8 +/- 1 s.d.=24.0; range: 55.6-222.2 m-2

BIOMASS LEVELS: juveniles: mean=2 +/- 1.0 s.d.=1.4 mg m-2; range: 1-44 mg m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: 100-m x 100-m sampling grid established on tidal flat; ten permanent sites selected from random coordinates; sampled late June/early July and two weeks later (to test effects of Sevin application)

REPLICATION: n=10

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Willapa Bay, Washington; intertidal oyster tracts on Bay Center Channel, between Bone River channel and Bay Center Cutoff Channel

REFERENCES:

Simenstad, C. A., and J. R. Cordell (in prep.) Effects of Sevin application on littoral flat meiofauna: Preliminary sampling on Willapa Bay, June-July 1988 Fish. Res. Inst., Univ. Wash., Seattle, WA.

RESPONDENT: Simenstad; Fisheries Research Institute

Corophium spp.

GROUP: surface epifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silt-sand w/ some gravel beneath surface

TEMPERATURE: 8.0 degrees C (March) to 24 degrees C (July)

SALINITY: greater than 25 ppt

FOOD:

OTHER: dense Zostera marina

OCCURENCE

ABUNDANCE LEVELS: juveniles:mean = 15.8 +/- 1 s.d. = 53.6 m-2; range: 62.5-222.2 m-2

BIOMASS LEVELS: juveniles:mean = 2 +/- 1 s.d. = 10 mg m-2; range: 13-22 mg m-2

SEASONALITY: maxima in mid-May

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: permanent sampling points established randomly along transect line through eelgrass meadow at same tidal elevation

REPLICATION: n = 5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Drayton Harbor, Washington; mid-intertidal (0.6 m MLLW) eelgrass meadow east of Blaine Marina

REFERENCES:

Thom, R. M., C. A. Simenstad, J. R. Cordell, and E. O. Salo 1989. Fish and their epibenthic prey in a marine and adjacent mudflats and eelgrass meadow in a small estuarine bay FRI-UW-8901, Final Rep. prep. for The Port of Bellingham, Fish. Res. Inst., Univ. Wash., Seattle, WA. 27 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Corophium spp.

GROUP: surface epifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silt-clay on flats; silt to medium sand in channels

TEMPERATURE: 8 degrees C (February) to 20 degrees C (June)

SALINITY: 0 to 7 ppt

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: juveniles: mean=55.6 +/- 1 s.d.=111.1 m-2; range: 0-222.2 m-2 (no other life history stages found)

BIOMASS LEVELS: juveniles: mean=5.5 +/- 1 s.d.=11.0 mg m-2; range: 0-22 mg m-2 (no other life history stages found)

SEASONALITY: maxima in May

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: permanent sampling points established randomly along transect lines transecting tidal flats and channels; epibenthos sampled monthly, March-June 1987

REPLICATION: n=5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise, Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Lincoln Avenue restored wetland system, Puyallup river estuary, Washington; tidal channel draining vegetated flat

REFERENCES:

Thom, R. M., C. A. Simenstad, D. K. Shreffler, J. R. Cordell, and E. O. Salo 1988. The Lincoln Avenue wetland system in the Puyallup River estuary, Washington: Phase II report; year two monitoring, January-December 1987 FRI-UW-8812, Ann. Rep. to Port of Tacoma, Fish. Res. Inst., Univ. Wash., Seattle, WA. 80 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Corophium spp.

GROUP: surface epifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: 1/2 to 3/4 in. gravel placed over sandflat

TEMPERATURE:

SALINITY:

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: juveniles and adults combined: mean = 1.1 +/- 1 s.d. = 7.9 m-2; range: 0-55.6 m-2

BIOMASS LEVELS: juveniles and adults combined: mean = less than 1 +/- 1 s.d. = less than 1 mg m-2; range: 0-6 mg m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: random samples along transect line established at same tidal elevation, parallel to shoreline; one collection, early April

REPLICATION: n = 50

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; "jacknife" procedure used to determine optimal replication according to stabilization of standard error

GRAPHS AND FIGURES: plots of mean and standard error of density as function of number of replicates

SOURCES

LOCATION: Bywater Bay, northern Hood Canal, Washington; WDF beach graveling experimental site

REFERENCES:
C. A. Simenstad and J. R. Cordell (in prep.) (unpubl.) Fish. Res. Inst., Univ. Wash., Seattle, WA

RESPONDENT: Simenstad; Fisheries Research Institute

Corophium spp.

GROUP: surface epifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: 1/4-3/4 in. gravel spread out over natural mudflat

TEMPERATURE:

SALINITY:

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: juveniles and adults combined: mean = 138.9 +/- 1 s.d. = 92.0 m-2; range: 55.6-500.0 m-2

BIOMASS LEVELS: juveniles and adults combined: mean = 5 +/- 1 s.d. = 1 mg m-2; range: 0-6 mg m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: random samples along transect line established at same tidal elevation, parallel to shoreline; one collection, early April

REPLICATION: n = 50

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; "jacknife" procedure used to determine optimal replication according to stabilization of standard error

GRAPHS AND FIGURES: plots of mean and standard error of density as function of number of replicates

SOURCES

LOCATION: Oakland Bay, southern Puget Sound, Washington; mid-intertidal beach graveling experimental site in upper Bay

REFERENCES:
C. A. Simenstad and J. R. Cordell (in prep.) (unpubl.) Fish. Res. Inst., Univ. Wash., Seattle, WA

RESPONDENT: Simenstad; Fisheries Research Institute

Corophium spp.

GROUP: surface epifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: fine mud

TEMPERATURE:

SALINITY:

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: juveniles and adults combined: mean=582.2 +/- 1 s.d.=618.7 m-2; range: 55.6-3666.7 m-2

BIOMASS LEVELS: juveniles and adults combined: mean=5 +/- 1 s.d.=1 mg m-2; range: 0-6 mg m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: random samples along transect line established at same tidal elevation, parallel to shoreline; one collection, early April

REPLICATION: n=50

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; "jacknife" procedure used to determine optimal replication according to stabilization of standard error

GRAPHS AND FIGURES: plots of mean and standard error of density as function of number of replicates

SOURCES

LOCATION: Oakland Bay, southern Puget Sound, Washington; mid-intertidal mudflat control to WDF beach graveling experimental site

REFERENCES:
C. A. Simenstad and J. R. Cordell (in prep.) (unpubl.) Fish. Res. Inst., Univ. Wash., Seattle, WA

RESPONDENT: Simenstad; Fisheries Research Institute

Corophium spp.

GROUP: surface epifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: mid-intertidal (+0.3 ft. MLLW) brown mud

TEMPERATURE: not available

SALINITY: not available

FOOD:

OTHER: high marsh; Salicornia dominant vegetation

OCCURENCE

ABUNDANCE LEVELS: juveniles: mean=92.6 +/- 1 s.d.=115.6 m-2; range: 55.6-222.2 m-2

BIOMASS LEVELS: juveniles: mean=6 +/- 1 s.d.=1 mg m-2; range: 6-11 m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: random samples from similar tidal height within five distinct habitat strata along established transect line (perpendicular to elevation gradient); sampled once, late May 1987

REPLICATION: n=3

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); using NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Day Island, central Puget Sound, southern reach of The (Tacoma) Narrows; adjacent to Days Island Channel

REFERENCES:

Thom, R. M., C. A. Simenstad, and J. R. Cordell. 1987. Benthic productivity and epibenthic crustacean community structure at the Day Island Marina expansion site, Tacoma, Washington. Unpubl. rep. to Day Island Community Club.

RESPONDENT: Simenstad; Fisheries Research Institute

Corophium spp.

GROUP: surface epifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: mid-intertidal (+2.3 ft. MLLW) mud; Enteromorpha on surface

TEMPERATURE: not available

SALINITY: not available

FOOD:

OTHER: high marsh; Salicornia dominant vegetation

OCCURENCE

ABUNDANCE LEVELS: juveniles: mean=518.5 +/- 1 s.d.=898.1 m-2; range: 0-1555.6 m-2

BIOMASS LEVELS: juveniles: mean=22 +/- 1 s.d.=4 mg m-2; range: 0-67 mg m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: random samples from similar tidal height within five distinct habitat strata along established transect line (perpendicular to elevation gradient); sampled once, late May 1987

REPLICATION: n=3

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); using NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Day Island, central Puget Sound, southern reach of The (Tacoma) Narrows; adjacent to Days Island Channel

REFERENCES:

Thom, R. M., C. A. Simenstad, and J. R. Cordell. 1987. Benthic productivity and epibenthic crustacean community structure at the Day Island Marina expansion site, Tacoma, Washington. Unpubl. rep. to Day Island Community Club.

RESPONDENT: Simenstad; Fisheries Research Institute

Corophium spp.

GROUP: surface epifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: mid-intertidal (+2.6 ft. MLLW) gravel-cobble

TEMPERATURE: not available

SALINITY: not available

FOOD:

OTHER: high marsh; Salicornia dominant vegetation

OCCURENCE

ABUNDANCE LEVELS: juveniles: mean=37.0 +/- 1 s.d.=32.1 m-2; range: 0-55.6 m-2

BIOMASS LEVELS: juveniles: mean=4 +/- 1 s.d.=1 mg m-2; range: 0-60 mg m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: random samples from similar tidal height within five distinct habitat strata along established transect line (perpendicular to elevation gradient); sampled once, late May 1987

REPLICATION: n=3

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); using NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Day Island, central Puget Sound, southern reach of The (Tacoma) Narrows; adjacent to Days Island Channel

REFERENCES:

Thom. R. M., C. A. Simenstad, and J. R. Cordell. 1987. Benthic productivity and epibenthic crustacean community structure at the Day Island Marine expansion site, Tacoma, Washington. Unpubl. rep. to Day Island Community Club.

RESPONDENT: Simenstad; Fisheries Research Institute

Corophium spp.

GROUP: surface epifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silt, fine sand; some depressions and shallow drainage channels

TEMPERATURE: 8.0 degrees C (March) to 24 degrees C (July)

SALINITY: greater than 25 ppt

FOOD:

OTHER: Enteromorpha and Vaucheria covered flats much of spring

OCCURENCE

ABUNDANCE LEVELS: juveniles: mean = 17.0 +/- 1 s.d. = 43.7 m-2; range = 55.6-1611.1 m-2 (no other life history stages found)

BIOMASS LEVELS: juveniles: mean = 2 mg +/- 1 s.d. = 0 mg m-2; range = 6-89 mg m-2 (no other life history stages found)

SEASONALITY: maxima observed in late June (last sampling date)

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: two points, corresponding to two microhabitats, sampled along each of five transects across littoral flat; transects positioned randomly along perpendicular baseline; sampled biweekly March-June 1988

REPLICATION: n = 10 at habitat level; n = 5 at microhabitat level

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-tract mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Drayton Harbor, Washington; protected mudflat inside Blaine Marina; upper margin of flats @ 1.8 m MLLW

REFERENCES:

Thom, R. M., C. A. Simenstad, J. R. Cordell, and E. O. Salo 1989. Fish and their epibenthic prey in a marina and adjacent mudflats and eelgrass meadow in a small estuarine bay FRI-UW-8901, Final Rep. prep. for The Port of Bellingham, Fish. Res. Inst., Univ. Wash., Seattle, WA. 27 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Corophium spp.

GROUP: surface epifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silt, fine sand; some depressions and shallow drainage channels

TEMPERATURE: 8.0 degrees C (March) to 24 degrees C (July)

SALINITY: greater than 25 ppt

FOOD:

OTHER: Enteromorpha abundant during much of spring

OCCURENCE

ABUNDANCE LEVELS: juveniles: mean = 169.8 +/- 1 s.d. = 401.5 m-2; range = 555.6-2222.2 m-2

BIOMASS LEVELS: juveniles: mean = 13 mg +/- 1 s.d. = 3 mg m-2; range = 6-133 mg m-2

SEASONALITY: maxima observed in late April-early May

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: two points, corresponding to two microhabitats, sampled along each of five transects across littoral flat; transects positioned randomly along perpendicular baseline; sampled biweekly March-May (1988)

REPLICATION: n = 10 at habitat level; n = 5 at microhabitat level

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-tract mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Drayton Harbor, Washington; exposed, high intertidal mudflat (+1.8 m MLLW) in Harbor immediately east of marina breakwater

REFERENCES:

Thom, R. M., C. A. Simenstad, J. R. Cordell, and E. O. Salo 1989. Fish and their epibenthic prey in a marina and adjacent mudflats and eelgrass meadow in a small estuarine bay FRI-UW-8901, Final Rep. prep. for The Port of Bellingham, Fish. Res. Inst., Univ. Wash., Seattle, WA. 27 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Corophium spp.

GROUP: surface epifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: coarse sand w/ gravel, some silt patches; thick Zostera marina growth; +0.5 ft. MLLW tidal elevation

TEMPERATURE: 23.0 degrees C

SALINITY: 28-29 ppt

FOOD:

OTHER: weather sunny, no wave disturbance

OCCURENCE

ABUNDANCE LEVELS: juveniles: mean=20.8 +/- 1 s.d.=36.1 m-2 (no other life history stages found)

BIOMASS LEVELS: juveniles: mean=2.0 +/- 1 s.d.=0 mg m-2 (no other life history stages found)

SEASONALITY: no data other than for early May

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/130-um mesh on intake ports; sieved through 130-um screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: randomly selected sites within same tidal elevation along "established" research transect in PBNERR;sampled with 0.5 to 1.5 m water depth

REPLICATION: n=5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5 as modified by FRI; archived on 9-tract tape at UW ACC (Cyber); all NODC codes used

STATISTICAL ANALYSIS: standardized to density and standing crop m-2; log transformed for statistical comparisons; ANOVA used if uniform variance dist., otherwise Kruskal-Wallis non-parametric

GRAPHS AND FIGURES: line plots, histograms, etc. using Statgraphics

SOURCES

LOCATION: Padilla Bay National Estuarine Research Reserve; established littoral flat gradient research transect; flat just off "Gun Club marsh"

REFERENCES:

Simenstad, C. A., J. R. Cordell, R. C. Wissmar, K. L. Fresh, S. L. Schroder, M. Carr, G. Sanborn, and M. E. Burg 1988. Assemblage structure, microhabitat distribution, and food web linkages of epibenthic crustaceans in Padilla Bay National Estuarine Research Reserve, Washington FRI-UW-8813, Fish. Res. Inst., Univ. Wash., Seattle, WA. 60 pp. (also NOAA Tech. Rep. Series OCRM/MEMD)

RESPONDENT: Simenstad; Fisheries Research Institute

Corophium spp.

GROUP: surface epifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: fine clay mud (channel bottom); clean sand (sandflat); silty sand (marsh)

TEMPERATURE: apx. 0-25 C

SALINITY: 0-32 ppt

FOOD: macro algae, diatoms, etc.

OTHER: effects of eelgrass on benthos; effect of tidal flat pools

OCCURENCE

ABUNDANCE LEVELS: range = 200-40,000 invertebrates m-2

BIOMASS LEVELS:

SEASONALITY: highest numbers in summer/fall; freshwater input accects species composition

SAMPLING METHODOLOGY

TECHNIQUES: 0.05 m2 sampler used to 15 cm depth and then dug out; seived through a .595 nm screen

DESIGN: sampled monthly at 11 station located from a marsh area to subtidal channel bottom; during summer sampled eelgrass and non-eelgrass sediments

REPLICATION: n = 3 at each station

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: paper data sheets with station and number of invertebrates

STATISTICAL ANALYSIS: number m-2; log transformed for statistical analysis

GRAPHS AND FIGURES: plots by tidal height; location

SOURCES

LOCATION: Baker Bay, Columbia River Estuary, near Ilwaco, Washington

REFERENCES:

Furota, and R.L. Emmett. in prep. Benthic invertebrates along a transect in Baker Bay Unpubl. rep., NOAA-NMFS, Northwest Alaska Fish. Center, Seattle, WA.

RESPONDENT: Emmett; National Marine Fisheries Service

Corophium spp.

GROUP: surface epifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: fine sand; silt clay with high organics (wood chips)

TEMPERATURE: 0-25 C

SALINITY: 0-32 ppt

FOOD: algal, micro flora on detritus particles

OTHER: currents, wave action on flats

OCCURENCE

ABUNDANCE LEVELS: 0-60,000 m-2 depending on species

BIOMASS LEVELS: available at NMFS

SEASONALITY: peaks in spring of fall-winter depending on species and station location

SAMPLING METHODOLOGY

TECHNIQUES: 0.05 Powan dredge; samples were collected during high tide from vessel, washed through .595 (#30) mesh siz, preserved in formalin (10%) and then identified in lab

DESIGN: quarterly samples of many (non-random) selected sites throughout the estuary

REPLICATION: n=2 per station for invertebrates; n=1 for sediment structure

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: on paper, never archived properly

STATISTICAL ANALYSIS: standardized to m-2

GRAPHS AND FIGURES: number m-2 at each station/season; sediment grain size

SOURCES

LOCATION: Columbia River estuary

REFERENCES:

Durkin, J.T., and R.L. Emmett. 1978. Benthic invertebrates of Baker Bay, Young's Bay, and adjacent areas in the Columbia River estuary. Unpubl. rep., NOAA-NMFS, Northwest Alaska Fish. Cent., Seattle, WA.

RESPONDENT: Emmett; National Marine Fisheries Service

Corophium spp.

GROUP: surface epifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: sand, some Enteromorpha

TEMPERATURE:

SALINITY: >25 ppt

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: mean = 33,209 +/- 2,092 (study area); mean = 33,822 +/- 19,071 (control); range 21,529 to 61,883 m-2; included in total epibenthos

BIOMASS LEVELS:

SEASONALITY: sampled once only, August 25, 1983

SAMPLING METHODOLOGY

TECHNIQUES: 0.164 m2 underwater suction (benthic/epibenthic) sampler modified from Gale & Thompson (1975); powered by submerged bilge pump run by battery from boat; samples retained in 295 um Nitex mesh

DESIGN: lower intertidal for control and for development area along 1 transect (= tidal elevation); water depths 0.5 to 2.0m

REPLICATION: n=3 for each station; subsamples obtained by pooling replicates and elutriation process undertaken & 10 subsamples obtained using method from H. Muncie (PBS, Nanaimo)

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: data tables; figures (histogram)

STATISTICAL ANALYSIS: standardized to m-2; mean +/- std. deviation

GRAPHS AND FIGURES: abundance (m-2) vs. substrate

SOURCES

LOCATION: Duncan Bay barge terminal site, apx. 6.5 km north of Campbell River on Vancouver Island

REFERENCES:

Gale, W.F. and J.D. Thompson. 1975. A suction sampler for quantatively sampling benthos on rocky substrate in rivers. Trans. Am. Fish. Soc. 104:398-405.

Waddell, B. and S. Markowski. 1983. Campbell River foreshore biophysical inventory. Water Use Unit, Habitat Management Division, Dept. of Fish and Oceans, Vancouver, B.C. 53 pp.

Williams, G.L. 1983. A survey of the marine benthic invertebrates and vegetation at the proposed Transp. Can. barge loading facility at Campbell River (Middle Pt.) B.C. unpublished report to Public Works Candada. 30 pp.

RESPONDENT: Williams; G.L. WIlliams and Associates, Ltd.

Corophium spp.

GROUP: surface epifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: cobble with Fucus

TEMPERATURE:

SALINITY: >25 ppt

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: mean = 9,705 +/- 6,484 (study area); mean = 8,678 +/- 4,174 (control); range 3,036 to 19,249 m-2; included in total epibenthos

BIOMASS LEVELS:

SEASONALITY: sampled once only, August 24, 1983

SAMPLING METHODOLOGY

TECHNIQUES: 0.164 m2 underwater suction (benthic/epibenthic) sampler modified from Gale & Thompson (1975); powered by submerged bilge pump run by battery from boat; samples retained in 295 um Nitex mesh

DESIGN: lower intertidal for control and for development area along 1 transect (=tidal elevation); water depths 0.5 to 2.0 m; 1 min. suction/sample

REPLICATION: n=3 for each station; subsamples obtained by pooling replicates and elutriation process undertaken & 10 subsamples obtained using method from H. Muncie (PBS, Nanaimo)

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: data tables; figures (histogram)

STATISTICAL ANALYSIS: standardized to m-2; mean +/- std. deviation

GRAPHS AND FIGURES: abundance (m-2) vs. substrate

SOURCES

LOCATION: Duncan Bay barge terminal site, apx. 6.5 km north of Campbell River on Vancouver Island

REFERENCES:

Gale, W.F. and J.D. Thompson. 1975. A suction sampler for quantitatively sampling benthos on rocky substrate in rivers. Trans. Am. Fish. Soc. 104:398-405.

Waddell, B. and S. Markowski. 1983. Campbell River foreshore biophysical inventory. Water Use Unit, Habitat Management Division, Dept. of Fish and Oceans, Vancouver, B.C. 53 pp.

Williams, G.L. 1983. A survey of the marine benthic invertebrates and vegetation at the proposed Transp. Can. barge loading facility at Campbell River (Middle Pt.), B.C. unpublished report to Public Works, Canada. 30 pp.

RESPONDENT: Williams; G.L. WIlliams and Associates, Ltd.

Corophium spp.

GROUP: surface epifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: inmixed cobble sediments at approximately 0-0.9 m MLLW

TEMPERATURE: unknown

SALINITY: apx. 28-30 ppt

FOOD: unknown

OTHER:

OCCURENCE

ABUNDANCE LEVELS: 1-100 m-2

BIOMASS LEVELS:

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: 0.25 m2 quadrat; 30 cm deep; seived through 6 mm mesh screen for bivalves and large infauna; 31.2 cm2 surface area core, 15 cm deep seived thri a 1.0 mm screen for small infauna

DESIGN: stratified random samples by habitat type and tide height (0, +0.9, +1.8 m above MLLW)

REPLICATION: 2 reps for 0.25 m2 samples; 4 reps for cores at each station

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: hard copy; species abundance and distribution by tide height, season, habitat

STATISTICAL ANALYSIS: species area curves; cluster analysis; regression; "T" tests; discriminant analysis

GRAPHS AND FIGURES:

SOURCES

LOCATION: 5 central Puget Sound beaches: Alki; Carkeek; Lincoln Park; Richmond; West Point

REFERENCES:

Armstrong, J. 1977. The impact of subtidal sewage outfalls on the intertidal macrofauna of several central Puget Sound beaches. PhD Dissertation, University of Washington. 183 pp. and Appendices.

RESPONDENT: Armstrong,; Environmental Protection Agency

Corophium spp.

GROUP: surface epifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: on mixed cobble sediments and algae 0-1.8 m MLLW

TEMPERATURE: unknown

SALINITY: apx. 28-30 ppt

FOOD: unknown

OTHER: Corophium acherusicum

OCCURENCE

ABUNDANCE LEVELS: 2->100 m-2

BIOMASS LEVELS:

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: 0.25 m2 quadrat; 30 cm deep; seived through 6 mm mesh screen for bivalves and large infauna; 31.2 cm2 surface area core, 15 cm deep seived thri a 1.0 mm screen for small infauna

DESIGN: stratified random samples by habitat type and tide height (0, +0.9, +1.8 m above MLLW)

REPLICATION: 2 reps for 0.25 m2 samples; 4 reps for cores at each station

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: hard copy; species abundance and distribution by tide height, season, habitat

STATISTICAL ANALYSIS: species area curves; cluster analysis; regression; "T" tests; discriminant analysis

GRAPHS AND FIGURES:

SOURCES

LOCATION: 5 central Puget Sound beaches: Alki; Carkeek; Lincoln Park; Richmond; West Point

REFERENCES:

Armstrong, J. 1977. The impact of subtidal sewage outfalls on the intertidal macrofauna of several central Puget Sound beaches. PhD Dissertation, University of Washington. 183 pp. and Appendices.

RESPONDENT: Armstrong,; Environmental Protection Agency

Corophium spp.

GROUP: surface epifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: mud

TEMPERATURE: 12.5-13.5 degrees C

SALINITY: 16-24 ppt

FOOD:

OTHER: moderate gradient beach

OCCURENCE

ABUNDANCE LEVELS: juveniles: mean = 150.0 +/- 1 s.d. = 136.5 m-2; range: 120-320 m-2

BIOMASS LEVELS: juveniles: mean = 3 +/- 1 s.d. = 1 mg m-2; range: 4-8 mg m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 1.10-m2 epibenthic suction pump (FRI macropump); gas engine powered; w/ 130-um mesh on ports; organisms filtered through nested 500-um, 253-um, and 130-um mesh nets; pumped for 45 sec.

DESIGN: sampling on one occasion (late May) at 0.0 ft, tidal elevation at slack, flood and ebb tide stages, approximately 6 hours apart

REPLICATION: n=2 per tide stage

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; tabulated

GRAPHS AND FIGURES: chronological line plots

SOURCES

LOCATION: Moon Island (northern shore) reach of North Channel, Grays Harbor, Washington

REFERENCES:

Cordell, J. R., and C. A. Simenstad. 1981. Community structure and standing stock of epibenthic zooplankton at Moon Island. Pp. 128-145 in C. A. Simenstad and D. M. Eggers (eds.), Juvenile salmon and baitfish distribution, abundance, and prey resources in selected areas of Grays Harbor, Washington. FRI-UW-8116. Univ.Wash.

RESPONDENT: Simenstad; Fisheries Research Institute

Corophium spp.

GROUP: surface epifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silty sand with occassional rocks and cobble; clayey silts with common wood dibris

TEMPERATURE:

SALINITY:

FOOD:

OTHER: water currents 50-290 ft hr-1 during ebb and flood tides

OCCURENCE

ABUNDANCE LEVELS: 840-4640 m-2

BIOMASS LEVELS:

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: hydraulic lift; Ventari suction device; sampling 0.05 m2 x 100 mm core; sieved through a 0.5 mm mesh bag

DESIGN: five stations sampled withinn project area, one in a nearby dredged area; elevations were +0.4 to -10.7 ft; all sampled on 19 October 1983 (1320-1430)

REPLICATION: none

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: simple numerical summaries

STATISTICAL ANALYSIS: none

GRAPHS AND FIGURES: none

SOURCES

LOCATION: Gig Harbor near Donkey Creek, at site of now constructed 'Murphy's Landing', a 90 slip marina where 5 acres of intertidal/subtidal bottom area were developed

REFERENCES:

Cheney, D., C. Cheney, M. Jordan, and M. Kyte. 1983. Turner Marina, Gig Harbor, Washington. Supplemental Environmental Information.

RESPONDENT: Cheney; BioAquatics International

Corophium spp.

GROUP: surface epifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: mixed fines (sand and silt) with gravel cobble; log raft on 1/3 of site removed in 1988

TEMPERATURE:

SALINITY:

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: 1987: upper 1910 m-2; mid 13,007 m-2; lower 1857 m-2; 1988: upper marsh 1080 m-2; upper 1460 m-2; mid 2620 m-2; lower 2870 m-2

BIOMASS LEVELS:

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: hydraulic pump; filtered water lying over 0.1 m2; filtered with a 0.25 mm net; pumped for 30 to 45 seconds; sampled 19 May 1987 and 29 August 1988

DESIGN: both periods: 3 stations (upper and low intertidal, and upper subtidal); August 1988: additional 'marsh' station sampled; 1988 subtidal in basin dredeged on 8/87

REPLICATION: five stations sampled; three/station analyzed (2/station archived)

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: 'Lotus' spreadsheet; data files archived at University of Washington computer center

STATISTICAL ANALYSIS: basic statistical summaries only

GRAPHS AND FIGURES: none

SOURCES

LOCATION: Gig Harbor at foot of Dorotich Street

REFERENCES:

BioAquatics International (Cheney). 1987. Derotich Marina mitigation and monitoring plan. Prepared for U.S. Fish and Wildlife Servie, Olympia.

RESPONDENT: Cheney; BioAquatics International

Crangon spp.

GROUP: evasive macroepifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: coarse sand

TEMPERATURE:

SALINITY:

FOOD:

OTHER: dense Zostera marina meadow

OCCURENCE

ABUNDANCE LEVELS: juveniles: mean=8.0 +/- 1. s.d.=17.9 m-2; range: 0.0-40.0 m-2

BIOMASS LEVELS: juveniles: mean=9 +/- 1 s.d.=20 mg m-2; range: 0-44 mg m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.10-m2 epibenthic suction pump (FRI macropump); gas engine powered; w/ 130-um mesh on ports; organisms filtered through nested 500-um, 253-um, and 130-um mesh nets; pumped for 45 sec.

DESIGN: random samples from discrete substrate and tidal elevation; sampled on one occasion (early July)

REPLICATION: n=5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archieved on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2

GRAPHS AND FIGURES: (data not processed beyond tabulation)

SOURCES

LOCATION: Alki Point (Seattle), central Puget Sound

REFERENCES:
Simenstad, C. A., and J. R. Cordell. 1984. n.a. Unpubl. data.

RESPONDENT: Simenstad; Fisheries Research Institute

Crangon spp.

GROUP: evasive macroepifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: in mixed cobble sediments; in sand at 0 m MLLW

TEMPERATURE: unknown

SALINITY: apx. 28-30 ppt

FOOD: unknown

OTHER: epifauna abundance at 0.9 m > > 0 m or 1.8 m MLLW

OCCURENCE

ABUNDANCE LEVELS: 2-100 m-2

BIOMASS LEVELS:

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: 100 cm2 quadrats; all organisms identified

DESIGN: stratified random samples by habitat type and tide height (0, +0.9, +1.8 m above MLLW)

REPLICATION: 8 reps per station

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: hard copy; species abundance and distribution by tide height, season, habitat

STATISTICAL ANALYSIS: species area curves; cluster analysis; regression; "T" tests; discriminant analysis

GRAPHS AND FIGURES:

SOURCES

LOCATION: 5 central Puget Sound beaches: Alki; Carkeek; Lincoln Park; Richmond; West Point

REFERENCES:

Armstrong, J. 1977. The impact of subtidal sewage outfalls on the intertidal macrofauna of several central Puget Sound beaches. PhD Dissertation, University of Washington. 183 pp. and Appendices.

RESPONDENT: Armstrong,; Environmental Protection Agency

Crangon spp.

GROUP: evasive macroepifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: in sand, in mixed sediments, at 0 m MLLW

TEMPERATURE: unknown

SALINITY: apx. 28-30 ppt

FOOD: unknown

OTHER:

OCCURENCE

ABUNDANCE LEVELS: 2-100 m-2

BIOMASS LEVELS:

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: 100 cm2 quadrats; all organisms identified

DESIGN: stratified random samples by habitat type and tide height (0, +0.9, +1.8 m above MLLW)

REPLICATION: 8 reps per station

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: hard copy; species abundance and distribution by tide height, season, habitat

STATISTICAL ANALYSIS: species area curves; cluster analysis; regression; "T" tests; discriminant analysis

GRAPHS AND FIGURES:

SOURCES

LOCATION: 5 central Puget Sound beaches: Alki; Carkeek; Lincoln Park; Richmond; West Point

REFERENCES:

Armstrong, J. 1977. The impact of subtidal sewage outfalls on the intertidal macrofauna of several central Puget Sound beaches. PhD Dissertation, University of Washington. 183 pp. and Appendices.

RESPONDENT: Armstrong,; Environmental Protection Agency

Crangon spp.

GROUP: evasive macroepifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: clean sands to fine clay/mud

TEMPERATURE: 0-25 C

SALINITY: 0-32 ppt

FOOD: amphipods (Corophium spp.), Macoma spp., polychaetes, harpacticoid copepods, Crangon franciscosum, Neomysis spp., Archaemysis, cumacea, etc.

OTHER:

OCCURENCE

ABUNDANCE LEVELS: 0-100,000 hectare

BIOMASS LEVELS: available from NMFS, Hammond, Oregon

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: 8 m MacInovitch trawl; 5 min. tows; distance measured; 8.5 m vessel; trawl with liner in cod-end; crabs, shrimp, and fish were identified, measured (mm), and weighed

DESIGN: once/month, various stations

REPLICATION: none

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: ASCii NMFS format; stored on NWAFC Burroughs computer; archived on tape

STATISTICAL ANALYSIS: number/hectare; length frequency analysis; annual variations; Kruski-Wallace non-parametric test, length/weight (log.log) relationships

GRAPHS AND FIGURES: bar graphs of catches, lengths

SOURCES

LOCATION: Columbia River estuary, Oregon-Washington; specific locations available from NMFS

REFERENCES:

McCabe, G.T., and R.J. McConnell. 1989. Abundance and size-class structure of Dungeness crabs in or near frequently-dredged areas in the Columbia River estuary. Unpubl. rep., NOAA-NMFS to U.S. Army Corps of Engineers, Northwest Alaska Fish. Cent., Seattle, WA. 22 pp.

RESPONDENT: Emmett; National Marine Fisheries Service

Cumella vulgaris

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: fine-sand, mud; scattered, sparse eelgrass, Ulva and Enteromorpha

TEMPERATURE: 16 to 17 degrees C

SALINITY:

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: juveniles: mean = 283.4 +/- 1 s.d. = 303.8 m-2; range: 55.6-1555.6 m-2; adults: mean = 109.7 +/- 1 s.d. = 187.2 m-2; range: 0-1555.6 m-2

BIOMASS LEVELS: juveniles: mean = 10.3 +/- 1 s.d. = 10.7 mg m-2; range: 6-50 mg m-2; adult: mean = 9.0 +/- 1 s.d. = 14.8 mg m-2; range: 0-122 mg m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: 100-m x 100-m sampling grid established on tidal flat; ten permanent sites selected from random coordinates; sampled late June/early July and two weeks later (to test effects of Sevin application)

REPLICATION: n = 10

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Willapa Bay, Washington; intertidal oyster tracts on Bay Center Channel, between Bone River channel and Bay Center Cutoff Channel

REFERENCES:

Simenstad, C. A., and J. R. Cordell (in prep.) Effects of Sevin application on littoral flat meiofauna: Preliminary sampling on Willapa Bay, June-July 1988 Fish. Res. Inst., Univ. Wash., Seattle, WA.

RESPONDENT: Simenstad; Fisheries Research Institute

Cumella vulgaris

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silt-sand w/ some gravel beneath surface

TEMPERATURE: 8.0 degrees C (March) to 24 degrees C (July)

SALINITY: greater than 25 ppt

FOOD:

OTHER: dense Zostera marina

OCCURENCE

ABUNDANCE LEVELS: all adults and juveniles:mean = 148.5 +/- 1 s.d. = 263.9 m-2; range: 55.6-777.8 m-2

BIOMASS LEVELS: all adults and juveniles:mean = 10 +/- 1 s.d. = 20 mg m-2; range: 6-67 mg m-2

SEASONALITY: maxima in late June

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: permanent sampling points established randomly along transect line through eelgrass meadow at same tidal elevation

REPLICATION: n = 5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Drayton Harbor, Washington; mid-intertidal (0.6 m MLLW) eelgrass meadow east of Blaine Marina

REFERENCES:

Thom, R. M., C. A. Simenstad, J. R. Cordell, and E. O. Salo 1989. Fish and their epibenthic prey in a marine and adjacent mudflats and eelgrass meadow in a small estuarine bay FRI-UW-8901, Final Rep. prep. for The Port of Bellingham, Fish. Res. Inst., Univ. Wash., Seattle, WA. 27 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Cumella vulgaris

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: 1/2 to 3/4 in. gravel placed over sandflat

TEMPERATURE:

SALINITY:

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: juveniles and adults combined: mean = 10.0 +/- 1 s.d. = 26.8 m-2; range: 55.6-111.1 m-2

BIOMASS LEVELS: juveniles and adults combined: mean = 1 +/- 1 s.d. = 1 mg m-2; range: 0-6 mg m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: random samples along transect line established at same tidal elevation, parallel to shoreline; one collection, early April

REPLICATION: n = 50

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; "jacknife" procedure used to determine optimal replication according to stabilization of standard error

GRAPHS AND FIGURES: plots of mean and standard error of density as function of number of replicates

SOURCES

LOCATION: Bywater Bay, northern Hood Canal, Washington; WDF beach graveling experimental site

REFERENCES:
C. A. Simenstad and J. R. Cordell (in prep.) (unpubl.) Fish. Res. Inst., Univ. Wash., Seattle, WA

RESPONDENT: Simenstad; Fisheries Research Institute

Cumella vulgaris

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: 1/4-3/4 in. gravel spread out over natural mudflat

TEMPERATURE:

SALINITY:

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: juveniles and adults combined: mean = 235.6 +/- 1 s.d. = 266.2 m-2; range: 55.6-1222.2 m-2

BIOMASS LEVELS: juveniles and adults combined: mean = 5 +/- 1 s.d. = 1 mg m-2; range: 0-6 mg m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: random samples along transect line established at same tidal elevation, parallel to shoreline; one collection, early April

REPLICATION: n = 50

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; "jacknife" procedure used to determine optimal replication according to stabilization of standard error

GRAPHS AND FIGURES: plots of mean and standard error of density as function of number of replicates

SOURCES

LOCATION: Oakland Bay, southern Puget Sound, Washington; mid-intertidal beach graveling experimental site in upper Bay

REFERENCES:
C. A. Simenstad and J. R. Cordell (in prep.) (unpubl.) Fish. Res. Inst., Univ. Wash., Seattle, WA

RESPONDENT: Simenstad; Fisheries Research Institute

Cumella vulgaris

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: fine mud

TEMPERATURE:

SALINITY:

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: juveniles and adults combined: mean = 106.7 +/- 1 s.d. = 113.8 m-2; range: 55.6-500.0 m-2

BIOMASS LEVELS: juveniles and adults combined: mean = 4 +/- 1 s.d. = 1 mg m-2; range: 0-6 mg m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: random samples along transect line established at same tidal elevation, parallel to shoreline; one collection, early April

REPLICATION: n = 50

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; "jacknife" procedure used to determine optimal replication according to stabilization of standard error

GRAPHS AND FIGURES: plots of mean and standard error of density as function of number of replicates

SOURCES

LOCATION: Oakland Bay, southern Puget Sound, Washington; mid-intertidal mudflat control to WDF beach graveling experimental site

REFERENCES:
C. A. Simenstad and J. R. Cordell (in prep.) (unpubl.) Fish. Res. Inst., Univ. Wash., Seattle, WA

RESPONDENT: Simenstad; Fisheries Research Institute

Cumella vulgaris

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: fine sand

TEMPERATURE:

SALINITY:

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: juveniles and adults combined: mean = 203.3 +/- 1 s.d. = 224.9 m-2; range: 55.6-1111.1 m-2

BIOMASS LEVELS: juveniles and adults combined: mean = 4 +/- 1 s.d. = 1 mg m-2; range: 0-6 mg m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: random samples along transect line established at same tidal elevation, parallel to shoreline; one collection, early April

REPLICATION: n = 50

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; "jacknife" procedure used to determine optimal replication according to stabilization of standard error

GRAPHS AND FIGURES: plots of mean and standard error of density as function of number of replicates

SOURCES

LOCATION: Bywater Bay, northern Hood Canal, Washington; mid-intertidal sandflat adjacent to WDF beach graveling experimental site

REFERENCES:
C. A. Simenstad and J. R. Cordell (in prep.) (unpubl.) Fish. Res. Inst., Univ. Wash., Seattle, WA

RESPONDENT: Simenstad; Fisheries Research Institute

Cumella vulgaris

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: mid-intertidal (+0.3 ft. MLLW) brown mud

TEMPERATURE: not available

SALINITY: not available

FOOD:

OTHER: high marsh; Salicornia dominant vegetation

OCCURENCE

ABUNDANCE LEVELS: juveniles and adults combined: mean=796.3 +/- 1 s.d.=562.0 m-2; range: 444.4-1444.4 m-2

BIOMASS LEVELS: juveniles and adults combinded: mean=6 +/- 1 s.d.=1 mg m-2; range: 56-144 m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: random samples from similar tidal height within five distinct habitat strata along established transect line (perpendicular to elevation gradient); sampled once, late May 1987

REPLICATION: n=3

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); using NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Day Island, central Puget Sound, southern reach of The (Tacoma) Narrows; adjacent to Days Island Channel

REFERENCES:

Thom, R. M., C. A. Simenstad, and J. R. Cordell. 1987. Benthic productivity and epibenthic crustacean community structure at the Day Island Marina expansion site, Tacoma, Washington. Unpubl. rep. to Day Island Community Club.

RESPONDENT: Simenstad; Fisheries Research Institute

Cumella vulgaris

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: mid-intertidal (+2.e3 ft. MLLW) mud; Enteromorpha on surface

TEMPERATURE: not available

SALINITY: not available

FOOD:

OTHER: high marsh; Salicornia dominant vegetation

OCCURENCE

ABUNDANCE LEVELS: juveniles: mean=333.3 +/- 1 s.d.=577.4 m-2; range: 0 1000.0 m-2

BIOMASS LEVELS: juveniles: mean=11 +/- 1 s.d.=2 mg m-2; range: 0-33 mg m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: random samples from similar tidal height within five distinct habitat strata along established transect line (perpendicular to elevation gradient); sampled once, late May 1987

REPLICATION: n=3

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); using NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Day Island, central Puget Sound, southern reach of The (Tacoma) Narrows; adjacent to Days Island Channel

REFERENCES:

Thom, R. M., C. A. Simenstad, and J. R. Cordell. 1987. Benthic productivity and epibenthic crustacean community structure at the Day Island Marina expansion site, Tacoma, Washington. Unpubl. rep. to Day Island Community Club.

RESPONDENT: Simenstad; Fisheries Research Institute

Cumella vulgaris

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: mid-intertidal (-0.1 ft. MLLW) gravel-cobble

TEMPERATURE: not available

SALINITY: not available

FOOD:

OTHER: high marsh; Salicornia dominant vegetation

OCCURENCE

ABUNDANCE LEVELS: juveniles: mean = 74.1 +\- 1 s.d. = 128.3 m-2; range: 0-222.2 m-2; adults: mean = 518.6 +/- 1 s.d. = 803.8m-2; range: 111.1-1444.4 m-2

BIOMASS LEVELS: juveniles: mean = 7 +/- 1 s.d. = 1 mg m-2; range: 0-22 m-2; adults: mean = 67 +/- 1 s.d. = 11 mg m-2; range: 11-189

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: random samples from similar tidal height within five distinct habitat strata along established transect line (perpendicular to elevation gradient); sampled once, late May 1987

REPLICATION: n = 3

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); using NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Day Island, central Puget Sound, southern reach of The (Tacoma) Narrows; adjacent to Days Island Channel

REFERENCES:

Thom, R. M., C. A. Simenstad, and J. R. Cordell. 1987. Benthic productivity and epibenthic crustacean community structure at the Day Island Marina expansion site, Tacoma, Washington. Unpubl. rep. to Day Island Community Club.

RESPONDENT: Simenstad; Fisheries Research Institute

Cumella vulgaris

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silt, fine sand; some depressions and shallow drainage channels

TEMPERATURE: 8.0 degrees C (March) to 24 degrees C (July)

SALINITY: greater than 25 ppt

FOOD:

OTHER: Enteromorpha common during much of spring

OCCURENCE

ABUNDANCE LEVELS: juveniles and adults combined: mean=231.5 +/- 1 s.d.=423.1 m-2; range=55.6-1500.0 m-2

BIOMASS LEVELS: juveniles and adults combined: mean=21 mg +/- 1 s.d.=40 mg m-2; range=6-188 mg m-2

SEASONALITY: adult maxima observed in early March, juveniles in April-May

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: two points, corresponding to two microhabitats, sampled along each of five transects across littoral flat; transects positioned randomly along perpendicular baseline; sampled biweekly March-May (1988)

REPLICATION: n=10 at habitat level; n=5 at microhabitat level

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-tract mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Drayton Harbor, Washington; exposed, high intertidal mudflat (+1.8 m MLLW) in Harbor immediately east of marine breakwater

REFERENCES:

Thom, R. M., C. A. Simenstad, J. R. Cordell, and E. O. Salo 1989. Fish and their epibenthic prey in a marina and adjacent mudflats and eelgrass meadow in a small estuarine bay FRI-UW-8901, Final Rep. prep. for The Port of Bellingham, Fish. Res. Inst., Univ. Wash., Seattle, WA. 27 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Cumella vulgaris

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: in tidal channel draining lagoon behind dredge spoil islands; sandy at 0.0 m MLLW

TEMPERATURE:

SALINITY:

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: all adults combined: mean= 525.0 +/- 1 s.d.=801.1 m2; range: 125.0-1937.5 m-2; juveniles: mean=462.5 +/- 1 s.d.=260.0; range: 62.5-750.0 m-2

BIOMASS LEVELS: all adults combined: mean=58 +/- 1 s.d.=90 mg m-2; range: 6-219 mg m-2; juveniles: mean=26 +/- 1 s.d.=20 mg m-2; range: 6-50 mg m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 150-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.

DESIGN: Random samples collected from same tidal elevation and substrate characteristics; sampled on one occasion (early March)

REPLICATION: n=5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2

GRAPHS AND FIGURES: microcomputer-generated histrograms

SOURCES

LOCATION: Swinomish Channel; tidal channel in mudflat emptying lagoon just north of railroad bridge on west dredge spill islands

REFERENCES:
Cordell, J. R. 1986. Swinomish Boat Basin site epibenthic zooplankton, 1 March, 1986. Unpubl. rep. to URS, Inc., 43 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Cumella vulgaris

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: coarse sand w/ gravel, some silt patches; thick Zostera marina growth; +0.5 ft. MLLW tidal elevation

TEMPERATURE: 23.0 degrees C

SALINITY: 28-29 ppt

FOOD:

OTHER: weather sunny, no wave disturbance

OCCURENCE

ABUNDANCE LEVELS: juvenile: mean = 145.8 +/- 1 s.d. - 252.6 m 2; egg c females: mean = 20.8 +/- 1 s.d. - 36.1 m-2 (no adults found)

BIOMASS LEVELS: juveniles: mean = 2.0 +/- 1 s.d. = 0 mg m-2; egg-c females: mean = 6.0 +/- 1 s.d. = 0 mg m-2 (no adults found)

SEASONALITY: no data other than for early May

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/130-um mesh on intake ports; sieved through 130-um screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: randomly selected sites within same tidal elevation along "established" research transect in PBNERR;sampled with 0.5 to 1.5 m water depth

REPLICATION: n = 5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5 as modified by FRI; archived on 9-tract tape at UW ACC (Cyber); all NODC codes used

STATISTICAL ANALYSIS: standardized to density and standing crop m-2; log transformed for statistical comparisons; ANOVA used if uniform variance dist., otherwise Kruskal-Wallis non-parametric

GRAPHS AND FIGURES: line plots, histograms, etc. using Statgraphics

SOURCES

LOCATION: Padilla Bay National Estuarine Research Reserve; established littoral flat gradient research transect; flat just off "Gun Club marsh"

REFERENCES:

Simenstad, C. A., J. R. Cordell, R. C. Wissmar, K. L. Fresh, S. L. Schroder, M. Carr, G. Sanborn, and M. E. Burg 1988. Assemblage structure, microhabitat distribution, and food web linkages of epibenthic crustaceans in Padilla Bay National Estuarine Research Reserve, Washington FRI-UW-8813, Fish. Res. Inst., Univ. Wash., Seattle, WA. 60 pp. (also NOAA Tech. Rep. Series OCRM/MEMD)

RESPONDENT: Simenstad; Fisheries Research Institute

Cumella vulgaris

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: mud-fine sand; no surface organics

TEMPERATURE: 23.0 degrees C

SALINITY: 28-29 ppt

FOOD:

OTHER: weather sunny, no wave disturbance

OCCURENCE

ABUNDANCE LEVELS: juveniles: mean=20.8, 1 s.d.=36.1 (no adults found)

BIOMASS LEVELS: juveniles: mean=6.0 +/- 1 s.d.=0.0 mg m-2 (no adults found)

SEASONALITY: no data other than for early May

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/130-um mesh on intake ports; sieved through 130-um screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: randomly selected sites within same tidal elevation along "established" research transect in PBNERR;sampled with 0.5 to 1.5 m water depth

REPLICATION: n=5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5 as modified by FRI; archived on 9-tract tape at UW ACC (Cyber); all NODC codes used

STATISTICAL ANALYSIS: standardized to density and standing crop m-2; log transformed for statistical comparisons; ANOVA used if uniform variance dist., otherwise Kruskal-Wallis non-parametric

GRAPHS AND FIGURES: line plots, histograms, etc. using Statgraphics

SOURCES

LOCATION: Padilla Bay National Estuarine Research Reserve; established littoral flat gradient research transect; flat just off "Gun Club marsh"

REFERENCES:

Simenstad, C. A., J. R. Cordell, R. C. Wissmar, K. L. Fresh, S. L. Schroder, M. Carr, G. Sanborn, and M. E. Burg 1988. Assemblage structure, microhabitat distribution, and food web linkages of epibenthic crustaceans in Padilla Bay National Estuarine Research Reserve, Washington FRI-UW-8813, Fish. Res. Inst., Univ. Wash., Seattle, WA. 60 pp. (also NOAA Tech. Rep. Series OCRM/MEMD)

RESPONDENT: Simenstad; Fisheries Research Institute

Cumella vulgaris

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: cobble with Fucus

TEMPERATURE:

SALINITY: >25 ppt

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: mean = 9,705 +/- 6,484 (study area); mean = 8,678 +/- 4,174 (control); range 3,036 to 19,249 m-2; included in total epibenthos

BIOMASS LEVELS:

SEASONALITY: sampled once only, August 24, 1983

SAMPLING METHODOLOGY

TECHNIQUES: 0.164 m2 underwater suction (benthic/epibenthic) sampler modified from Gale & Thompson (1975); powered by submerged bilge pump run by battery from boat; samples retained in 295 um Nitex mesh

DESIGN: lower intertidal for control and for development area along 1 transect (=tidal elevation); water depths 0.5 to 2.0 m; 1 min. suction/sample

REPLICATION: n=3 for each station; subsamples obtained by pooling replicates and elutriation process undertaken & 10 subsamples obtained using method from H. Muncie (PBS, Nanaimo)

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: data tables; figures (histogram)

STATISTICAL ANALYSIS: standardized to m-2; mean +/- std. deviation

GRAPHS AND FIGURES: abundance (m-2) vs. substrate

SOURCES

LOCATION: Duncan Bay barge terminal site, apx. 6.5 km north of Campbell River on Vancouver Island

REFERENCES:

Gale, W.F. and J.D. Thompson. 1975. A suction sampler for quantitatively sampling benthos on rocky substrate in rivers. Trans. Am. Fish. Soc. 104:398-405.

Waddell, B. and S. Markowski. 1983. Campbell River foreshore biophysical inventory. Water Use Unit, Habitat Management Division, Dept. of Fish and Oceans, Vancouver, B.C. 53 pp.

Williams, G.L. 1983. A survey of the marine benthic invertebrates and vegetation at the proposed Transp. Can. barge loading facility at Campbell River (Middle Pt.), B.C. unpublished report to Public Works, Canada. 30 pp.

RESPONDENT: Williams; G.L. WIlliams and Associates, Ltd.

Cumella vulgaris

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: on mixed cobble sediments and algae, in mixed sediments, 0-+1.8 m MLLW

TEMPERATURE: unknown

SALINITY: apx. 28-30 ppt

FOOD: unknown

OTHER:

OCCURENCE

ABUNDANCE LEVELS: apx. 100 m-2

BIOMASS LEVELS:

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: 100 cm2 quadrats; all organisms identified

DESIGN: stratified random samples by habitat type and tide height (0, +0.9, +1.8 m above MLLW)

REPLICATION: 8 reps per station

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: hard copy; species abundance and distribution by tide height, season, habitat

STATISTICAL ANALYSIS: species area curves; cluster analysis; regression; "T" tests; discriminant analysis

GRAPHS AND FIGURES:

SOURCES

LOCATION: 5 central Puget Sound beaches: Alki; Carkeek; Lincoln Park; Richmond; West Point

REFERENCES:

Armstrong, J. 1977. The impact of subtidal sewage outfalls on the intertidal macrofauna of several central Puget Sound beaches. PhD Dissertation, University of Washington. 183 pp. and Appendices.

RESPONDENT: Armstrong,; Environmental Protection Agency

Cymatogaster aggregata

GROUP: motile fish

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: small (<12cm) perch of this species are usually found associated with rocky habitats and/or eel grass, high canopy kelp beds, etc.; forages over soft substrate bottom surrounding rocky outcrops

TEMPERATURE: 7+ C

SALINITY:

FOOD: gammarid amphipods, harpacticoid copepods, small clams (primarily Transenella tantilla)

OTHER: this species of perch (<12 cm) are the primary diets of large (adult) copper rockfish and lingcod during their peak abundance periods; once this perch species grow past 12cm they are rarely eaten

OCCURENCE

ABUNDANCE LEVELS: 0.33-10.0 fish m-2; mean=2.96 fish m-2; SD=4.60

BIOMASS LEVELS:

SEASONALITY: peaks from October-December; young of year usually born in June, July

SAMPLING METHODOLOGY

TECHNIQUES: 23m x 6.1m-53m x 6.1m strip transects (using SCUBA)

DESIGN: randomly selected sites at similar depths

REPLICATION: n=2 at each depth interval

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: no specific format

STATISTICAL ANALYSIS: standardized to per square meter; log transformation will normalize data

GRAPHS AND FIGURES: chronological line plots or bar charts

SOURCES

LOCATION: Gedney Island artifical reef

REFERENCES:

Hueckel, G.J., R.M. Buckley, and B.L. Benson. 1983. The biological and fishery development on concrete habitat enhancement structures off Gedney Island in Puget Sound, Washington.

RESPONDENT: Hueckel; Washington Department of Fisheries

Decapoda (larvae)

GROUP: pelagic zooplankton

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: any substrate with some plant, shell, or debris cover

TEMPERATURE: 10-25 C

SALINITY: >15 ppt

FOOD: planktonic organisms

OTHER:

OCCURENCE

ABUNDANCE LEVELS: megalops only; up to apx. 10 m-2

BIOMASS LEVELS:

SEASONALITY: May-September

SAMPLING METHODOLOGY

TECHNIQUES: 0.25 m2 quadrats dug & screend from intertidal areas; see Miller et al. 1988 for trawl protocol

DESIGN: random with habitat type along transects or within sampling plots

REPLICATION: up to 30 reps within plots; usually 3 reps/habitat type for transects

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: UW/Cyber or pc spreadsheet (Excel)

STATISTICAL ANALYSIS: catches standardized to crab/hectare; generally non-parametric statistical procedures or log-transformation with parametric statistics

GRAPHS AND FIGURES: line charts, bar charts, histograms

SOURCES

LOCATION: various locations throughout Puget Sound, Grays Harbor (complete list of sampling sites available)

REFERENCES:

Armstrong, D.A., J.L. Armstrong, and P.A. Dinnel. 1987. Ecology and population dynamics of Dungeness crab, Cancer magister, in Ship Harbor, Anacortes, Washington. Final Rpt. for Leeward Development Company and Washington Department of Fisheries. FRI-UW-8701.

Armstrong, D.A., T.C. Wainwright, J. Orensanz, P.A. Dinnel, and B.R. Dumbauld. 1987. Model of dredging impact on Dungeness crab in Grays Harbor, Washington. Final Rpt. to Battelle Northwest Laboratories and U.S. Army Corp of Engineers. FRI-UW-8701. 67 pp.

Dinnel, P.A. R.R. Lauth, D.A. Armstrong, J.L. Armstrong, K. Larsen, and S.D. Sulkin. 1989. Marine fish predation on juvenile Dungeness crab, Cancer magister, in Padilla Bay, Washington. Final Rpt. to NOAA/NOS/OCRM, Marine and Estuarine Management Division by School of Fisheries, University of Washington, Seattle. In preparation.

Dinnel, P.A., D.A. Armstrong, and B.R. Dumbauld, and T.C. Wainwright. 1986. Impact of dredging on Dungeness crab, Cancer magister, in Grays Harbor, Washington during August 1986. Final Rpt. for U.S. Army Corps of Engineers by Fisheries Research Institute, University of Washington, Seattle. FRI-UW-8611. 34 pp.

Dinnel, P.A., D.A. Armstrong, and B.R. Dumbauld, T.C. Wainwright, A.J. Whiley, R. Burge, and R. Bumgarner. 1987. Padilla Bay Dungeness crab, Cancer magister, habitat study. Final Rpt. to NOAA/OCRM/DMEM and the Washington State Department of Ecology by Fisheries Research Institute, University of Washington, Seattle. FRI-UW-8704. 78 pp.

Dinnel, P.A., D.A. Armstrong, and B.R. Dumbauld. 1986. Impact of dredging and dredged material disposal on Dungeness crab, Cancer magister, in Grays Harbor, Washington during October 1985. Final Rpt. for U.S. Army Corps of Engineers by Fisheries Research Institute, University of Washington, Seattle. FRI-UW-8606. 30 pp.

Dinnel, P.A., D.A. Armstrong, and C. Dungan. 1985. Initiation of a Dungeness crab (Cancer magister) habitat study in North Puget Sound. pages 327-337 in: Proceedings of the Symposium on Dungeness Crab BIology and Management. Alaska Sea Grant Rpt. No. 85-3, University of Alaska, Fairbanks.

Dinnel, P.A., D.A. Armstrong, and R.O. McMillan. (in prep.) Settlement patterns, timing, and early post-larval growth of Dungeness crab, Cancer magister, in Puget Sound, Washington. Manuscript in preparation for J. Marine Biology.

Dinnel, P.A., D.A. Armstrong, and R.O. McMillan. 1985. Survey of Dungeness crab, Cancer magister, resources in Oak Harbor, Washington. Final Rpt. for the Seattle District, U.S. Army Corp of Engineers by School of Fisheries, University of Washington, Seattle. 23 pp.

Dinnel, P.A., D.A. Armstrong, and R.O. McMillan. 1986. Dungeness crab, Cancer magister, distribution, recruitment, growth, and habitat use in Lummi Bay, Washington. Final Rpt. for the Lummi Indian Tribe by Fisheries Research Institute, University of Washington, Seattle. FRI-UW-8612. 61 pp.

Dinnel, P.A., D.A. Armstrong, and R.R. Lauth 1988. Invertebrate resource assessments in and around proposed dredged materials disposal sites in Puget Sound. in: Proceedings of the First Annual Conference on Puget Sound Research. Vol 1:337-343. Puget Sound Water Quality Authority, Seattle, Washington.

Dinnel, P.A., D.A. Armstrong, B.S. Miller, and R.F. Donnelly. 1986. Puget Sound Dredge Disposal Analysis (PSDDA) disposal site investigations: Phase I trawl studies in Saratoga Passage, Port Gardner, Elliott Bay, and Commencement Bay, Washington. Final Rpt. for U.S. Army Corps of Engineers by Fisheries Research Institute, University of Washington, Seattle. FRI-UW-8615. 208 pp.

Dinnel, P.A., D.A. Armstrong, R.R. Lauth, and K. Larsen. 1988. Puget Sound Dredge Disposal Analysis (PSDDA) disposal site investigations: Phase II trawl studies in north and south Puget Sound. Invertebrate resource assessments. Final Rpt. for Washington Sea Grant and Seattle District, U.S. Army Corp of Engineers by School of Fisheries, University of Washington, Seattle. FRI-UW-8818. 92 pp.

Dinnel, P.A., D.A. Armstrong, R.R. Lauth, T.C. Wainwright, J.L. Armstrong, and K. Larsen. 1988. U.S. Navy Homeport disposal site investigations in Port Gardner, Washington. Invertebrate resource assessments. Two-year Final Rpt. for Washington Sea Grant, U.S. Navy, and U.S. Army Corps of Engineers by School of Fisheries, University of Washington, Seattle. FRI-UW-8820. 25 pp.

Dinnel, P.A., G. Jamieson, B.S. Miller, D.A. Armstrong, and R.R. Lauth. 1987. Use of Pisces IV submersible for determining the distribution of Dungenss crab, shrimp, and bottomfish in Port Gardner, Washington. Final Rpt. for Washington Sea Grant, U.S. Army Corp of Engineers, and U.S. Navy by Fisheries Research Institute, University of Washington, Seattle. FRI-UW-8709. 16 pp.

Dumbauld, B.R., D.A. Armstrong, T.C. Wainwright, and P.A. Dinnel 1988. Impact of dredging on Dungeness crab, Cancer magister, in Grays Harbor, Washington during August 1987. Final Rpt. for Seattle District, U.S. Army Corps of Engineers by School of Fisheries, University of Washington, Seattle. FRI-UW-8820. 25 pp.

McGraw, K.A., L.L. Conquest, J.O. Waller, P.A. Dinnel, and D.A. Armstrong. 1988. Entrainment of Dungeness crabs, Cancer magister Dana, by hopper dredge in Grays Harbor, Washington. J. Shellfish Res. 7(2):219-231. Paper also presented by K.A. Chew at the National Shellfisheries Association Annual Meeting, New Orleans, Louisiana, June 1988.

Miller, B.S., D.R. Gunderson, D.A. Armstrong, P.A. Dinnel, and R.F. Donnelly. 1988. Recommended protocols for standardized collections of Puget Sound bottomfish. Final Rpt. to Tetra Tech, Inc. and Office of Puget Sound, U.S. Environmental Protection Agency, Region 10, Seattle, Washington. 42 pp.

RESPONDENT: Dinnel; School of Fisheries

Decapoda (unid.)

GROUP:

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silt

TEMPERATURE: 0-30 C

SALINITY: generally > 15 ppt

FOOD: any live or freshly dead animal tissue

OTHER:

OCCURENCE

ABUNDANCE LEVELS: less than for sand or silty sand substrate

BIOMASS LEVELS:

SEASONALITY: all seasons

SAMPLING METHODOLOGY

TECHNIQUES: 0.25 m2 quadrats dug & screend from intertidal areas

DESIGN: quadrat samples collected along transects or randomly within plots

REPLICATION: generally n = 1 to 30

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: UW/Cyber or pc spreadsheet (Excel)

STATISTICAL ANALYSIS: catches standardized to crab/hectare; generally non-parametric statistical procedures or log-transformation with parametric statistics

GRAPHS AND FIGURES: line charts, bar charts, histograms

SOURCES

LOCATION: Samish Bay, Padilla Bay, Oak Harbor

REFERENCES:

Dinnel, P.A., D.A. Armstrong, and R.O. McMillan. 1985. Survey of Dungeness crab, Cancer magister, resources in Oak Harbor, Washington. Final Report for the Seattle District, U.S. Army Corp of Engineers by School of Fisheries, University of Washington, Seattle. 23 pp.

Dinnel, P.A., R.O. McMillan, D.A. Armstrong, T.C. Wainwright, A.J. Whiley, R. Burge, and R. Bumgarner. 1987. Padilla Bay Dungeness crab, Cancer magister, habiat study. Final Report to NOAA/OCRM/DMEM and the Washington Department of Ecology by Fisheries Research Institute, University of Washington, Seattle. FRI-UW-8704. 78 pp.

RESPONDENT: Dinnel; School of Fisheries

Deschampsia cespitosa

GROUP: rooted vascular plants

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE:

TEMPERATURE:

SALINITY:

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS:

BIOMASS LEVELS: Deschampsia assemblage 500-1580 g dry wt m-2

SEASONALITY: all seasons - peak live material in August.

SAMPLING METHODOLOGY

TECHNIQUES: standing stock: 0.25 or 1.0 m2 quadrats

DESIGN: random samples within strata

REPLICATION: 2-30

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: "Statgraphics" data files; "Lotus" files

STATISTICAL ANALYSIS: summary statistics per unit area (usually m2)

GRAPHS AND FIGURES: line plots of spatial-temporal variation

SOURCES

LOCATION: Grays Harbor, Drayton Harbor

REFERENCES:

Thom, R.M. 1981. Primary productivity and carbon input to Grays Harbor estuary. Seattle District, U.S. Army Corps of Engineers, Seattle, Washington.

Thom, R.M., C.A. Simenstad, J.R. Cordell, and E.O. Salo. 1988. Fisheries mitigation plan for expansion of moorage at Blaine Marina, Blaine, Washington. FRI-UW-8817. Fisheries Research Institute, University of Washington, Seattle.

RESPONDENT: Thom; Fisheries Research Institute

Eleocharis palustris

GROUP: rooted vascular plants

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: sand to clay

TEMPERATURE: soil temp = 12-16 C in May

SALINITY: 0-12 ppt

FOOD:

OTHER: redox. (+)155-(-)435 mV

OCCURENCE

ABUNDANCE LEVELS:

BIOMASS LEVELS: 70 g dry weight m-2

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: vegetation transects; continuous presence/absence data; added to 16 environmental stations; sampled weekly at environmental plots for phenology, growth, salinity, temperature

DESIGN: sampled production at end of season

REPLICATION: n=5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: only reduced data available

STATISTICAL ANALYSIS: multivariate techniques: regression, binary discriminate analysis, PCA, decorana

GRAPHS AND FIGURES: numerous, in dissertation and journals

SOURCES

LOCATION: Skagit Bay, intertidal marsh between Freshwater Slough and North Fork

REFERENCES:

Ewing, K. 1982. Plant response to environmental variation in the Skagit marsh. PhD dissertation, University of Washington.
Ewing, K. 1983. Environmental controls in Pacific Northwest intertidal plant communities. Can. J. Bot. 61:1105-1116.
Ewing, K. 1986. Plant growth and productivity along complex gradients in a Pacific northwest brackish intertidal marsh. Estuaries 9:49-62.
Ewing, K. 1989. (manuscript)

RESPONDENT: Ewing; Range Science Department

Eleocharis spp.

GROUP: rooted vascular plants

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: cobble/gravel

TEMPERATURE: 8-28 C

SALINITY: 15-31 ppt

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS:

BIOMASS LEVELS: in excess of 30 g dry wt m-2; net primary productivity apx. 200 g C m-2 yr-1

SEASONALITY: spring-summer max. biomass

SAMPLING METHODOLOGY

TECHNIQUES: 0.06 m2; 0.10 m2; 0.25 m2 quadrats; 1) standing stock: a) % cover of each species; b) remove above ground part, dry, and weigh. 2) primary productivity; light & dark bottle incubations with DO flux

DESIGN: standing stock: random samples within depth and/or habitat strata; primary productivity: calculate rates based on standing stock estimates and incubations

REPLICATION: depends on complexity; range 3-30 samples

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: "Statgraphics" data files; "Lotus" files

STATISTICAL ANALYSIS: summary statistics per unit area (usually m2)

GRAPHS AND FIGURES: line plots of spatial-temporal variation

SOURCES

LOCATION: Drayton Harbor; Cherry Point; Padilla Bay; Seahurst Bight; Tramp Harbor; Lincoln Park; Skiff Point; Grays Harbor; Elliott Bay; Neah Bay; central Puget Sound beaches

REFERENCES:

Armstrong, J.W., C.P. Staude, R.M. Thom, and K.K. Chew. 1976. Habitats and relative abundance of the intertidal macrofauna on five Puget Sound beaches in the Seattle area. Syesis 9:277-290.

RESPONDENT: Thom; Fisheries Research Institute

Eleocharis spp.

GROUP: rooted vascular plants

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: clay/mud

TEMPERATURE:

SALINITY: 0.0 ppt

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: percent cover up to 100%

BIOMASS LEVELS:

SEASONALITY: summer max. cover

SAMPLING METHODOLOGY

TECHNIQUES: 1.0 m2 quadrat for percent cover

DESIGN: systematic samples along elevation gradient

REPLICATION:

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: "Statgraphics" data files; "Lotus" files

STATISTICAL ANALYSIS: summary statistics per unit area (usually m2)

GRAPHS AND FIGURES: line plots of spatial-temporal variation

SOURCES

LOCATION: Puyallup River estuary

REFERENCES:

Thom, R.M., C.A. Simenstad, and E.O. Salo. 1987. The Lincoln Street wetland system in the Puyallup River estuary, Washington. Phase I report: Construction and initial monitoring, July 1985-December 1986.

Thom, R.M., C.A. Simenstad, D.K. Shreffler, J.R. Cordell, and E.O. Salo. 1988. The Lincoln Street wetland system in the Puyallup River estuary, Washington. Phase II report: Year two monitoring, January-December 1987. Fisheries Research Institute, University of Washington, Seattle. FRI-UW-8812.

RESPONDENT: Thom; Fisheries Research Institute

Eleocharis spp.

GROUP: rooted vascular plants

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: sand silt

TEMPERATURE:

SALINITY: 0 ppt (freshwater)

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS:

BIOMASS LEVELS:

SEASONALITY: one sampling only; Sept. 1987

SAMPLING METHODOLOGY

TECHNIQUES: Braun-Blonquet sociability classes (1 to 5); abundance & coverage (+,1-6)

DESIGN: 10 plots; 1 m2 plots; to obtain natural marsh coverage data at marina development site prior to construction; compensation site monitoring: species i.d.; 1 m2 plots (n=15); aerial color photographs

REPLICATION: n=10-15

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: raw data; not processed; compensation monitoring on going

STATISTICAL ANALYSIS: data will be processed this fall

GRAPHS AND FIGURES: data will be processed this fall

SOURCES

LOCATION: Bridge Pont Harbour Market site North Arm (immediately below Oak St. Bridge in Richmond); compensation site on south side of Mitchell Island (immediately downstream of Arrow Transfer)

REFERENCES:

Williams, G.L. 1985. Outline of habitat compensation for proposed Bridge Point Harbour Market development, Richmond, B.C. unpubl. report for North Fraser Harbour Commission, Richmond. 35 pp.
Williams, G.L. 1989. Final report on marsh construction.

RESPONDENT: Williams; G.L. WIlliams and Associates, Ltd.

Embiotocidae (unid.)

GROUP: motile fish

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: small (<12cm) perch of this species (Embiotoca lateralis) are usually found associated with rocky habitats and/or eel grass, high canopy kelp beds, etc.; forages over soft substrate bottom surrounding

TEMPERATURE: 7+ C

SALINITY:

FOOD: gammarid amphipods, harpacticoid copepods, small clams (primarily Transenella tantilla)

OTHER: this species of perch (<12 cm) are the primary diets of large (adult) copper rockfish and lingcod during their peak abundance periods; once this perch species grow past 12cm they are rarely eaten

OCCURENCE

ABUNDANCE LEVELS: 0.33-10.0 fish m-2; mean=2.96 fish m-2; SD=4.60

BIOMASS LEVELS:

SEASONALITY: peaks from October-December; young of year usually born in June, July

SAMPLING METHODOLOGY

TECHNIQUES: 23m x 6.1m-53m x 6.1m strip transects (using SCUBA)

DESIGN: randomly selected sites at similar depths

REPLICATION: n=2 at each depth interval

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: no specific format

STATISTICAL ANALYSIS: standardized to per square meter; log transformation will normalize data

GRAPHS AND FIGURES: chronological line plots or bar charts

SOURCES

LOCATION: Gedney Island artifical reef

REFERENCES:

Hueckel, G.J., R.M. Buckley, and B.L. Benson. 1983. The biological and fishery development on concrete habitat enhancement structures off Gedney Island in Puget Sound, Washington.

RESPONDENT: Hueckel; Washington Department of Fisheries

Embiotocidae (unid.)

GROUP: motile fish

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: small (<12cm) perch of this species (Rhacochilus vacca) are usually found associated with rocky habitats and/or eel grass, high canopy kelp beds, etc.; forages over soft substrate bottom surrounding

TEMPERATURE: 7+ C

SALINITY:

FOOD: gammarid amphipods, harpacticoid copepods, small clams (primarily Transenella tantilla)

OTHER: this species of perch (<12 cm) are the primary diets of large (adult) copper rockfish and lingcod during their peak abundance periods; once this perch species grow past 12cm they are rarely eaten

OCCURENCE

ABUNDANCE LEVELS: 0.33-10.0 fish m-2; mean=2.96 fish m-2; SD=4.60

BIOMASS LEVELS:

SEASONALITY: peaks from October-December; young of year usually born in June, July

SAMPLING METHODOLOGY

TECHNIQUES: 23m x 6.1m-53m x 6.1m strip transects (using SCUBA)

DESIGN: randomly selected sites at similar depths

REPLICATION: n=2 at each depth interval

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: no specific format

STATISTICAL ANALYSIS: standardized to per square meter; log transformation will normalize data

GRAPHS AND FIGURES: chronological line plots or bar charts

SOURCES

LOCATION: Gedney Island artifical reef

REFERENCES:

Hueckel, G.J., R.M. Buckley, and B.L. Benson. 1983. The biological and fishery development on concrete habitat enhancement structures off Gedney Island in Puget Sound, Washington.

RESPONDENT: Hueckel; Washington Department of Fisheries

Engraulis mordax

GROUP: motile fish

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: various

TEMPERATURE: 0-25 C

SALINITY: 0-32 ppt

FOOD: Corophium spp., calanoid copepods, insects, mysids, Daphnia spp., etc.

OTHER: tidal stage, time of day, tidal height

OCCURENCE

ABUNDANCE LEVELS: 0-40,000/set; depends on schooling fish and hatchery releases

BIOMASS LEVELS:

SEASONALITY: highest numbers in summer/fall depending on species of concern and area in estuary

SAMPLING METHODOLOGY

TECHNIQUES: purse seine; collect, identify, measure, and weigh fish species; sample once/month depending on study; sometimes more intensive during salmonid migration

DESIGN: 10-200 m deep; 0.5 in. stretch mesh; knotless bunt; 2 vessels used; seining done all at flood, high slack tide

REPLICATION: none

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: ASCii NMFS format, species code; transformed to CPUE

STATISTICAL ANALYSIS: ANOVA on logged (x+1) data; chi-square

GRAPHS AND FIGURES: length-frequency distribution; numbers/month; # species/month

SOURCES

LOCATION: Columbia River estuary

REFERENCES:

McCabe, G.T., R.L. Emmett, and R.J. McConnell. 1987. Abundance and size-class structure of Dungeness crabs in or near frequently-dredged areas in the Columbia River estuary. Unpubl. rep., NOAA-NMFS to U.S. Army Corps of Engineers, Northwest Alaska Fish. Cent., Seattle, WA. 31 pp.

McCabe, G.T., R.L. Emmett, T.C. Colby, and R.J. McConnell. 1986. Distribution, abundance, and size-class structure of Dungeness crabs in the Columbia River estuary. Unpubl. rep., NOAA-NMFS to U.S. Army Corps of Engineers, Northwest Alaska Fish. Cent., Seattle, WA. 57 pp.

RESPONDENT: Emmett; National Marine Fisheries Service

Enteromorpha spp.

GROUP: benthic macroalgae

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: cobble/gravel

TEMPERATURE: 8-28 C

SALINITY: 15-31 ppt

FOOD: N/A

OTHER:

OCCURENCE

ABUNDANCE LEVELS:

BIOMASS LEVELS: in excess of 30 g dry wt m-2; net primary productivity apx. 200 g C m-2 yr-1

SEASONALITY: spring-summer maximum biomass

SAMPLING METHODOLOGY

TECHNIQUES: 0.06 m2; 0.10 m2; 0.25 m2 quadrats. 1) standing stock (a) % cover @ spp. (b) remove above ground part, dry, & weigh. 2) primary productivity; light & dark growth bottels w/ DO flux

DESIGN: standing stock: random samples within depth and/or habitat strata. primary productivity: calculate rates based on standing stock estimates and incubations

REPLICATION: depends upon complexity; range = 3-30 samples

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: "Statgraphics" data files; "Lotus" files

STATISTICAL ANALYSIS: summary stats. per unit area (usually sq. m)

GRAPHS AND FIGURES: line plots of spatial & temporal variation

SOURCES

LOCATION: Drayton Harbor; Cherry Point; Padilla Bay; Seahurst Bight; Tramp Harbor; Lincoln Park; Skiff Point; Grays Harbor; Elliott Bay; Neah Bay, and central Puget Sound beaches

REFERENCES:

Shapiro and Associates, with Ardea Enterprises. 1988. Results of 1988 Biological and chemical monitoring in the southeast Georgia Strait for the Mobil Oil Ferndal Refinery.

Simenstad, C.A., R.M. Thom, J.R. Cordell, K.A. Kuzis, and D.K. Shreffler. 1988. Nearshore community studies of Neah Bay, Washington. FRI-UW-8811, Fisheries Research Institue, University of Washington, Seattle.

Thom, R.M. (in prep.) Effects of depth and season on plant standing stock and primary production in a temperate seagrass system. Marine Biology.

Thom, R.M. 1981. Primary productivity and carbon input to Grays Harbor estuary. Seattle District, U.S. Army Corp of Engineers, Seattle, Washington.

Thom, R.M. 1983. Compostition, habitats, seasonal changes and productivity of the macro algea in Grays Harbor estuary, Washington. Estuaries 7:51-60.

Thom, R.M. 1988. Benthic primary production in the eelgrass meadow at the Padilla Bay National Estuarine Research Reserve. NOAA Tech. Rept. Series OCRM/MEMD. Fisheries Research Institute, Univiversity of Washington, Seattle. FRI-UW-8808.

Thom, R.M. 1988. Lincoln Park eelgrass baseline study. Final report, Seattle District, U.S. Army Corp of Engineers. Seattle, Washington.

Thom, R.M. and R.E. Albright. (in prep.) Relationship between temporal variations in benthic vegetation standing stock, irradiance, and water properties in the nearshore zone of central Puget Sound.

Thom, R.M., C.A. Simenstad, J.R. Cordell, and E.O. Salo. (in prep.) Fish and their prey in a marina and adjacent mudflats and eelgrass meadow in a small estuarine harbor.

Thom, R.M., K.K. Chew, D. Crisostomo, B. Dumbauld, A. Escofet, C. Falmagne, J. Hampel, C. Law, J. Orensanz, and D. Waunmanndepinet. 1979. Habitats, abundance, and diversity of the intertidal benthic biota of Skiff Point, Bainbridge Island, Washington. A report prepared in cooperation with the Municipality of Metropolitan Seattle. 61 pp.

Thom, R.M., R. Albright, and E.O. Salo. 1984. Intertidal and shallow subtidal benthic ecology. Chap. 4, pp. 87-139 in Q.J. Stober and K. Chew, Principal Investigators, Renton Sewage Treatment Plant Project: Duwamish Head. Publ. FRI-UW-8417, Fish. Res. Inst., Univ. of Wash. 177 pp.

RESPONDENT: Thom; Fisheries Research Institute

Enteromorpha spp.

GROUP: benthic macroalgae

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: mud-cobble

TEMPERATURE:

SALINITY:

FOOD: N/A

OTHER:

OCCURENCE

ABUNDANCE LEVELS: variable

BIOMASS LEVELS: variable

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: 0.06 m2; 0.10 m2; 0.25 m2 quadrats. 1) standing stock (a) % cover @ spp. (b) remove above ground part, dry, & weigh. 2) primary productivity; light & dark growth bottels w/ DO flux

DESIGN: standing stock: random samples within depth and/or habitat strata. primary productivity: calculate rates based on standing stock estimates and incubations

REPLICATION: depends upon complexity; range = 3-30 samples

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: "Statgraphics" data files; "Lotus" files

STATISTICAL ANALYSIS: summary stats. per unit area (usually sq. m)

GRAPHS AND FIGURES: line plots of spatial & temporal variation

SOURCES

LOCATION: Drayton Harbor; Cherry Point; Padilla Bay; Seahurst Bight; Tramp Harbor; Lincoln Park; Skiff Point; Grays Harbor; Elliott Bay; Neah Bay, and central Puget Sound beaches

REFERENCES:

Shapiro and Associates, with Ardea Enterprises. 1988. Results of 1988 Biological and chemical monitoring in the southeast Georgia Strait for the Mobil Oil Ferndal Refinery.

Simenstad, C.A., R.M. Thom, J.R. Cordell, K.A. Kuzis, and D.K. Shreffler. 1988. Nearshore community studies of Neah Bay, Washington. FRI-UW-8811, Fisheries Research Institue, University of Washington, Seattle.

Thom, R.M. (in prep.) Effects of depth and season on plant standing stock and primary production in a temperate seagrass system. Marine Biology.

Thom, R.M. 1981. Primary productivity and carbon input to Grays Harbor estuary. Seattle District, U.S. Army Corp of Engineers, Seattle, Washington.

Thom, R.M. 1983. Compostition, habitats, seasonal changes and productivity of the macro algea in Grays Harbor estuary, Washington. Estuaries 7:51-60.

Thom, R.M. 1988. Benthic primary production in the eelgrass meadow at the Padilla Bay National Estuarine Research Reserve. NOAA Tech. Rept. Series OCRM/MEMD. Fisheries Research Institute, Univiversity of Washington, Seattle. FRI-UW-8808.

Thom, R.M. 1988. Lincoln Park eelgrass baseline study. Final report, Seattle District, U.S. Army Corp of Engineers. Seattle, Washington.

Thom, R.M. and R.E. Albright. (in prep.) Relationship between temporal variations in benthic vegetation standing stock, irradiance, and water properties in the nearshore zone of central Puget Sound.

Thom, R.M., C.A. Simenstad, J.R. Cordell, and E.O. Salo. (in prep.) Fish and their prey in a marina and adjacent mudflats and eelgrass meadow in a small estuarine harbor.

Thom, R.M., K.K. Chew, D. Crisostomo, B. Dumbauld, A. Escofet, C. Falmagne, J. Hampel, C. Law, J. Orensanz, and D. Waunmanndepinet. 1979. Habitats, abundance, and diversity of the intertidal benthic biota of Skiff Point, Bainbridge Island, Washington. A report prepared in cooperation with the Municipality of Metropolitan Seattle. 61 pp.

Thom, R.M., R. Albright, and E.O. Salo. 1984. Intertidal and shallow subtidal benthic ecology. Chap. 4, pp. 87-139 in Q.J. Stober and K. Chew, Principal Investigators, Renton Sewage Treatment Plant Project: Duwamish Head. Publ. FRI-UW-8417, Fish. Res. Inst., Univ. of Wash. 177 pp.

RESPONDENT: Thom; Fisheries Research Institute

Enteromorpha spp.

GROUP: benthic macroalgae

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: cobble/gravel

TEMPERATURE: 8-28 C

SALINITY: 15-31 ppt

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS:

BIOMASS LEVELS: in excess of 30 g dry wt m-2; net primary productivity apx. 200 g C m-2 yr-1

SEASONALITY: spring-summer max. biomass

SAMPLING METHODOLOGY

TECHNIQUES: 0.06 m2; 0.10 m2; 0.25 m2 quadrats; 1) standing stock: a) % cover of each species; b) remove above ground part, dry, and weigh. 2) primary productivity; light & dark bottle incubations with DO flux

DESIGN: standing stock: random samples within depth and/or habitat strata; primary productivity: calculate rates based on standing stock estimates and incubations

REPLICATION: depends on complexity; range 3-30 samples

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: "Statgraphics" data files; "Lotus" files

STATISTICAL ANALYSIS: summary statistics per unit area (usually m2)

GRAPHS AND FIGURES: line plots of spatial-temporal variation

SOURCES

LOCATION: Drayton Harbor; Cherry Point; Padilla Bay; Seahurst Bight; Tramp Harbor; Lincoln Park; Skiff Point; Grays Harbor; Elliott Bay; Neah Bay; central Puget Sound beaches

REFERENCES:

Shapiro and Associates, with Ardea Enterprises. 1988. Results of 1988 biological and chemical monitoring in the southeast Georgia Strait for the Mobil Oil Ferndal refinery.

Thom, R.M. 1978. The compostion, growth, seasonal periodicity, and habitats of benthic algae on the eastern shore of central Puget Sound, with special reference to sewage pollution. PhD dissertation, University of Washington, Seattle, Washington. 237 pp.

Thom, R.M. 1980. Seasonality of low intertidal benthic marine algal communities in central Puget Sound, Washington. U.S.A. Botanica Marina 23:7-11.

Thom, R.M. 1985. An oceanographic analysis of odorous beach conditions in Fauntleroy Cove, West Seattle. Submitted to the City of Seattle, Washington.

Thom, R.M. 1988. Lincoln Park eelgrass baseline study. Final report, Seattle District, U.S. Army Corp of Engineers, Seattle, Washington.

Thom, R.M., J.W. Armstrong, C.P. Staude, and K.K. Chew. 1977. Impact of sewage on benthic marine flora of the Seattle, Washington, area. pages 200-220 in The use, study, and management of Puget Sound. Washington Sea Grant Publ. WSG-WO 77-1.

Thom, R.M., J.W. Armstrong, C.P. Staude, K.K. Chew, and R.E. Norris. 1976. A survey of the attached marine flora at five beaches in the Seattle, Washington, area. Syesis 9:267-275.

RESPONDENT: Thom; Fisheries Research Institute

Enteromorpha spp.

GROUP: benthic macroalgae

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: mud-cobble

TEMPERATURE:

SALINITY:

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: variable

BIOMASS LEVELS: variable

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: 0.06 m2; 0.10 m2; 0.25 m2 quadrats; 1) standing stock: a) % cover of each species; b) remove above ground part, dry, and weigh. 2) primary productivity; light & dark bottle incubations with DO flux

DESIGN: standing stock: random samples within depth and/or habitat strata; primary productivity: calculate rates based on standing stock estimates and incubations

REPLICATION: depends on complexity; range 3-30 samples

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: "Statgraphics" data files; "Lotus" files

STATISTICAL ANALYSIS: summary statistics per unit area (usually m2)

GRAPHS AND FIGURES: line plots of spatial-temporal variation

SOURCES

LOCATION: Drayton Harbor; Cherry Point; Padilla Bay; Seahurst Bight; Tramp Harbor; Lincoln Park; Skiff Point; Grays Harbor; Elliott Bay; Neah Bay; central Puget Sound beaches

REFERENCES:

Armstrong, J.W., C.P. Staude, R.M. Thom, and K.K. Chew. 1976. Habitats and relative abundance of the intertidal macrofauna on five Puget Sound beaches in the Seattle area. Syesis 9:277-290.

Shapiro and Associates, with Ardea Enterprises. 1988. Results of 1988 biological and chemical monitoring in the southeast Georgia Strait for the Mobil Oil Ferndal refinery.

Thom, R.M. 1978. The compostion, growth, seasonal periodicity, and habitats of benthic algae on the eastern shore of central Puget Sound, with special reference to sewage pollution. PhD dissertation, University of Washington, Seattle, Washington. 237 pp.

Thom, R.M. 1980. Seasonality of low intertidal benthic marine algal communities in central Puget Sound, Washington. U.S.A. Botanica Marina 23:7-11.

Thom, R.M. 1985. An oceanographic analysis of odorous beach conditions in Fauntleroy Cove, West Seattle. Submitted to the City of Seattle, Washington.

Thom, R.M. 1988. Lincoln Park eelgrass baseline study. Final report, Seattle District, U.S. Army Corp of Engineers, Seattle, Washington.

Thom, R.M., J.W. Armstrong, C.P. Staude, and K.K. Chew. 1977. Impact of sewage on benthic marine flora of the Seattle, Washington, area. pages 200-220 in The use, study, and management of Puget Sound. Washington Sea Grant Publ. WSG-WO 77-1.

Thom, R.M., J.W. Armstrong, C.P. Staude, K.K. Chew, and R.E. Norris. 1976. A survey of the attached marine flora at five beaches in the Seattle, Washington, area. Syesis 9:267-275.

RESPONDENT: Thom; Fisheries Research Institute

Enteromorpha spp.

GROUP: benthic macroalgae

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: gravel/cobble

TEMPERATURE: 10-32 C

SALINITY: 15-32 ppt

FOOD: N/A

OTHER:

OCCURENCE

ABUNDANCE LEVELS:

BIOMASS LEVELS: <0.001 - 41.0 g dry wt m-2

SEASONALITY: spring-summer

SAMPLING METHODOLOGY

TECHNIQUES: 0.06 m2; 0.10 m2; 0.25 m2 quadrats; 1) standing stock: a) % cover of each spp. b) remove above ground part, dry, and weigh. 2) primary productivity: light & dark bottle incubations with DO flux

DESIGN: standing stock: random samples within depth and/or habitat strata; primary production: calculate rates based on standing stock estimates & incubations

REPLICATION: depends on complexity; range = 3-30 samples

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: "Statgraphics" data files; "Lotus" files

STATISTICAL ANALYSIS: summary statistics per unit area (usually m2)

GRAPHS AND FIGURES: line plots of spatial-temporal variation

SOURCES

LOCATION: Padilla Bay, Grays Harbor

REFERENCES:

Thom, R.M. (in prep.) Plant standing stock and productivity on tidal flats and gravel in Padilla Bay, Washington: a temperate North Pacific estuarine embayment.

Thom, R.M. 1984. Primary production in Grays Harbor estuary, Washington. Bull. Southern California Acad. Sciences 83:99-105.

RESPONDENT: Thom; Fisheries Research Institute

Enteromorpha spp.

GROUP: benthic macroalgae

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: cobble/gravel

TEMPERATURE: 8-28 C

SALINITY: 15-31 ppt

FOOD: N/A

OTHER:

OCCURENCE

ABUNDANCE LEVELS:

BIOMASS LEVELS: in excess of 30 g dry wt m-2; net primary productivity apx. 200 g C m-2 yr-1

SEASONALITY: spring-summer maximum biomass

SAMPLING METHODOLOGY

TECHNIQUES: 0.06 m2; 0.10 m2; 0.25 m2; quadrats. 1) standing stock (a) % cover @ spp. (b) remove above ground part, dry, & weigh. 2) primary productivity; light & dark growth bottels w/ DO flux

DESIGN: standing stock: random samples within depth and/or habitat strata. primary productivity: calculate rates based on standing stock estimates and incubations

REPLICATION: depends upon complexity; range = 3-30 samples

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: "Statgraphics" data files; "Lotus" files

STATISTICAL ANALYSIS: summary stats. per unit area (usually sq. m)

GRAPHS AND FIGURES: line plots of spatial & temporal variation

SOURCES

LOCATION: Drayton Harbor; Cherry Point; Padilla Bay; Seahurst Bight; Tramp Harbor; Lincoln Park; Skiff Point; Grays Harbor; Elliott Bay; Neah Bay, and central Puget Sound beaches

REFERENCES:

Thom, R.M. 1984. Primary Production in Grays Harbor estuary, Washington. Bull. Southern California Acad. Sciences 83:99-105.

Thom, R.M., R. Albright, C. Simenstad, J. Hampel, J. Cordell, and K. Chew. 1984. Intertidal and shallow subtidal benthic ecology. Vol. IV, Section 5, in Q.J. Stober and K. Chew, Principal Investigators, Renton Sewage Treatment Plant Project: Duwamish Head. Publ. FRI-UW-8417, Fish. Res. Inst., Univ. of Wash. 177 pp.

RESPONDENT: Thom; Fisheries Research Institute

Enteromorpha spp.

GROUP: benthic macroalgae

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: mud-cobble

TEMPERATURE:

SALINITY:

FOOD: N/A

OTHER:

OCCURENCE

ABUNDANCE LEVELS: variable

BIOMASS LEVELS: variable

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: 0.06 m2; 0.10 m2; 0.25 m2; quadrats. 1) standing stock (a) % cover @ spp. (b) remove above ground part, dry, & weigh. 2) primary productivity; light & dark growth bottels w/ DO flux

DESIGN: standing stock: random samples within depth and/or habitat strata. primary productivity: calculate rates based on standing stock estimates and incubations

REPLICATION: depends upon complexity; range = 3-30 samples

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: "Statgraphics" data files; "Lotus" files

STATISTICAL ANALYSIS: summary stats. per unit area (usually sq. m)

GRAPHS AND FIGURES: line plots of spatial & temporal variation

SOURCES

LOCATION: Drayton Harbor; Cherry Point; Padilla Bay; Seahurst Bight; Tramp Harbor; Lincoln Park; Skiff Point; Grays Harbor; Elliott Bay; Neah Bay, and central Puget Sound beaches

REFERENCES:

Thom, R.M. 1984. Primary Production in Grays Harbor estuary, Washington. Bull. Southern California Acad. Sciences 83:99-105.

Thom, R.M., R. Albright, C. Simenstad, J. Hampel, J. Cordell, and K. Chew. 1984. Intertidal and shallow subtidal benthic ecology. Vol. IV, Section 5, in Q.J. Stober and K. Chew, Principal Investigators, Renton Sewage Treatment Plant Project: Duwamish Head. Publ. FRI-UW-8417, Fish. Res. Inst., Univ. of Wash. 177 pp.

RESPONDENT: Thom; Fisheries Research Institute

Eogammarus confervicolus

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silt and detritus; decaying marsh litter and trapped eelgrass and other debris

TEMPERATURE: 8.0 degrees C (March) to 24 degrees C (July)

SALINITY: greater than 25 ppt

FOOD:

OTHER: marsh vegetation dominated by Scirpus, Triglochin, and Distichlis

OCCURENCE

ABUNDANCE LEVELS: juveniles: mean = 1321.8 +/- 1 s.d. = 2320.7 m-2; range = 166.7-5888.9 m-2

BIOMASS LEVELS: juveniles: mean = 127 mg +/- 1 s.d. = 260 mg m-2; range = 13-656 mg m-2

SEASONALITY: most abundant in mid-March (only sampled twice, in March)

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: permanent sampling points established randomly along transect line bisecting marsh vegetation along same tidal elevation

REPLICATION: n = 5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-tract mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Drayton Harbor, Washington; high intertidal emergent marsh within Blaine Marina

REFERENCES:

Thom, R. M., C. A. Simenstad, J. R. Cordell, and E. O. Salo 1989. Fish and their epibenthic prey in a marina and adjacent mudflats and eelgrass meadow in a small estuarine bay FRI-UW-8901, Final Rep. prep. for The Port of Bellingham, Fish. Res. Inst., Univ. Wash., Seattle, WA. 27 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Eogammarus confervicolus

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silt, fine sand; some depressions and shallow drainage channels

TEMPERATURE: 8.0 degrees C (March) to 24 degrees C (July)

SALINITY: greater than 25 ppt

FOOD:

OTHER: Enteromorpha abundant during much of spring

OCCURENCE

ABUNDANCE LEVELS: juveniles: mean = 19.3 +/- 1 s.d. = 43.3 m-2; range = 555.6-166.7 m-2

BIOMASS LEVELS: juveniles: mean = 46 mg +/- 1 s.d. = 140 mg m-2; range = 0-33 mg m-2

SEASONALITY: maxima observed in early-mid-March

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: two points, corresponding to two microhabitats, sampled along each of five transects across littoral flat; transects positioned randomly along perpendicular baseline; sampled biweekly March-May (1988)

REPLICATION: n = 10 at habitat level; n = 5 at microhabitat level

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-tract mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Drayton Harbor, Washington; exposed, high intertidal mudflat (+1.8 m MLLW) in Harbor immediately east of marina breakwater

REFERENCES:

Thom, R. M., C. A. Simenstad, J. R. Cordell, and E. O. Salo 1989. Fish and their epibenthic prey in a marina and adjacent mudflats and eelgrass meadow in a small estuarine bay FRI-UW-8901, Final Rep. prep. for The Port of Bellingham, Fish. Res. Inst., Univ. Wash., Seattle, WA. 27 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Eogammarus confervicolus

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silt, fine sand; some depressions and shallow drainage channels

TEMPERATURE: 8.0 degrees C (March) to 24 degrees C (July)

SALINITY: greater than 25 ppt

FOOD:

OTHER: Enteromorpha and Vaucheria covered flats much of spring

OCCURENCE

ABUNDANCE LEVELS: juveniles and adults combined: mean = 23.1 +/- 1 s.d. = 50.4 m-2; range = 55.6-222.2 m-2

BIOMASS LEVELS: juveniles and adults combined: mean = 73 mg +/- 1 s.d. = 340 mg m-2; range = 6-2222 mg m-2

SEASONALITY: maxima observed in early April

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: two points, corresponding to two microhabitats, sampled along each of five transects across littoral flat; transects positioned randomly along perpendicular baseline; sampled biweekly March-May (1988)

REPLICATION: n = 10 at habitat level; n = 5 at microhabitat level

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-tract mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Drayton Harbor, Washington; protected mudflat inside Blaine Marina; upper margin of flats @ 1.8 m MLLW

REFERENCES:

Thom, R. M., C. A. Simenstad, J. R. Cordell, and E. O. Salo 1989. Fish and their epibenthic prey in a marina and adjacent mudflats and eelgrass meadow in a small estuarine bay FRI-UW-8901, Final Rep. prep. for The Port of Bellingham, Fish. Res. Inst., Univ. Wash., Seattle, WA. 27 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Eogammarus confervicolus

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: mud

TEMPERATURE: 12.5-13.5 degrees C

SALINITY: 16-24 ppt

FOOD:

OTHER: moderate gradient beach

OCCURENCE

ABUNDANCE LEVELS: juveniles: mean = 15.0 +/- 1 s.d. = 42.4 m-2; range: 0-120.0 m-2

BIOMASS LEVELS: juveniles: mean = 5 +/- 1 s.d. = 10 mg m-2; range: 40-40 mg m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 1.10-m2 epibenthic suction pump (FRI macropump); gas engine powered; w/ 130-um mesh on ports; organisms filtered through nested 500-um, 253-um, and 130-um mesh nets; pumped for 45 sec.

DESIGN: sampling on one occasion (late May) at 0.0 ft, tidal elevation at slack, flood and ebb tide stages, approximately 6 hours apart

REPLICATION: n = 2 per tide stage

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; tabulated

GRAPHS AND FIGURES: chronological line plots

SOURCES

LOCATION: Moon Island (northern shore) reach of North Channel, Grays Harbor, Washington

REFERENCES:

Cordell, J. R., and C. A. Simenstad. 1981. Community structure and standing stock of epibenthic zooplankton at Moon Island. Pp. 128-145 in C. A. Simenstad and D. M. Eggers (eds.), Juvenile salmon and baitfish distribution, abundance, and prey resources in selected areas of Grays Harbor, Washington. FRI-UW-8116. Univ.Wash.

RESPONDENT: Simenstad; Fisheries Research Institute

Eogammarus confervicolus

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: on algae, on sand, on mixed sand, +0.9-1.8 m MLLW

TEMPERATURE: unknown

SALINITY: apx. 28-30 ppt

FOOD: unknown

OTHER: epifauna abundance at 0.9 m > > 0 m or 1.8 m MLLW

OCCURENCE

ABUNDANCE LEVELS: apx. 100 m-2

BIOMASS LEVELS:

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: 100 cm2 quadrats; all organisms identified

DESIGN: stratified random samples by habitat type and tide height (0, +0.9, +1.8 m above MLLW)

REPLICATION: 8 reps per station

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: hard copy; species abundance and distribution by tide height, season, habitat

STATISTICAL ANALYSIS: species area curves; cluster analysis; regression; "T" tests; discriminant analysis

GRAPHS AND FIGURES:

SOURCES

LOCATION: 5 central Puget Sound beaches: Alki; Carkeek; Lincoln Park; Richmond; West Point

REFERENCES:

Armstrong, J. 1977. The impact of subtidal sewage outfalls on the intertidal macrofauna of several central Puget Sound beaches. PhD Dissertation, University of Washington. 183 pp. and Appendices.

RESPONDENT: Armstrong,; Environmental Protection Agency

Eogammarus spp.

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: cobble with Fucus

TEMPERATURE:

SALINITY: >25 ppt

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: mean = 9,705 +/- 6,484 (study area); mean = 8,678 +/- 4,174 (control); range 3,036 to 19,249 m-2; included in total epibenthos

BIOMASS LEVELS:

SEASONALITY: sampled once only, August 24, 1983

SAMPLING METHODOLOGY

TECHNIQUES: 0.164 m2 underwater suction (benthic/epibenthic) sampler modified from Gale & Thompson (1975); powered by submerged bilge pump run by battery from boat; samples retained in 295 um Nitex mesh

DESIGN: lower intertidal for control and for development area along 1 transect (=tidal elevation); water depths 0.5 to 2.0 m; 1 min. suction/sample

REPLICATION: n=3 for each station; subsamples obtained by pooling replicates and elutriation process undertaken & 10 subsamples obtained using method from H. Muncie (PBS, Nanaimo)

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: data tables; figures (histogram)

STATISTICAL ANALYSIS: standardized to m-2; mean +/- std. deviation

GRAPHS AND FIGURES: abundance (m-2) vs. substrate

SOURCES

LOCATION: Duncan Bay barge terminal site, apx. 6.5 km north of Campbell River on Vancouver Island

REFERENCES:

Gale, W.F. and J.D. Thompson. 1975. A suction sampler for quantitatively sampling benthos on rocky substrate in rivers. Trans. Am. Fish. Soc. 104:398-405.

Waddell, B. and S. Markowski. 1983. Campbell River foreshore biophysical inventory. Water Use Unit, Habitat Management Division, Dept. of Fish and Oceans, Vancouver, B.C. 53 pp.

Williams, G.L. 1983. A survey of the marine benthic invertebrates and vegetation at the proposed Transp. Can. barge loading facility at Campbell River (Middle Pt.), B.C. unpublished report to Public Works, Canada. 30 pp.

RESPONDENT: Williams; G.L. WIlliams and Associates, Ltd.

Eogammarus spp.

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: mud

TEMPERATURE: 12.5-13.5 degrees C

SALINITY: 16-24 ppt

FOOD:

OTHER: moderate gradient beach

OCCURENCE

ABUNDANCE LEVELS: juveniles: mean = 10.0 +/- 1 s.d. = 28.3 m-2; range: 0-80.0.3 m-2

BIOMASS LEVELS: juveniles: mean = 1 +/- 1 s.d. = 1 mg m-2; range: 0-4 mg m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 1.10-m2 epibenthic suction pump (FRI macropump); gas engine powered; w/ 130-um mesh on ports; organisms filtered through nested 500-um, 253-um, and 130-um mesh nets; pumped for 45 sec.

DESIGN: sampling on one occasion (late May) at 0.0 ft, tidal elevation at slack, flood and ebb tide stages, approximately 6 hours apart

REPLICATION: n = 2 per tide stage

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; tabulated

GRAPHS AND FIGURES: chronological line plots

SOURCES

LOCATION: Moon Island (northern shore) reach of North Channel, Grays Harbor, Washington

REFERENCES:

Cordell, J. R., and C. A. Simenstad. 1981. Community structure and standing stock of epibenthic zooplankton at Moon Island. Pp. 128-145 in C. A. Simenstad and D. M. Eggers (eds.), Juvenile salmon and baitfish distribution, abundance, and prey resources in selected areas of Grays Harbor, Washington. FRI-UW-8116. Univ.Wash.

RESPONDENT: Simenstad; Fisheries Research Institute

Eogammarus spp.

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: on mixed cobble sediments and algea, 0-+1.8 m MLLW

TEMPERATURE: unknown

SALINITY: apx. 28-30 ppt

FOOD: unknown

OTHER:

OCCURENCE

ABUNDANCE LEVELS: 2-100 m-2

BIOMASS LEVELS:

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: 100 cm2 quadrats; all organisms identified

DESIGN: stratified random samples by habitat type and tide height (0, +0.9, +1.8 m above MLLW)

REPLICATION: 8 reps per station

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: hard copy; species abundance and distribution by tide height, season, habitat

STATISTICAL ANALYSIS: species area curves; cluster analysis; regression; "T" tests; discriminant analysis

GRAPHS AND FIGURES:

SOURCES

LOCATION: 5 central Puget Sound beaches: Alki; Carkeek; Lincoln Park; Richmond; West Point

REFERENCES:

Armstrong, J. 1977. The impact of subtidal sewage outfalls on the intertidal macrofauna of several central Puget Sound beaches. PhD Dissertation, University of Washington. 183 pp. and Appendices.

RESPONDENT: Armstrong,; Environmental Protection Agency

epiphytic algae/animals

GROUP: benthic microbiota

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: leaves of eelgrass

TEMPERATURE: 2-28 C

SALINITY: 15-35 ppt

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: net production = 200-300 g C m-2 yr-1

BIOMASS LEVELS: up to 300 g dry wt m-2

SEASONALITY: spring ephemerals

SAMPLING METHODOLOGY

TECHNIQUES: 0.06 m2; 0.10 m2; 0.25 m2 quadrats; 1) standing stock: a) % cover of each spp. b) remove above ground part, dry, and weigh. 2) primary productivity: light & dark bottle incubations with DO flux

DESIGN: standing stock: random samples within depth and/or habitat strata; primary production: calculate rates based on standing stock estimates & incubations

REPLICATION: depends on complexity; range = 3-30 samples

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: "Statgraphics" data files; "Lotus" files

STATISTICAL ANALYSIS: summary statistics per unit area (usually m2)

GRAPHS AND FIGURES: line plots of spatial-temporal variation

SOURCES

LOCATION: Paddilla Bay, Drayton Harbor, Cherry Pt., central Puget Sound

REFERENCES:

Thom, R.M. 1983. Composition, habitats, seasonal changes, and productivity of macroalgea in Grays Harbor estuary, Wshington. Estuaries 7:51-60.

Thom, R.M. 1984. Primary production in Grays Harbor estuary, Washington. Bull. Southern California Acad. Sciences 83:99-105.

Thom, R.M., K. Chew, D. Crisostomo, B, Dumbauld, A. Escofet, C. Falmagne, J. Hampel, C. Law, J. Orensanz, and D. Waunmanndepinet. 1979. Habitats, abundance, and diversity of the intertidal benthic biota of Skiff Point, Bainbridge Island, Washington. A report prepared in cooperation with the Municipality of Metropolitan Seattle. 61 pp.

RESPONDENT: Thom; Fisheries Research Institute

epiphytic algae/animals

GROUP: benthic microbiota

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: leaves of eelgrass

TEMPERATURE: 2-28 C

SALINITY: 15-35 ppt

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: net production = 200-300 g C m-2 yr-1

BIOMASS LEVELS: up to 300 g dry wt m-2

SEASONALITY: spring ephemerals

SAMPLING METHODOLOGY

TECHNIQUES: 0.06 m2; 0.10 m2; 0.25 m2 quadrats; 1) standing stock: a) % cover of each spp. b) remove above ground part, dry, and weigh. 2) primary productivity: light & dark bottle incubations with DO flux

DESIGN: standing stock: random samples within depth and/or habitat strata; primary production: calculate rates based on standing stock estimates & incubations

REPLICATION: depends on complexity; range = 3-30 samples

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: "Statgraphics" data files; "Lotus" files

STATISTICAL ANALYSIS: summary statistics per unit area (usually m2)

GRAPHS AND FIGURES: line plots of spatial-temporal variation

SOURCES

LOCATION: Padilla Bay, Drayton Harbor, Cherry Pt., central Puget Sound

REFERENCES:

Shapiro and Associates, with Ardea Enterprise. 1988. Results of 1988 biological and chemical monitoring in the southeast Georgia Strait for the Mobil Oil Ferndal Refinery.

Thom, R. (in prep.) Effects of depth and season on plant standing stock and primary production in a temperate seagrass system. Marine Biology.

Thom, R. 1988. Benthic primary production in the eelgrass meadow at the Padilla Bay National Estuarine Research Reserve. NOAA Tech. Rpt. Series OCRM/MEMD. Fisheries Research Institute, University of Washington, Seattle. FRI-UW-8808.

Thom, R., C.A. Simenstad, J.R. Cordell, and E.O. Salo. 1988. Fisheries mitigation plan for expansion of moorage at Blaine Marina, Blaine, Washington. FRI-UW-8817. Fisheries Research Institute, University of Washington, Seattle.

Thom, R., R. Albright, C. Simenstad, and K. Chew. 1984. Intertidal and shallow subtidal benthic ecology. Chap. 4, pp. 87-139 in Q.J. Stober and K.K. Chew, Principal Investigators, Renton Sewage Treatment Plant Project: Seahurst Baseline Study. Publ. FRI-UW-8413, Fish. Res. Inst., Univ. of Wash, Seattle.

Thom, R., R. Albright, C. Simenstad, J. Hampel, J. Cordell, and K. Chew. 1984. Intertidal and shallow subtidal benthic ecology. Vol. IV, Sec. 5, in Q.J. Stober and K.K. Chew, Principal Investigators, Renton Sewage Treatment Plant Project: Seahurst Baseline Study. Publ. FRI-UW-8413, Fish. Res. Inst., Univ. of Wash, Seattle. 177

Thom, R.M. (in prep.) Plant standing stock and procuctivity on tidal flats and gravel in Padilla Bay, Washington: a temperate North Pacific estuarine embayment.

Thom, R.M. 1988. Lincoln Park eelgrass baseline study. Final report, Seattle District, U.S. Army Corp of Engineers. Seattle, Washington.

Thom, R.M., C.A. Simenstad, J.R. COrdell, and E.O. Salo. (in prep.) Fish and their prey in a marina and adjacent mudflats and eelgrass meadow in a small estuarine harbor.

RESPONDENT: Thom; Fisheries Research Institute

epiphytic algae/animals

GROUP: benthic microbiota

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: eelgrass leaves

TEMPERATURE: 6-25 C

SALINITY: 24-28 ppt

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS:

BIOMASS LEVELS: on Z. japonica 0.87 +/- 0.73 to 20.8 +/- 9.4 mg dry weight/shoot; on Z. marina 3.4 +/- 1.0 to 58.1 +/- 25.2 mg dry weight/shoot

SEASONALITY: minimum winter, maximum summer and winter

SAMPLING METHODOLOGY

TECHNIQUES: scrape eelgrass shoots of epiphytes; filter onto pre-weighed gf filters, dry at <90 C weigh

DESIGN: monthly, more frequently (1-2 weeks) during spring bloom (epiphytes disappear quuickly)

REPLICATION: 12-15 shoots/plot to detect 5% difference in mean at 10% level with 80%

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: 'Lotus', 'Excel', or 'Cricket' spreadsheets

STATISTICAL ANALYSIS: mean, standard deviation at each sampling date

GRAPHS AND FIGURES:

SOURCES

LOCATION: Padilla Bay intertidal sediments

REFERENCES:
Williams, S.L. (unpubl.)

RESPONDENT: Williams,; Friday Harbor Laboratories

Gammaridea (unid.)

GROUP:

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: cobble with Fucus

TEMPERATURE:

SALINITY: >25 ppt

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: mean = 9,705 +/- 6,484 (study area); mean = 8,678 +/- 4,174 (control); range 3,036 to 19,249 m-2; included in total epibenthos

BIOMASS LEVELS:

SEASONALITY: sampled once only, August 24, 1983

SAMPLING METHODOLOGY

TECHNIQUES: 0.164 m2 underwater suction (benthic/epibenthic) sampler modified from Gale & Thompson (1975); powered by submerged bilge pump run by battery from boat; samples retained in 295 um Nitex mesh

DESIGN: lower intertidal for control and for development area along 1 transect (=tidal elevation); water depths 0.5 to 2.0 m; 1 min. suction/sample

REPLICATION: n=3 for each station; subsamples obtained by pooling replicates and elutriation process undertaken & 10 subsamples obtained using method from H. Muncie (PBS, Nanaimo)

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: data tables; figures (histogram)

STATISTICAL ANALYSIS: standardized to m-2; mean +/- std. deviation

GRAPHS AND FIGURES: abundance (m-2) vs. substrate

SOURCES

LOCATION: Duncan Bay barge terminal site, apx. 6.5 km north of Campbell River on Vancouver Island

REFERENCES:

Gale, W.F. and J.D. Thompson. 1975. A suction sampler for quantitatively sampling benthos on rocky substrate in rivers. Trans. Am. Fish. Soc. 104:398-405.

Waddell, B. and S. Markowski. 1983. Campbell River foreshore biophysical inventory. Water Use Unit, Habitat Management Division, Dept. of Fish and Oceans, Vancouver, B.C. 53 pp.

Williams, G.L. 1983. A survey of the marine benthic invertebrates and vegetation at the proposed Transp. Can. barge loading facility at Campbell River (Middle Pt.), B.C. unpublished report to Public Works, Canada. 30 pp.

RESPONDENT: Williams; G.L. WIlliams and Associates, Ltd.

Gammaridea (unid.)

GROUP:

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: rocky, with turf algae; usually more abundunt in filamentous than foliose algae

TEMPERATURE: 7+ C

SALINITY:

FOOD: detritus

OTHER:

OCCURENCE

ABUNDANCE LEVELS: 0-760 m-2; mean = 146; SD = 266

BIOMASS LEVELS: 0-3.8 gm m-2; mean 0.83 gm; SD = 1.39 gm

SEASONALITY: unknown

SAMPLING METHODOLOGY

TECHNIQUES: airlift (using SCUBA) by 'vacuuming' 10 cm-2 areas from hard substrata; screened to 1mm in the laboratory

DESIGN: randomly selected sites along a transect line at similar depths; see Benson 1989 re. design

REPLICATION: n = 5 at each depth interval

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: no specific format

STATISTICAL ANALYSIS: standardized to per square meter

GRAPHS AND FIGURES: chronological line plots or bar charts

SOURCES

LOCATION: artificial reefs off Gedney Island, Onamanc Point, Possession Point, Misery Point, Point Heyer, Toliva Shoal, Itsami Ledge, and Boeing Creek

REFERENCES:

Benson, B.L. 1989. Air-lift sampler: Applications for sampling hard substrat. Bull. Mar. Sci. (in press).
Hueckel, G.J., and R.M. Buckley. 1987. The influence of prey communities on fish species assemblages on artificial reefs in Puget Sound, Washington. Env. Biol. Fish. 19(3):195-214.

RESPONDENT: Hueckel; Washington Department of Fisheries

Gammaridea (unid.)

GROUP:

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: soft sediment

TEMPERATURE: 7+ C

SALINITY:

FOOD: detritus

OTHER:

OCCURENCE

ABUNDANCE LEVELS: 212-215 m-2

BIOMASS LEVELS:

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: samples of the sediment taken underwater (using SCUBA) with 29mm cores penetrated 5cm into bottom with a 25 m-2 grid

DESIGN: randomly selected sites at similar depths; samples were pooled for two sampling periods; 10 samples each were taken from five different depths

REPLICATION: 10 cores per sampling depth

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: no specific format

STATISTICAL ANALYSIS: standardized to per square meter

GRAPHS AND FIGURES: bar charts

SOURCES

LOCATION: Edmonds artificial reef

REFERENCES:

Hueckel, G.J. 1980. Foraging on an artificial reef by three Puget SOund fish species. Wash. Dept. Fish. Tech. Rept. 53. 110 pp.

RESPONDENT: Hueckel; Washington Department of Fisheries

Gasterosteus aculeatus

GROUP: motile fish

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silt, fine sand; some depressions and shallow drainage channels

TEMPERATURE: 8.0 degrees C (March) to 24 degrees C (July)

SALINITY: greater than 25 ppt

FOOD:

OTHER: Enteromorpha abundant during much of spring

OCCURENCE

ABUNDANCE LEVELS: mean = 69.6 +/- 1 s.d. = 236.5 m-2; range: 0-820.5 m-2

BIOMASS LEVELS: (not summarized; data available)

SEASONALITY: maxima in late August

SAMPLING METHODOLOGY

TECHNIQUES: 37-m long beach seine (UW School of Fisheries research seine) w/ 7-mm mesh bag; set 30 m from and parallel to shore; retrieved to sample 520 m2

DESIGN: adjacent, consecutive sets made in identical shallow subtidal habitats; small catches retained, large catches subsampled; sorted to spp. and life history stage; enumerated and weighed (damp wet wt.)

REPLICATION: n = 3

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 3; archived on 9-tract mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Drayton Harbor, Washington; exposed, high intertidal mudflat (+1.8 m MLLW) in Harbor immediately east of marina breakwater

REFERENCES:

Thom, R. M., C. A. Simenstad, J. R. Cordell, and E. O. Salo 1989. Fish and their epibenthic prey in a marina and adjacent mudflats and eelgrass meadow in a small estuarine bay FRI-UW-8901, Final Rep. prep. for The Port of Bellingham, Fish. Res. Inst., Univ. Wash., Seattle, WA. 27 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Gasterosteus aculeatus

GROUP: motile fish

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silt, fine sand; some depressions and shallow drainage channels

TEMPERATURE: 8.0 degrees C (March) to 24 degrees C (July)

SALINITY: greater than 25 ppt

FOOD:

OTHER: Enteromorpha and Vaucheria covered flats much of spring

OCCURENCE

ABUNDANCE LEVELS: mean=0.1 +/- 1 s.d.=0.2 m-2; range: 0-0.5 m-2

BIOMASS LEVELS: (not summarized; data available)

SEASONALITY: maxima in late June

SAMPLING METHODOLOGY

TECHNIQUES: 37-m long beach seine (UW School of Fisheries research seine) w/ 7-mm mesh bag; set 30 m from and parallel to shore; retrieved to sample 520 m2

DESIGN: adjacent, consecutive sets made in identical shallow subtidal habitats; small catches retained, large catches subsampled; sorted to spp. and life history stage; enumerated and weighed (damp wet wt.)

REPLICATION: n=3

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 3; archived on 9-tract mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Drayton Harbor, Washington; protected mudflat inside Blaine Marina; upper margin of flats @ 1.8 m MLLW

REFERENCES:

Thom, R. M., C. A. Simenstad, J. R. Cordell, and E. O. Salo 1989. Fish and their epibenthic prey in a marina and adjacent mudflats and eelgrass meadow in a small estuarine bay FRI-UW-8901, Final Rep. prep. for The Port of Bellingham, Fish. Res. Inst., Univ. Wash., Seattle, WA. 27 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Gnorimosphaeroma oregonese

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silt and detritus; decaying marsh litter and trapped eelgrass and other debris

TEMPERATURE: 8.0 degrees C (March) to 24 degrees C (July)

SALINITY: greater than 25 ppt

FOOD:

OTHER: marsh vegetation dominated by Scirpus, Triglochin, and Distichlis

OCCURENCE

ABUNDANCE LEVELS: juveniles and adults combined: mean = 115.7 +/- 1 s.d. = 189.6 m-2; range = 250.0-444.4 m-2

BIOMASS LEVELS: juveniles and adults combined: mean = 250 mg +/- 1 s.d. = 510 mg m-2; range = 225-1278 mg m-2

SEASONALITY: most abundant in mid-March (only sampled twice, in March)

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: permanent sampling points established randomly along transect line bisecting marsh vegetation along same tidal elevation

REPLICATION: n = 5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-tract mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Drayton Harbor, Washington; high intertidal emergent marsh within Blaine Marina

REFERENCES:

Thom, R. M., C. A. Simenstad, J. R. Cordell, and E. O. Salo 1989. Fish and their epibenthic prey in a marina and adjacent mudflats and eelgrass meadow in a small estuarine bay FRI-UW-8901, Final Rep. prep. for The Port of Bellingham, Fish. Res. Inst., Univ. Wash., Seattle, WA. 27 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Gnorimosphaeroma oregonese

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: compacted silt

TEMPERATURE: not available

SALINITY: not available

FOOD:

OTHER: high (+7.9 ft. MLLW) marsh; Salicornia dominant vegetation

OCCURENCE

ABUNDANCE LEVELS: juveniles: mean=74.1 +/- 1 s.d.=128.3 m-2; range: 0-222 m-2

BIOMASS LEVELS: juveniles: mean=17 +/- 1 s.d.=3 mg m-2; range: 0-50 mg m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: random samples from similar tidal height within five distinct habitat strata along established transect line (perpendicular to elevation gradient); sampled once, late May 1987

REPLICATION: n=3

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); using NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Day Island, central Puget Sound, southern reach of The (Tacoma) Narrows; adjacent to Days Island Channel

REFERENCES:

Thom, R. M., C. A. Simenstad, and J. R. Cordell. 1987. Benthic productivity and epibenthic crustacean community structure at the Days Island Marina expansion site, Tacoma, Washington. Unpubl. rep. to Day Island Community Club.

RESPONDENT: Simenstad; Fisheries Research Institute

Harpacticoida (unid.)

GROUP:

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: cobble with Fucus

TEMPERATURE:

SALINITY: >25 ppt

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: mean = 9,705 +/- 6,484 (study area); mean = 8,678 +/- 4,174 (control); range 3,036 to 19,249 m-2; included in total epibenthos

BIOMASS LEVELS:

SEASONALITY: sampled once only, August 24, 1983

SAMPLING METHODOLOGY

TECHNIQUES: 0.164 m2 underwater suction (benthic/epibenthic) sampler modified from Gale & Thompson (1975); powered by submerged bilge pump run by battery from boat; samples retained in 295 um Nitex mesh

DESIGN: lower intertidal for control and for development area along 1 transect (=tidal elevation); water depths 0.5 to 2.0 m; 1 min. suction/sample

REPLICATION: n=3 for each station; subsamples obtained by pooling replicates and elutriation process undertaken & 10 subsamples obtained using method from H. Muncie (PBS, Nanaimo)

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: data tables; figures (histogram)

STATISTICAL ANALYSIS: standardized to m-2; mean +/- std. deviation

GRAPHS AND FIGURES: abundance (m-2) vs. substrate

SOURCES

LOCATION: Duncan Bay barge terminal site, apx. 6.5 km north of Campbell River on Vancouver Island

REFERENCES:

Gale, W.F. and J.D. Thompson. 1975. A suction sampler for quantitatively sampling benthos on rocky substrate in rivers. Trans. Am. Fish. Soc. 104:398-405.

Waddell, B. and S. Markowski. 1983. Campbell River foreshore biophysical inventory. Water Use Unit, Habitat Management Division, Dept. of Fish and Oceans, Vancouver, B.C. 53 pp.

Williams, G.L. 1983. A survey of the marine benthic invertebrates and vegetation at the proposed Transp. Can. barge loading facility at Campbell River (Middle Pt.), B.C. unpublished report to Public Works, Canada. 30 pp.

RESPONDENT: Williams; G.L. WIlliams and Associates, Ltd.

Harpacticoida (unid.)

GROUP:

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silty sands near Snohomish River channerl; sandy silt and silty clay in inner basin, with abundant wood debris

TEMPERATURE:

SALINITY:

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: % of total: all harpacticoids 69; Leimia spp. 57; Microarth spp. 4.6; also Eogammarus spp. 17.5

BIOMASS LEVELS: % of total: all harpacticoids 38.7; Leimia spp. 34.3; Microarth spp. 1.0; also Eogammarus spp. 17.5

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: hydraulic pump; filtered water lying over 0.1 m2; filtered with 0.25 mm net; pumped for 30 to 45 seconds

DESIGN: 16 stations from under and adjacent to log rafts; depth (bottom elevation) ranged from +4.5 to -13.0 ft; all sampled on 23-24 May, 1987

REPLICATION: 5 samples per station; 10 station locations anlyzed with 3 randomly drawn replicates analyzed per station

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: raw data compiled on 'Lotus' spreadsheets; also archived at University of Washington computer center

STATISTICAL ANALYSIS: none

GRAPHS AND FIGURES: none

SOURCES

LOCATION: Everett Harbor, immediately south of public boat launch ramps

REFERENCES:
BioAquatics International (Cheny). 1987. Marina mitigation and monitoring plan. William Hulbert Mill Company.

RESPONDENT: Cheney; BioAquatics International

Harpacticoida (unid.)

GROUP:

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: mixed fines (sand and silt) with gravel cobble; log raft on 1/3 of site removed in 1988

TEMPERATURE:

SALINITY:

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: 1987: upper 1910 m-2; mid 13,007 m-2; lower 1857 m-2; 1988: upper marsh 1080 m-2; upper 1460 m-2; mid 2620 m-2; lower 2870 m-2

BIOMASS LEVELS:

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: hydraulic pump; filtered water lying over 0.1 m2; filtered with a 0.25 mm net; pumped for 30 to 45 seconds; sampled 19 May 1987 and 29 August 1988

DESIGN: both periods: 3 stations (upper and low intertidal, and upper subtidal); August 1988: additional 'marsh' station sampled; 1988 subtidal in basin dredeged on 8/87

REPLICATION: five stations sampled; three/station analyzed (2/station archived)

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: 'Lotus' spreadsheet; data files archived at University of Washington computer center

STATISTICAL ANALYSIS: basic statistical summaries only

GRAPHS AND FIGURES: none

SOURCES

LOCATION: Gig Harbor at foot of Dorotich Street

REFERENCES:

BioAquatics International (Cheney). 1987. Derotich Marina mitigation and monitoring plan. Prepared for U.S. Fish and Wildlife Servie, Olympia.

RESPONDENT: Cheney; BioAquatics International

Harpacticus uniremis

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silt-sand w/ some gravel beneath surface

TEMPERATURE: 8.0 degrees C (March) to 24 degrees C (July)

SALINITY: greater than 25 ppt

FOOD:

OTHER: dense Zostera marina

OCCURENCE

ABUNDANCE LEVELS: all adults: mean = 4355.3 +/- 1 s.d. = 12655.5 m-2; range: 55.6-52222.2 m-2

BIOMASS LEVELS: all adults: mean = 292 +/- 1 s.d. = 780 mg m-2; range: 6-3222 mg m-2

SEASONALITY: maxima in late April

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: permanent sampling points established randomly along transect line through eelgrass meadow at same tidal elevation

REPLICATION: n = 5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Drayton Harbor, Washington; mid-intertidal (0.6 m MLLW) eelgrass meadow east of Blaine Marina

REFERENCES:

Thom, R. M., C. A. Simenstad, J. R. Cordell, and E. O. Salo 1989. Fish and their epibenthic prey in a marine and adjacent mudflats and eelgrass meadow in a small estuarine bay FRI-UW-8901, Final Rep. prep. for The Port of Bellingham, Fish. Res. Inst., Univ. Wash., Seattle, WA. 27 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Harpacticus uniremis

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: compacted silt at edge of emergent marsh; approximate tidal elevation +2 m MLLW

TEMPERATURE:

SALINITY:

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: all adults combined: mean=2037.5 +/- 1 s.d.= 1147.5 m2; range: 750.0-3437.5 m-2; copepodids: mean=3075 +/- 1 s.d.=673.7; range: 2187.5-3812.5

BIOMASS LEVELS: all adults combined: mean=314 +/- 1 s.d.=8 mg m-2; range: 113-519 mg m-2; copepodids: mean=68 +/- 1 s.d.=10 mg m-2; range: 50-81 mg m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 150-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.

DESIGN: Random samples collected from same tidal elevation and substrate characteristics; sampled on one occasion (early March)

REPLICATION: n=5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2

GRAPHS AND FIGURES: microcomputer-generated histrograms

SOURCES

LOCATION: Swinomish Channel; salt marsh adjacent to bingo parlor just west of railroad bridge crossing of channel

REFERENCES:

Cordell, J. R. 1986. Swinomish Boat Basin site epibenthic zooplankton, 1 March, 1986. Unpubl. rep. to URS, Inc., 43 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Harpacticus uniremis

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: in tidal channel draining lagoon behind dredge spoil islands; sandy at 0.0 m MLLW

TEMPERATURE:

SALINITY:

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: all adults combined: mean= 37.5 +/- 1 s.d.=62.2 m2; range: 0-125.0 m-2; copepodids: mean=1687.5 +/- 1 s.d.=805.3; range: 687.5-2312.5 m-2

BIOMASS LEVELS: all adults combined: mean=4 +/- 1 s.d.=1 mg m-2; range: 0-6 mg m-2; copepodids: mean=15 +/- 10 s.d.=less than 1 mg m-2; range: 6-19 mg m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 150-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.

DESIGN: Random samples collected from same tidal elevation and substrate characteristics; sampled on one occasion (early March)

REPLICATION: n=5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2

GRAPHS AND FIGURES: microcomputer-generated histrograms

SOURCES

LOCATION: Swinomish Channel; tidal channel in mudflat emptying lagoon just north of railroad bridge on west dredge spill islands

REFERENCES:

Cordell, J. R. 1986. Swinomish Boat Basin site epibenthic zooplankton, 1 March, 1986. Unpubl. rep. to URS, Inc., 43 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Harpacticus uniremis

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: on promontory just across channel from dredge spoil island, at outer edge of salt marsh; mud at + 1.5 m MLLW

TEMPERATURE:

SALINITY:

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: all adults combined: mean=925.0 +/- 1 s.d.=833.0 m2; range: 375-2062.5 m-2; copepodids: mean=650.0 +/- 1 s.d.=575.5; range: 250-1250

BIOMASS LEVELS: all adults combined: mean=145 +/- 1 s.d.=13 mg m-2; range: 63-300 mg m-2; copepodids: mean=30 +/- 1 s.d.=3 mg m-2; range: 13-63 mg m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 150-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.

DESIGN: Random samples collected from same tidal elevation and substrate characteristics; sampled on one occasion (early March)

REPLICATION: n=5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2

GRAPHS AND FIGURES: microcomputer-generated histrograms

SOURCES

LOCATION: Swinomish Channel; mud at margin of saltmarsh north of railroad bridge on west dredge spill islands

REFERENCES:

Cordell, J. R. 1986. Swinomish Boat Basin site epibenthic zooplankton, 1 March, 1986. Unpubl. rep. to URS, Inc., 43 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Harpacticus uniremis

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: coarse sand w/ gravel, some silt patches; thick Zostera marina growth; +0.5 ft. MLLW tidal elevation

TEMPERATURE: 23.0 degrees C

SALINITY: 28-29 ppt

FOOD:

OTHER: weather sunny, no wave disturbance

OCCURENCE

ABUNDANCE LEVELS: copepodids: mean=520.8 +/- 1 s.d.=157.3 m-2 (no other life history stages found)

BIOMASS LEVELS: copepodids: mean=8.0 +/- 1 s.d.=0 mg m-2 (no other life history stages found)

SEASONALITY: no data other than for early May

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/130-um mesh on intake ports; sieved through 130-um screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: randomly selected sites within same tidal elevation along "established" research transect in PBNERR;sampled with 0.5 to 1.5 m water depth

REPLICATION: n=5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5 as modified by FRI; archived on 9-tract tape at UW ACC (Cyber); all NODC codes used

STATISTICAL ANALYSIS: standardized to density and standing crop m-2; log transformed for statistical comparisons; ANOVA used if uniform variance dist., otherwise Kruskal-Wallis non-parametric

GRAPHS AND FIGURES: line plots, histograms, etc. using Statgraphics

SOURCES

LOCATION: Padilla Bay National Estuarine Research Reserve; established littoral flat gradient research transect; flat just off "Gun Club marsh"

REFERENCES:

Simenstad, C. A., J. R. Cordell, R. C. Wissmar, K. L. Fresh, S. L. Schroder, M. Carr, G. Sanborn, and M. E. Burg 1988. Assemblage structure, microhabitat distribution, and food web linkages of epibenthic crustaceans in Padilla Bay National Estuarine Research Reserve, Washington FRI-UW-8813, Fish. Res. Inst., Univ. Wash., Seattle, WA. 60 pp. (also NOAA Tech. Rep. Series OCRM/MEMD)

RESPONDENT: Simenstad; Fisheries Research Institute

Harpacticus uniremis

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: coarse sand

TEMPERATURE:

SALINITY:

FOOD:

OTHER: dense Zostera marina meadow

OCCURENCE

ABUNDANCE LEVELS: mean=64.0 +/- 143.1 m-2; range: 0-320 m-2

BIOMASS LEVELS: mean=3 +/- 10 mg m-2; range: 0-16 mg m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.10-m2 epibenthic suction pump (FRI macropump); gas engine powered; w/ 130-um mesh on ports; organisms filtered through nested 500-um, 253-um, and 130-um mesh nets; pumped for 45 sec.

DESIGN: random samples from discrete substrate and tidal elevation; sampled on one occasion (early July)

REPLICATION: n=5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archieved on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2

GRAPHS AND FIGURES: (data not processed beyond tabulation)

SOURCES

LOCATION: Alki Point (Seattle), central Puget Sound

REFERENCES:
Simenstad, C. A., and J. R. Cordell. 1984. n.a. Unpubl. data.

RESPONDENT: Simenstad; Fisheries Research Institute

Harpacticus uniremis

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: coarse sand w/ gravel, some silt patches; thick Zostera marina growth; +0.5 ft. MLLW tidal elevation

TEMPERATURE: 23.0 degrees C

SALINITY: 28-29 ppt

FOOD:

OTHER: weather sunny, no wave disturbance

OCCURENCE

ABUNDANCE LEVELS: adults: mean=3.0 +/- 1 s.d.=5.1 100-cm2; copepodids: mean= 3.5 +/- 1 s.d.=4.5 100-cm2, for high epiphyte plant; none on non-epiphyte plant

BIOMASS LEVELS: adults: mean=0.5 +/- 1 s.d.=0.8 mg 100-cm2; copepodids: mean=0.01 +/- 1 s.d.=0.01 mg 100-cm2, for high epiphyte plant, none on non-epiphyte plant

SEASONALITY: no data other than for early May

SAMPLING METHODOLOGY

TECHNIQUES: Zostera marina plants collected intact, or as 10-cm segments, without disturbance of epiphytes (e.g., in situ); in laboratory, animals washed out of epiphytes and sieved to 253 um

DESIGN: randomly selected plants within same tidal elevation along "established" research transect in PBNERR;sampled with 0.5 to 1.5 m water depth

REPLICATION: n=2 plants

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5 as modified by FRI; archived on 9-tract tape at UW ACC (Cyber); all NODC codes used

STATISTICAL ANALYSIS: standardized to density and standing crop 100-cm2 surface area of blade; log transformed for statistical comparisons; ANOVA used if uniform variance dist., otherwise Kruskal-Wallis non-parametri

GRAPHS AND FIGURES: line plots, histograms, etc. using Statgraphics

SOURCES

LOCATION: Padilla Bay National Estuarine Research Reserve; established littoral flat gradient research transect; flat just off "Gun Club marsh"

REFERENCES:

Simenstad, C. A., J. R. Cordell, R. C. Wissmar, K. L. Fresh, S. L. Schroder, M. Carr, G. Sanborn, and M. E. Burg 1988. Assemblage structure, microhabitat distribution, and food web linkages of epibenthic crustaceans in Padilla Bay National Estuarine Research Reserve, Washington FRI-UW-8813, Fish. Res. Inst., Univ. Wash., Seattle, WA. 60 pp. (also NOAA Tech. Rep. Series OCRM/MEMD)

RESPONDENT: Simenstad; Fisheries Research Institute

Hemigrapsus spp.

GROUP: evasive macroepifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: cobble with Fucus

TEMPERATURE:

SALINITY: >25 ppt

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: mean = 9,705 +/- 6,484 (study area); mean = 8,678 +/- 4,174 (control); range 3,036 to 19,249 m-2; included in total epibenthos

BIOMASS LEVELS:

SEASONALITY: sampled once only, August 24, 1983

SAMPLING METHODOLOGY

TECHNIQUES: 0.164 m2 underwater suction (benthic/epibenthic) sampler modified from Gale & Thompson (1975); powered by submerged bilge pump run by battery from boat; samples retained in 295 um Nitex mesh

DESIGN: lower intertidal for control and for development area along 1 transect (=tidal elevation); water depths 0.5 to 2.0 m; 1 min. suction/sample

REPLICATION: n=3 for each station; subsamples obtained by pooling replicates and elutriation process undertaken & 10 subsamples obtained using method from H. Muncie (PBS, Nanaimo)

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: data tables; figures (histogram)

STATISTICAL ANALYSIS: standardized to m-2; mean +/- std. deviation

GRAPHS AND FIGURES: abundance (m-2) vs. substrate

SOURCES

LOCATION: Duncan Bay barge terminal site, apx. 6.5 km north of Campbell River on Vancouver Island

REFERENCES:

Gale, W.F. and J.D. Thompson. 1975. A suction sampler for quantitatively sampling benthos on rocky substrate in rivers. Trans. Am. Fish. Soc. 104:398-405.

Waddell, B. and S. Markowski. 1983. Campbell River foreshore biophysical inventory. Water Use Unit, Habitat Management Division, Dept. of Fish and Oceans, Vancouver, B.C. 53 pp.

Williams, G.L. 1983. A survey of the marine benthic invertebrates and vegetation at the proposed Transp. Can. barge loading facility at Campbell River (Middle Pt.), B.C. unpublished report to Public Works, Canada. 30 pp.

RESPONDENT: Williams; G.L. WIlliams and Associates, Ltd.

Hemigrapsus spp.

GROUP: evasive macroepifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: mixed cobble sediments; under boulders and cobble 0-+1.8 m MLLW

TEMPERATURE: unknown

SALINITY: apx. 28-30 ppt

FOOD: unknown

OTHER: Hemigrapsus oregonesis

OCCURENCE

ABUNDANCE LEVELS: 20-160 m-2 at +0.9 m MLLW

BIOMASS LEVELS:

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: 100 cm2 quadrats; all organisms identified

DESIGN: stratified random samples by habitat type and tide height (0, +0.9, +1.8 m above MLLW)

REPLICATION: 8 reps per station

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: hard copy; species abundance and distribution by tide height, season, habitat

STATISTICAL ANALYSIS: species area curves; cluster analysis; regression; "T" tests; discriminant analysis

GRAPHS AND FIGURES:

SOURCES

LOCATION: 5 central Puget Sound beaches: Alki; Carkeek; Lincoln Park; Richmond; West Point

REFERENCES:

Armstrong, J. 1977. The impact of subtidal sewage outfalls on the intertidal macrofauna of several central Puget Sound beaches. PhD Dissertation, University of Washington. 183 pp. and Appendices.

RESPONDENT: Armstrong,; Environmental Protection Agency

Heptacarpus spp.

GROUP: evasive macroepifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: tide pools, 0-1.8 m MLLW

TEMPERATURE: unknown

SALINITY: apx. 28-30 ppt

FOOD: unknown

OTHER:

OCCURENCE

ABUNDANCE LEVELS: 2-<100 m-2

BIOMASS LEVELS:

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: 100 cm2 quadrats; all organisms identified

DESIGN: stratified random samples by habitat type and tide height (0, +0.9, +1.8 m above MLLW)

REPLICATION: 8 reps per station

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: hard copy; species abundance and distribution by tide height, season, habitat

STATISTICAL ANALYSIS: species area curves; cluster analysis; regression; "T" tests; discriminant analysis

GRAPHS AND FIGURES:

SOURCES

LOCATION: 5 central Puget Sound beaches: Alki; Carkeek; Lincoln Park; Richmond; West Point

REFERENCES:

Armstrong, J. 1977. The impact of subtidal sewage outfalls on the intertidal macrofauna of several central Puget Sound beaches. PhD Dissertation, University of Washington. 183 pp. and Appendices.

RESPONDENT: Armstrong,; Environmental Protection Agency

Heptacarpus spp.

GROUP: evasive macroepifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: rocky, with turf algae; usually more abundant in filamentous, than foliose algae

TEMPERATURE: 7+ C

SALINITY:

FOOD: detritus

OTHER:

OCCURENCE

ABUNDANCE LEVELS: 0-240 m-2; mean=49 m-2; SD=75

BIOMASS LEVELS: 0-5 gm m-2; mean=2.86; SD=5.64

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: Airlift (using SCUBA), by scrapping and 'vacuuming' 10 cm2 areas with turf algae from the hard substrata

DESIGN: randomly selected sites at similar depths; see Benson 1989 re. design

REPLICATION: n=5 at each depth interval

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: no specific format

STATISTICAL ANALYSIS: standardized to per square meter

GRAPHS AND FIGURES: chronological line plots or bar charts

SOURCES

LOCATION: artificial reefs off Edmonds, Gedney Island, Onamac Point, Possession Point, Misery Point, Point Heyer, Toliva Shoal, Itsami Ledge, and Boeing Creek

REFERENCES:

Benson, B.L. 1989. Air-lift sampler: Applications for sampling hard substrata. Bull. Mar. Sci. 44(2). (in press).
Hueckel, G.J., and R.M. Buckley. 1987. The influence of prey communities on fish species assemblages on artificial reefs in Puget Sound, Washington. Env. Biol. Fish. 19(3):195-214.

RESPONDENT: Hueckel; Washington Department of Fisheries

Hippolytidae (unid.)

GROUP: evasive macroepifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: coarse sand

TEMPERATURE:

SALINITY:

FOOD:

OTHER: dense Zostera marina meadow

OCCURENCE

ABUNDANCE LEVELS: juveniles: mean=24.0 +/- 1. s.d.=21.9 m-2; range: 0.0-40.0 m-2

BIOMASS LEVELS: juveniles: mean=12 +/- 1 s.d.=10 mg m-2; range: 8-28 mg m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.10-m2 epibenthic suction pump (FRI macropump); gas engine powered; w/ 130-um mesh on ports; organisms filtered through nested 500-um, 253-um, and 130-um mesh nets; pumped for 45 sec.

DESIGN: random samples from discrete substrate and tidal elevation; sampled on one occasion (early July)

REPLICATION: n=5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archieved on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2

GRAPHS AND FIGURES: (data not processed beyond tabulation)

SOURCES

LOCATION: Alki Point (Seattle), central Puget Sound

REFERENCES:
Simenstad, C. A., and J. R. Cordell. 1984. n.a. Unpubl. data.

RESPONDENT: Simenstad; Fisheries Research Institute

Hippolytidae (unid.)

GROUP: evasive macroepifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: rocky, with turf algae; usually more abundant in filamentous, than foliose algae

TEMPERATURE: 7+ C

SALINITY:

FOOD: detritus

OTHER: Spirontocaris spp.

OCCURENCE

ABUNDANCE LEVELS: 0-240 m-2; mean=49 m-2; SD=75

BIOMASS LEVELS: 0-5 gm m-2; mean=2.86; SD=5.64

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: Airlift (using SCUBA), by scrapping and 'vacuuming' 10 cm2 areas with turf algae from the hard substrata

DESIGN: randomly selected sites at similar depths; see Benson 1989 re. design

REPLICATION: n=5 at each depth interval

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: no specific format

STATISTICAL ANALYSIS: standardized to per square meter

GRAPHS AND FIGURES: chronological line plots or bar charts

SOURCES

LOCATION: artificial reefs off Edmonds, Gedney Island, Onamac Point, Possession Point, Misery Point, Point Heyer, Toliva Shoal, Itsami Ledge, and Boeing Creek

REFERENCES:

Benson, B.L. 1989. Air-lift sampler: Applications for sampling hard substrata. Bull. Mar. Sci. 44(2). (in press).
Hueckel, G.J., and R.M. Buckley. 1987. The influence of prey communities on fish species assemblages on artificial reefs in Puget Sound, Washington. Env. Biol. Fish. 19(3):195-214.

RESPONDENT: Hueckel; Washington Department of Fisheries

Insecta (unid.)

GROUP:

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: fine clay mud (channel bottom); clean sand (sandflat); silty sand (marsh)

TEMPERATURE: apx. 0-25 C

SALINITY: 0-32 ppt

FOOD: macro algae, diatoms, etc.

OTHER: effects of eelgrass on benthos; effect of tidal flat pools

OCCURENCE

ABUNDANCE LEVELS: range = 200-40,000 invertebrates m-2

BIOMASS LEVELS:

SEASONALITY: highest numbers in summer/fall; freshwater input accects species composition

SAMPLING METHODOLOGY

TECHNIQUES: 0.05 m2 sampler used to 15 cm depth and then dug out; seived through a .595 nm screen

DESIGN: sampled monthly at 11 station located from a marsh area to subtidal channel bottom; during summer sampled eelgrass and non-eelgrass sediments

REPLICATION: n = 3 at each station

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: paper data sheets with station and number of invertebrates

STATISTICAL ANALYSIS: number m-2; log transformed for statistical analysis

GRAPHS AND FIGURES: plots by tidal height; location

SOURCES

LOCATION: Baker Bay, Columbia River Estuary, near Ilwaco, Washington

REFERENCES:

Furota, and R.L. Emmett. in prep. Benthic invertebrates along a transect in Baker Bay Unpubl. rep., NOAA-NMFS, Northwest Alaska Fish. Center, Seattle, WA.

RESPONDENT: Emmett; National Marine Fisheries Service

Ischyrocerus spp.

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: coarse sand

TEMPERATURE:

SALINITY:

FOOD:

OTHER: dense Zostera marina meadow

OCCURENCE

ABUNDANCE LEVELS: juveniles: mean=2992.0 +/- 1. s.d.=1498.4 m-2; range: 1440-4800 m-2; combined adults: mean=1844.0 +/- 1 s.d.=891.7 m-2; range: 840-2920 m-2

BIOMASS LEVELS: juveniles: mean=163 +/- 1 s.d.=90 mg m-2; range: 64-272 mg m-2; combined adults: meam=651 +/- 1 s.d.=430 mg m-2; range: 316-1260 mg m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.10-m2 epibenthic suction pump (FRI macropump); gas engine powered; w/ 130-um mesh on ports; organisms filtered through nested 500-um, 253-um, and 130-um mesh nets; pumped for 45 sec.

DESIGN: random samples from discrete substrate and tidal elevation; sampled on one occasion (early July)

REPLICATION: $\bar{n}=5$

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archieved on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2

GRAPHS AND FIGURES: (data not processed beyond tabulation)

SOURCES

LOCATION: Alki Point (Seattle), central Puget Sound

REFERENCES:
Simenstad, C. A., and J. R. Cordell. 1984. n.a. Unpubl. data.

RESPONDENT: Simenstad; Fisheries Research Institute

Ischyrocerus spp.

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: coarse sand w/ gravel, some silt patches; thick Zostera marina growth; +0.5 ft. MLLW tidal elevation

TEMPERATURE: 23.0 degrees C

SALINITY: 28-29 ppt

FOOD:

OTHER: weather sunny, no wave disturbance

OCCURENCE

ABUNDANCE LEVELS: adults: mean=0.2 +/- 1 s.d.=0.6 100-cm2; egg-c females: mean= 0.3 +/- 1 s.d.=1.0 100-cm2, for high epiphyte plant

BIOMASS LEVELS: adults: mean=0.4 +/- 1 s.d.=1.1 mg 100-cm2; egg-c females: mean=0.9 +/- 1 s.d.=2.7 mg 100-cm2, for high epiphyte plant

SEASONALITY: no data other than for early May

SAMPLING METHODOLOGY

TECHNIQUES: Zostera marina plants collected intact, or as 10-cm segments, without disturbance of epiphytes (e.g., in situ); in laboratory, animals washed out of epiphytes and sieved to 253 um

DESIGN: randomly selected plants within same tidal elevation along "established" research transect in PBNERR;sampled with 0.5 to 1.5 m water depth

REPLICATION: n=2 plants

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5 as modified by FRI; archived on 9-tract tape at UW ACC (Cyber); all NODC codes used

STATISTICAL ANALYSIS: standardized to density and standing crop 100-cm2 surface area of blade; log transformed for statistical comparisons; ANOVA used if uniform variance dist., otherwise Kruskal-Wallis non-parametri

GRAPHS AND FIGURES: line plots, histograms, etc. using Statgraphics

SOURCES

LOCATION: Padilla Bay National Estuarine Research Reserve; established littoral flat gradient research transect; flat just off "Gun Club marsh"

REFERENCES:

Simenstad, C. A., J. R. Cordell, R. C. Wissmar, K. L. Fresh, S. L. Schroder, M. Carr, G. Sanborn, and M. E. Burg 1988. Assemblage structure, microhabitat distribution, and food web linkages of epibenthic crustaceans in Padilla Bay National Estuarine Research Reserve, Washington FRI-UW-8813, Fish. Res. Inst., Univ. Wash., Seattle, WA. 60 pp. (also NOAA Tech. Rep. Series OCRM/MEMD)

RESPONDENT: Simenstad; Fisheries Research Institute

Leptocottus armatus

GROUP: sessile fish

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silt-sand w/ some gravel beneath surface

TEMPERATURE: 8.0 degrees C (March) to 24 degrees C (July)

SALINITY: greater than 25 ppt

FOOD:

OTHER: dense Zostera marina

OCCURENCE

ABUNDANCE LEVELS: juveniles and adults combined: mean=12.2 +/- 1 s.d. =20.7 m-2; range: 0.1-75.3 m-2

BIOMASS LEVELS: (standing crop data not summarized)

SEASONALITY: maxima in mid-/late July

SAMPLING METHODOLOGY

TECHNIQUES: 37-m long beach seine (UW School of Fisheries research seine) w/ 7-mm mesh bag, set 30-m from and parallel to shore; retrieved to sample 520 m2

DESIGN: adjacent, consecutive sets made in identical shallow subtidal habitats; small catches retained, large catches subsampled; sorted to spp. and life history stage, enumerated and weighed (damp wet wt.)

REPLICATION: n=3

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 3; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Drayton Harbor, Washington; mid-intertidal (0.6 m MLLW) eelgrass meadow east of Blaine Marina

REFERENCES:

Thom, R. M., C. A. Simenstad, J. R. Cordell, and E. O. Salo 1989. Fish and their epibenthic prey in a marine and adjacent mudflats and eelgrass meadow in a small estuarine bay FRI-UW-8901, Final Rep. prep. for The Port of Bellingham, Fish. Res. Inst., Univ. Wash., Seattle, WA. 27 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Leptocottus armatus

GROUP: sessile fish

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silt, fine sand; some depressions and shallow drainage channels

TEMPERATURE: 8.0 degrees C (March) to 24 degrees C (July)

SALINITY: greater than 25 ppt

FOOD:

OTHER: Enteromorpha abundant during much of spring

OCCURENCE

ABUNDANCE LEVELS: mean = 12.1 +/- 1 s.d. = 10.5 m-2; range: 2.2-38.7 m-2

BIOMASS LEVELS: (not summarized; data available)

SEASONALITY: maxima in mid-May

SAMPLING METHODOLOGY

TECHNIQUES: 37-m long beach seine (UW School of Fisheries research seine) w/ 7-mm mesh bag; set 30 m from and parallel to shore; retrieved to sample 520 m2

DESIGN: adjacent, consecutive sets made in identical shallow subtidal habitats; small catches retained, large catches subsampled; sorted to spp. and life history stage; enumerated and weighed (damp wet wt.)

REPLICATION: n=3

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 3; archived on 9-tract mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Drayton Harbor, Washington; exposed, high intertidal mudflat (+1.8 m MLLW) in Harbor immediately east of marina breakwater

REFERENCES:

Thom, R. M., C. A. Simenstad, J. R. Cordell, and E. O. Salo 1989. Fish and their epibenthic prey in a marina and adjacent mudflats and eelgrass meadow in a small estuarine bay FRI-UW-8901, Final Rep. prep. for The Port of Bellingham, Fish. Res. Inst., Univ. Wash., Seattle, WA. 27 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Leptocottus armatus

GROUP: sessile fish

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silt, fine sand; some depressions and shallow drainage channels

TEMPERATURE: 8.0 degrees C (March) to 24 degrees C (July)

SALINITY: greater than 25 ppt

FOOD:

OTHER: Enteromorpha and Vaucheria covered flats much of spring

OCCURENCE

ABUNDANCE LEVELS: mean=19.9 +/- 1 s.d.=20.2 m-2; range: 1.0-78.1

BIOMASS LEVELS: (not summarized; data available)

SEASONALITY: maxima in early March (recruits)

SAMPLING METHODOLOGY

TECHNIQUES: 37-m long beach seine (UW School of Fisheries research seine) w/ 7-mm mesh bag; set 30 m from and parallel to shore; retrieved to sample 520 m2

DESIGN: adjacent, consecutive sets made in identical shallow subtidal habitats; small catches retained, large catches subsampled; sorted to spp. and life history stage; enumerated and weighed (damp wet wt.)

REPLICATION: n=3

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 3; archived on 9-tract mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Drayton Harbor, Washington; protected mudflat inside Blaine Marina; upper margin of flats @ 1.8 m MLLW

REFERENCES:

Thom, R. M., C. A. Simenstad, J. R. Cordell, and E. O. Salo 1989. Fish and their epibenthic prey in a marina and adjacent mudflats and eelgrass meadow in a small estuarine bay FRI-UW-8901, Final Rep. prep. for The Port of Bellingham, Fish. Res. Inst., Univ. Wash., Seattle, WA. 27 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Leptocottus armatus

GROUP: sessile fish

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: sand to mud

TEMPERATURE:

SALINITY:

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: mean = 19.1; day & night catches comparable

BIOMASS LEVELS:

SEASONALITY: most abundant in spring & summer

SAMPLING METHODOLOGY

TECHNIQUES: 37m beach seine; floating

DESIGN: weekly or twice weekly samples collected February-July 1978; both day & night hauls made; 3 eelgrass sites sampled; 30m hauls

REPLICATION: 2 samples per site

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC/MESA

STATISTICAL ANALYSIS: none

GRAPHS AND FIGURES: none

SOURCES

LOCATION: Nisqually Reach

REFERENCES:

Fresh, K.L., D. Rabin, C.A. Simenstad, E.O. Salo, K. Garrison, and L. Matheson. 1979. Fish ecology studies in Nisqually Reach area of southern Puget Sound, Washington. Final report to Weyerhauser Company. Fisheries Research Institute, FRI-UW-7904. University of Washington, 229 pp.

RESPONDENT: Fresh; Washington Department of Fisheries

Littorina spp.

GROUP: surface epifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: on cobble; +0.9-1.8 m MLLW

TEMPERATURE: unknown

SALINITY: apx. 28-30 ppt

FOOD: unknown

OTHER: epifauna abundance at 0.9 m > > 0 m or 1.8 m MLLW

OCCURENCE

ABUNDANCE LEVELS: 0.9 m MLLW: 30-1075 m-2

BIOMASS LEVELS: 0 m MLLW: 40-740 gm m-2; +0.9 m MLLW: 10-625 gm m-2

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: 100 cm2 quadrats; all organisms identified

DESIGN: stratified random samples by habitat type and tide height (0, +0.9, +1.8 m above MLLW)

REPLICATION: 8 reps per station

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: hard copy; species abundance and distribution by tide height, season, habitat

STATISTICAL ANALYSIS: species area curves; cluster analysis; regression; "T" tests; discriminant analysis

GRAPHS AND FIGURES:

SOURCES

LOCATION: 5 central Puget Sound beaches: Alki; Carkeek; Lincoln Park; Richmond; West Point

REFERENCES:

Armstrong, J. 1977. The impact of subtidal sewage outfalls on the intertidal macrofauna of several central Puget Sound beaches. PhD Dissertation, University of Washington. 183 pp. and Appendices.

RESPONDENT: Armstrong,; Environmental Protection Agency

Macoma spp.

GROUP: sedentary infauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: fine clay mud (channel bottom); clean sand (sandflat); silty sand (marsh)

TEMPERATURE: apx. 0-25 C

SALINITY: 0-32 ppt

FOOD: macro algae, diatoms, etc.

OTHER: effects of eelgrass on benthos; effect of tidal flat pools

OCCURENCE

ABUNDANCE LEVELS: range = 200-40,000 invertebrates m-2

BIOMASS LEVELS:

SEASONALITY: highest numbers in summer/fall; freshwater input accects species composition

SAMPLING METHODOLOGY

TECHNIQUES: 0.05 m2 sampler used to 15 cm depth and then dug out; seived through a .595 nm screen

DESIGN: sampled monthly at 11 station located from a marsh area to subtidal channel bottom; during summer sampled eelgrass and non-eelgrass sediments

REPLICATION: n=3 at each station

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: paper data sheets with station and number of invertebrates

STATISTICAL ANALYSIS: number m-2; log transformed for statistical analysis

GRAPHS AND FIGURES: plots by tidal height; location

SOURCES

LOCATION: Baker Bay, Columbia River Estuary, near Ilwaco, Washington

REFERENCES:

Furota, and R.L. Emmett. in prep. Benthic invertebrates along a transect in Baker Bay Unpubl. rep., NOAA-NMFS, Northwest Alaska Fish. Center, Seattle, WA.

RESPONDENT: Emmett; National Marine Fisheries Service

Macoma spp.

GROUP: sedentary infauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: fine sand; silt clay with high organics (wood chips)

TEMPERATURE: 0-25 C

SALINITY: 0-32 ppt

FOOD: algal, micro flora on detritus particles

OTHER: currents, wave action on flats

OCCURENCE

ABUNDANCE LEVELS: 0-60,000 m-2 depending on species

BIOMASS LEVELS: available at NMFS

SEASONALITY: peaks in spring of fall-winter depending on species and station location

SAMPLING METHODOLOGY

TECHNIQUES: 0.05 Powan dredge; samples were collected during high tide from vessel, washed through .595 (#30) mesh siz, preserved in formalin (10%) and then identified in lab

DESIGN: quarterly samples of many (non-random) selected sites throughout the estuary

REPLICATION: n=2 per station for invertebrates; n=1 for sediment structure

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: on paper, never archived properly

STATISTICAL ANALYSIS: standardized to m-2

GRAPHS AND FIGURES: number m-2 at each station/season; sediment grain size

SOURCES

LOCATION: Columbia River estuary

REFERENCES:

Durkin, J.T., and R.L. Emmett. 1978. Benthic invertebrates of Baker Bay, Young's Bay, and adjacent areas in the Columbia River estuary. Unpubl. rep., NOAA-NMFS, Northwest Alaska Fish. Cent., Seattle, WA.

RESPONDENT: Emmett; National Marine Fisheries Service

Macoma spp.

GROUP: sedentary infauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: medium to fine sand to sandy silt

TEMPERATURE: 17 C

SALINITY: 26 ppt

FOOD: diatoms; 100-8,000 l-1

OTHER:

OCCURENCE

ABUNDANCE LEVELS: range = 3000-6,500 (in control and test plots)

BIOMASS LEVELS: range = 120-370 kg m-2

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: 0.25 or 0.10 m2 quadrat; sampling to 50 cm; sieved to 3-5 mm, sorted by species, counted, measured (to nearest mm), and weighed (net weight, whole)

DESIGN: fixed sampled points within a 5 to 100 acres area with randomly selected stations in a 100 m2 area around each point; sampled from -1 to +2 (MLLW); 15-30 samples/sample period

REPLICATION: usually none; sampling pepeated quarterly to annually; ocasional station with 3-5 replicates

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: 'Lotus' spreadsheets

STATISTICAL ANALYSIS: basic statistical summaries, length/weight curves fitted

GRAPHS AND FIGURES: length frequncies; length vs. weight and estimated age, total abundance (density); vs. sample period and age (size) group

SOURCES

LOCATION: Skagit Bay near Brown's Slough

REFERENCES:

Cheney, D. and Harmon. Pre- and post-harvest environmental studies of a hydraulic clam rake operation in Skagit Bay. University of Washington Sea Grant, Sea Harvest.

RESPONDENT: Cheney; BioAquatics International

Macoma spp.

GROUP: sedentary infauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: fine to medium sand to clay hardpan; shell debris abundant on unconsolidated substrate; nearly all clams (96%) were in sand to cobble sediments at 0 to -8 ft

TEMPERATURE:

SALINITY:

FOOD:

OTHER: Macoma nasata, M. secta

OCCURENCE

ABUNDANCE LEVELS: 0 to -5 ft: 24.5 m-2; -5 to -8 ft: 2.0 m-2; -8 to -15 ft: 0.0 m-2; -15 to -25 ft: 0.7 m-2; below -25 ft: 0.0; mean=9.3 m-2

BIOMASS LEVELS: mean=76.5 g m-2

SEASONALITY: none; not measured

SAMPLING METHODOLOGY

TECHNIQUES: venturi dredge; 6 in (i.d.) hydraulic suction dredge; clams were collected in a 0.75 in mesh vexar bag; substrate vacuumed with in a 0.25 m2 quadrat to a depth of 50 cm

DESIGN: samples from stations fixed by a predetermined transect perpendicular to shore at depths of -0.4 to -48.0 ft (MLLW); all sampled on August 15, 1986

REPLICATION: none, 22 samples overall

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: simple spreadsheets

STATISTICAL ANALYSIS: none; basic data summary only

GRAPHS AND FIGURES: none

SOURCES

LOCATION: Elliott Bay immediately west of piers 90-91

REFERENCES:

BioAquatics International (D. Cheney). 1986. Distribution and abundance of subtidal hardshell clams at the Elliott Bay Marina project site. Elliott Bay Marina Group. Project Rpt. 11 pp.

RESPONDENT: Cheney; BioAquatics International

Mya arenaria

GROUP: sedentary infauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: mixed cobble sediments at approximately 0 m MLLW

TEMPERATURE: unknown

SALINITY: apx. 28-30 ppt

FOOD: unknown

OTHER:

OCCURENCE

ABUNDANCE LEVELS: 2-100 m-2

BIOMASS LEVELS:

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: 0.25 m2 quadrat; 30 cm deep; seived through 6 mm mesh screen for bivalves and large infauna; 31.2 cm2 surface area core, 15 cm deep seived thri a 1.0 mm screen for small infauna

DESIGN: stratified random samples by habitat type and tide height (0, +0.9, +1.8 m above MLLW)

REPLICATION: 2 reps for 0.25 m2 samples; 4 reps for cores at each station

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: hard copy; species abundance and distribution by tide height, season, habitat

STATISTICAL ANALYSIS: species area curves; cluster analysis; regression; "T" tests; discriminant analysis

GRAPHS AND FIGURES:

SOURCES

LOCATION: 5 central Puget Sound beaches: Alki; Carkeek; Lincoln Park; Richmond; West Point

REFERENCES:

Armstrong, J. 1977. The impact of subtidal sewage outfalls on the intertidal macrofauna of several central Puget Sound beaches. PhD Dissertation, University of Washington. 183 pp. and Appendices.

RESPONDENT: Armstrong,; Environmental Protection Agency

Mya arenaria

GROUP: sedentary infauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: medium to fine sand to sandy silt

TEMPERATURE: 17 C

SALINITY: 26 ppt

FOOD: diatoms; 100-8,000 l-1

OTHER:

OCCURENCE

ABUNDANCE LEVELS: mean = 104 m-2

BIOMASS LEVELS: mean = 3 kg m-2

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: 0.25 or 0.10 m2 quadrat; sampling to 50 cm; sieved to 3-5 mm, sorted by species, counted, measured (to nearest mm), and weighed (net weight, whole)

DESIGN: fixed sampled points within a 5 to 100 acres area with randomly selected stations in a 100 m2 area around each point; sampled from -1 to +2 (MLLW); 15-30 samples/sample period

REPLICATION: usually none; sampling pepeated quarterly to annually; ocasional station with 3-5 replicates

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: 'Lotus' spreadsheets

STATISTICAL ANALYSIS: basic statistical summaries, length/weight curves fitted

GRAPHS AND FIGURES: length frequncies; length vs. weight and estimated age, total abundance (density); vs. sample period and age (size) group

SOURCES

LOCATION: Skagit Bay near Brown's Slough

REFERENCES:

Cheney, D. and Harmon. Pre- and post-harvest environmental studies of a hydraulic clam rake operation in Skagit Bay. University of Washington Sea Grant, Sea Harvest.

RESPONDENT: Cheney; BioAquatics International

Oncorhynchus gorbuscha (fry)

GROUP: motile fish

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: unknown

TEMPERATURE: available

SALINITY: available

FOOD: see Fresh et al. (1981)

OTHER:

OCCURENCE

ABUNDANCE LEVELS: all size classes captured; data available but not summarized; fish were 1+; probably were residents (had not left Puget Sound)

BIOMASS LEVELS:

SEASONALITY: not sufficient data

SAMPLING METHODOLOGY

TECHNIQUES: 500m x 55m (2 cm mesh) purse seine

DESIGN: 3 sampling trips made in 1979 in Puget Sound south of Possession Point; numerous sites sampled; both day & night hauls

REPLICATION: same sites

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: MESA/NODC; forms

STATISTICAL ANALYSIS: N/A

GRAPHS AND FIGURES: N/A

SOURCES

LOCATION: Puget Sound

REFERENCES:

Fresh, K.L., R.D. Cardwell, and R.R. Koons. 1981. Food habits of pacific salmon, baitfish, and their potential predators and competitors in the marine waters of Washington, August 1978 to September 1979. Washington Department of Fisheries Progress Report No. 145.

RESPONDENT: Fresh; Washington Department of Fisheries

Oncorhynchus kisutch

GROUP:

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: unknown

TEMPERATURE: available

SALINITY: available

FOOD: see Fresh et al. (1981)

OTHER:

OCCURENCE

ABUNDANCE LEVELS: all size classes captured; data available but not summarized; fish were 1+; probably were residents (had not left Puget Sound)

BIOMASS LEVELS:

SEASONALITY: not sufficient data

SAMPLING METHODOLOGY

TECHNIQUES: 500m x 55m (2 cm mesh) purse seine

DESIGN: 3 sampling trips made in 1979 in Puget Sound south of Possession Point; numerous sites sampled; both day & night hauls

REPLICATION: same sites

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: MESA/NODC; forms

STATISTICAL ANALYSIS: N/A

GRAPHS AND FIGURES: N/A

SOURCES

LOCATION: Puget Sound

REFERENCES:

Fresh, K.L., R.D. Cardwell, and R.R. Koons. 1981. Food habits of pacific salmon, baitfish, and their potential predators and competitors in the marine waters of Washington, August 1978 to September 1979. Washington Department of Fisheries Progress Report No. 145.

RESPONDENT: Fresh; Washington Department of Fisheries

Oncorhynchus spp. (fry)

GROUP: motile fish

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silt-sand w/ some gravel beneath surface

TEMPERATURE: 8.0 degrees C (March) to 24 degrees C (July)

SALINITY: greater than 25 ppt

FOOD:

OTHER: dense Zostera marina

OCCURENCE

ABUNDANCE LEVELS: juveniles: mean=3.7 +/- 1 s.d. =7.6 m-2; range: 0-22.6 m-2

BIOMASS LEVELS: (standing crop data not summarized)

SEASONALITY: maxima in mid-May

SAMPLING METHODOLOGY

TECHNIQUES: 37-m long beach seine (UW School of Fisheries research seine) w/ 7-mm mesh bag, set 30-m from and parallet to shore; retrieved to sample 520 m2

DESIGN: adjacent, consecutive sets made in identical shallow subtidal habitats; small catches retained, large catches subsampled; sorted to spp. and life history stage; enumerated and weighed (damp wet wt.)

REPLICATION: n=3

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 3; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Drayton Harbor, Washington; mid-intertidal (0.6 m MLLW) eelgrass meadow east of Blaine Marina

REFERENCES:

Thom, R. M., C. A. Simenstad, J. R. Cordell, and E. O. Salo 1989. Fish and their epibenthic prey in a marine and adjacent mudflats and eelgrass meadow in a small estuarine bay FRI-UW-8901, Final Rep. prep. for The Port of Bellingham, Fish. Res. Inst., Univ. Wash., Seattle, WA. 27 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Oncorhynchus spp. (fry)

GROUP: motile fish

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: fine mud to clean sand

TEMPERATURE: 0-25 C

SALINITY: 0-32 ppt

FOOD: Corophium spp, Eurytemora affinis, Daphnia spp., Neomysis mercedis, etc.

OTHER: length of residence, time of day, tidal stage, tidal height

OCCURENCE

ABUNDANCE LEVELS: highly variable depending on site; estimated 0-10,000; depends on schooling fish and hatchery releases

BIOMASS LEVELS:

SEASONALITY: highest numbers in spring-summer and fall; depending on species; winter low

SAMPLING METHODOLOGY

TECHNIQUES: beach seining; 4-50 m deep

DESIGN: various sites depending on study; sample every month

REPLICATION: none

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: Ascii, NMFS format; stored on NWAFC Burroughs computer

STATISTICAL ANALYSIS: CPUE

GRAPHS AND FIGURES: number vs. time; length frequency distribution; IRI figures

SOURCES

LOCATION: Columbia River Estuary

REFERENCES:

National Marine Fisheries Service. 1981. Columbia River Estuary Data Development Program report: Salmonid and non-salmonid fish. NOAA-NMFS, Northwest Alaska Fish. Center, Seattle, WA.

RESPONDENT: Emmett; National Marine Fisheries Service

Oncorhynchus spp. (fry)

GROUP: motile fish

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: various

TEMPERATURE: 0-25 C

SALINITY: 0-32 ppt

FOOD: Corophium spp., calanoid copepods, insects, mysids, Daphnia spp., etc.

OTHER: tidal stage, time of day, tidal height

OCCURENCE

ABUNDANCE LEVELS: 0-40,000/set; depends on schooling fish and hatchery releases

BIOMASS LEVELS:

SEASONALITY: highest numbers in summer/fall depending on species of concern and area in estuary

SAMPLING METHODOLOGY

TECHNIQUES: purse seine; collect, identify, measure, and weigh fish species; sample once/month depending on study; sometimes more intensive during salmonid migration

DESIGN: 10-200 m deep; 0.5 in. stretch mesh; knotless bunt; 2 vessels used; seining done all at flood, high slack tide

REPLICATION: none

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: ASCii NMFS format, species code; transformed to CPUE

STATISTICAL ANALYSIS: ANOVA on logged (x+1) data; chi-square

GRAPHS AND FIGURES: length-frequency distribution; numbers/month; # species/month

SOURCES

LOCATION: Columbia River estuary

REFERENCES:

McCabe, G.T., R.L. Emmett, and R.J. McConnell. 1987. Abundance and size-class structure of Dungeness crabs in or near frequently-dredged areas in the Columbia River estuary. Unpubl. rep., NOAA-NMFS to U.S. Army Corps of Engineers, Northwest Alaska Fish. Cent., Seattle, WA. 31 pp.

McCabe, G.T., R.L. Emmett, T.C. Colby, and R.J. McConnell. 1986. Distribution, abundance, and size-class structure of Dungeness crabs in the Columbia River estuary. Unpubl. rep., NOAA-NMFS to U.S. Army Corps of Engineers, Northwest Alaska Fish. Cent., Seattle, WA. 57 pp.

RESPONDENT: Emmett; National Marine Fisheries Service

Orchestoidea pugettensis

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: sand and mixed sand; at +0.9 m MLLW

TEMPERATURE: unknown

SALINITY: apx. 28-30 ppt

FOOD: unknown

OTHER: epifauna abundance at 0.9 m > > 0 m or 1.8 m MLLW

OCCURENCE

ABUNDANCE LEVELS: 2 100 m-2

BIOMASS LEVELS:

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: 100 cm2 quadrats; all organisms identified

DESIGN: stratified random samples by habitat type and tide height (0, +0.9, +1.8 m above MLLW)

REPLICATION: 8 reps per station

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: hard copy; species abundance and distribution by tide height, season, habitat

STATISTICAL ANALYSIS: species area curves; cluster analysis; regression; "T" tests; discriminant analysis

GRAPHS AND FIGURES:

SOURCES

LOCATION: 5 central Puget Sound beaches: Alki; Carkeek; Lincoln Park; Richmond; West Point

REFERENCES:

Armstrong, J. 1977. The impact of subtidal sewage outfalls on the intertidal macrofauna of several central Puget Sound beaches. PhD Dissertation, University of Washington. 183 pp. and Appendices.

RESPONDENT: Armstrong,; Environmental Protection Agency

Paraphoxus spp.

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: sand, some Enteromorpha

TEMPERATURE:

SALINITY: >25 ppt

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: mean = 33,209 +/- 2,092 (study area); mean = 33,822 +/- 19,071 (control); range 21,529 to 61,883 m-2; included in total epibenthos

BIOMASS LEVELS:

SEASONALITY: sampled once only, August 25, 1983

SAMPLING METHODOLOGY

TECHNIQUES: 0.164 m2 underwater suction (benthic/epibenthic) sampler modified from Gale & Thompson (1975); powered by submerged bilge pump run by battery from boat; samples retained in 295 um Nitex mesh

DESIGN: lower intertidal for control and for development area along 1 transect (= tidal elevation); water depths 0.5 to 2.0m

REPLICATION: n=3 for each station; subsamples obtained by pooling replicates and elutriation process undertaken & 10 subsamples obtained using method from H. Muncie (PBS, Nanaimo)

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: data tables; figures (histogram)

STATISTICAL ANALYSIS: standardized to m-2; mean +/- std. deviation

GRAPHS AND FIGURES: abundance (m-2) vs. substrate

SOURCES

LOCATION: Duncan Bay barge terminal site, apx. 6.5 km north of Campbell River on Vancouver Island

REFERENCES:

Gale, W.F. and J.D. Thompson. 1975. A suction sampler for quantatively sampling benthos on rocky substrate in rivers. Trans. Am. Fish. Soc. 104:398-405.

Waddell, B. and S. Markowski. 1983. Campbell River foreshore biophysical inventory. Water Use Unit, Habitat Management Division, Dept. of Fish and Oceans, Vancouver, B.C. 53 pp.

Williams, G.L. 1983. A survey of the marine benthic invertebrates and vegetation at the proposed Transp. Can. barge loading facility at Campbell River (Middle Pt.) B.C. unpublished report to Public Works Candada. 30 pp.

RESPONDENT: Williams; G.L. WIlliams and Associates, Ltd.

Paraphoxus spp.

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: sand and mixed sand; 0-+1.8 m MLLW

TEMPERATURE: unknown

SALINITY: apx. 28-30 ppt

FOOD: unknown

OTHER: epifauna abundance at 0.9 m > > 0 m or 1.8 m MLLW

OCCURENCE

ABUNDANCE LEVELS: rare, apx. 2 m-2

BIOMASS LEVELS:

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: 100 cm2 quadrats; all organisms identified

DESIGN: stratified random samples by habitat type and tide height (0, +0.9, +1.8 m above MLLW)

REPLICATION: 8 reps per station

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: hard copy; species abundance and distribution by tide height, season, habitat

STATISTICAL ANALYSIS: species area curves; cluster analysis; regression; "T" tests; discriminant analysis

GRAPHS AND FIGURES:

SOURCES

LOCATION: 5 central Puget Sound beaches: Alki; Carkeek; Lincoln Park; Richmond; West Point

REFERENCES:

Armstrong, J. 1977. The impact of subtidal sewage outfalls on the intertidal macrofauna of several central Puget Sound beaches. PhD Dissertation, University of Washington. 183 pp. and Appendices.

RESPONDENT: Armstrong,; Environmental Protection Agency

Platichthys stellatus

GROUP: sessile fish

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silt-sand w/ some gravel beneath surface

TEMPERATURE: 8.0 degrees C (March) to 24 degrees C (July)

SALINITY: greater than 25 ppt

FOOD:

OTHER: dense Zostera marina

OCCURENCE

ABUNDANCE LEVELS: juveniles and adults combined: mean=4.6 +/- 1 s.d. =9.2 m-2; range: 0-33.6 m-2

BIOMASS LEVELS: (standing crop data not summarized)

SEASONALITY: maxima in mid-/late July

SAMPLING METHODOLOGY

TECHNIQUES: 37-m long beach seine (UW School of Fisheries research seine) w/ 7-mm mesh bag, set 30-m from and parallel to shore; retrieved to sample 520 m2

DESIGN: adjacent, consecutive sets made in identical shallow subtidal habitats; small catches retained, large catches subsampled; sorted to spp. and life history stage; enumerated and weighed (damp wet wt.)

REPLICATION: n=3

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 3; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Drayton Harbor, Washington; mid-intertidal (0.6 m MLLW) eelgrass meadow east of Blaine Marina

REFERENCES:

Thom, R. M., C. A. Simenstad, J. R. Cordell, and E. O. Salo 1989. Fish and their epibenthic prey in a marine and adjacent mudflats and eelgrass meadow in a small estuarine bay FRI-UW-8901, Final Rep. prep. for The Port of Bellingham, Fish. Res. Inst., Univ. Wash., Seattle, WA. 27 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Platichthys stellatus

GROUP: sessile fish

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silt, fine sand; some depressions and shallow drainage channels

TEMPERATURE: 8.0 degrees C (March) to 24 degrees C (July)

SALINITY: greater than 25 ppt

FOOD:

OTHER: Enteromorpha abundant during much of spring

OCCURENCE

ABUNDANCE LEVELS: mean=2.1 +/- 1 s.d.=4.9 m-2; range: 0.1-17.4 m-2

BIOMASS LEVELS: (not summarized; data available)

SEASONALITY: maxima in late August

SAMPLING METHODOLOGY

TECHNIQUES: 37-m long beach seine (UW School of Fisheries research seine) w/ 7-mm mesh bag; set 30 m from and parallel to shore; retrieved to sample 520 m2

DESIGN: adjacent, consecutive sets made in identical shallow subtidal habitats; small catches retained, large catches subsampled; sorted to spp. and life history stage; enumerated and weighed (damp wet wt.)

REPLICATION: n=3

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 3; archived on 9-tract mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Drayton Harbor, Washington; exposed, high intertidal mudflat (+1.8 m MLLW) in Harbor immediately east of marina breakwater

REFERENCES:

Thom, R. M., C. A. Simenstad, J. R. Cordell, and E. O. Salo 1989. Fish and their epibenthic prey in a marina and adjacent mudflats and eelgrass meadow in a small estuarine bay FRI-UW-8901, Final Rep. prep. for The Port of Bellingham, Fish. Res. Inst., Univ. Wash., Seattle, WA. 27 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Platichthys stellatus

GROUP: sessile fish

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silt, fine sand; some depressions and shallow drainage channels

TEMPERATURE: 8.0 degrees C (March) to 24 degrees C (July)

SALINITY: greater than 25 ppt

FOOD:

OTHER: Enteromorpha and Vaucheria covered flats much of spring

OCCURENCE

ABUNDANCE LEVELS: mean=0.3 +/- 1 s.d.=0.6 m-2; range: 0-2.1 m-2

BIOMASS LEVELS: (not summarized; data available)

SEASONALITY: maxima in August

SAMPLING METHODOLOGY

TECHNIQUES: 37-m long beach seine (UW School of Fisheries research seine) w/ 7-mm mesh bag; set 30 m from and parallel to shore; retrieved to sample 520 m2

DESIGN: adjacent, consecutive sets made in identical shallow subtidal habitats; small catches retained, large catches subsampled; sorted to spp. and life history stage; enumerated and weighed (damp wet wt.)

REPLICATION: n=3

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 3; archived on 9-tract mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Drayton Harbor, Washington; protected mudflat inside Blaine Marina; upper margin of flats @ 1.8 m MLLW

REFERENCES:

Thom, R. M., C. A. Simenstad, J. R. Cordell, and E. O. Salo 1989. Fish and their epibenthic prey in a marina and adjacent mudflats and eelgrass meadow in a small estuarine bay FRI-UW-8901, Final Rep. prep. for The Port of Bellingham, Fish. Res. Inst., Univ. Wash., Seattle, WA. 27 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Platichthys stellatus

GROUP: sessile fish

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: sand to mud

TEMPERATURE:

SALINITY:

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: mean = 1.50; day & night catches comparable

BIOMASS LEVELS:

SEASONALITY: sporadically abundant

SAMPLING METHODOLOGY

TECHNIQUES: 37m beach seine; floating

DESIGN: weekly or twice weekly samples collected February-July 1978; both day & night hauls made; 3 eelgrass sites sampled; 30m hauls

REPLICATION: 2 samples per site

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC/MESA

STATISTICAL ANALYSIS: none

GRAPHS AND FIGURES: none

SOURCES

LOCATION: Nisqually Reach

REFERENCES:

Fresh, K.L., D. Rabin, C.A. Simenstad, E.O. Salo, K. Garrison, and L. Matheson. 1979. Fish ecology studies in Nisqually Reach area of southern Puget Sound, Washington. Final report to Weyerhauser Company. Fisheries Research Institute, FRI-UW-7904. University of Washington, 229 pp.

RESPONDENT: Fresh; Washington Department of Fisheries

Plecoptera (unid.)

GROUP:

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: mud and detritus

TEMPERATURE: 11-22 C

SALINITY: 0-7 ppt

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: 222 m-2 (June 1987)

BIOMASS LEVELS: 22 mg m-2

SEASONALITY: peak in June

SAMPLING METHODOLOGY

TECHNIQUES: FRI mesopump (epibenthic suction sampler); 0.016 m2 sampling area; sieved on 150 um mesh screen

DESIGN: 20 sites along transect; sampled monthly March-June (1987) & April (1988)

REPLICATION: n=20

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT:

STATISTICAL ANALYSIS:

GRAPHS AND FIGURES:

SOURCES

LOCATION: Lincoln Ave. wetland, Puyallup River, Tacoma WA

REFERENCES:

Shreffler, D.K. 1989. Temporary residence and foraging by juvenile salmon in a restored estuarine wetland. M.S. thesis. Univ. of Washington. 100 pp.

RESPONDENT: Shreffler; Fisheries Research Institute

Pleuronichthys vetulus

GROUP: sessile fish

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: fine mud to clean sand

TEMPERATURE: 0-25 C

SALINITY: 0-32 ppt

FOOD: Corophium spp, Eurytemora affinis, Daphnia spp., Neomysis mercedis, etc.

OTHER: length of residence, time of day, tidal stage, tidal height

OCCURENCE

ABUNDANCE LEVELS: highly variable depending on site; estimated 0-10,000

BIOMASS LEVELS:

SEASONALITY: highest numbers in spring-summer and fall; depending on species; winter low

SAMPLING METHODOLOGY

TECHNIQUES: beach seining; 4-50 m deep

DESIGN: various sites depending on study; sample every month

REPLICATION: none

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: Ascii, NMFS format; stored on NWAFC Burroughs computer

STATISTICAL ANALYSIS: CPUE

GRAPHS AND FIGURES: number vs. time; length frequency distribution; IRI figures

SOURCES

LOCATION: Columbia River Estuary

REFERENCES:

National Marine Fisheries Service. 1981. Columbia River Estuary Data Development Program report: Salmonid and non-salmonid fish. NOAA-NMFS, Northwest Alaska Fish. Center, Seattle, WA.

RESPONDENT: Emmett; National Marine Fisheries Service

Polychaeta (unid.)

GROUP:

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: sand, some Enteromorpha

TEMPERATURE:

SALINITY: >25 ppt

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: mean = 33,209 +/- 2,092 (study area); mean = 33,822 +/- 19,071 (control); range 21,529 to 61,883 m-2; included in total epibenthos

BIOMASS LEVELS:

SEASONALITY: sampled once only, August 25, 1983

SAMPLING METHODOLOGY

TECHNIQUES: 0.164 m2 underwater suction (benthic/epibenthic) sampler modified from Gale & Thompson (1975); powered by submerged bilge pump run by battery from boat; samples retained in 295 um Nitex mesh

DESIGN: lower intertidal for control and for development area along 1 transect (= tidal elevation); water depths 0.5 to 2.0m

REPLICATION: n=3 for each station; subsamples obtained by pooling replicates and elutriation process undertaken & 10 subsamples obtained using method from H. Muncie (PBS, Nanaimo)

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: data tables; figures (histogram)

STATISTICAL ANALYSIS: standardized to m-2; mean +/- std. deviation

GRAPHS AND FIGURES: abundance (m-2) vs. substrate

SOURCES

LOCATION: Duncan Bay barge terminal site, apx. 6.5 km north of Campbell River on Vancouver Island

REFERENCES:

Gale, W.F. and J.D. Thompson. 1975. A suction sampler for quantatively sampling benthos on rocky substrate in rivers. Trans. Am. Fish. Soc. 104:398-405.

Waddell, B. and S. Markowski. 1983. Campbell River foreshore biophysical inventory. Water Use Unit, Habitat Management Division, Dept. of Fish and Oceans, Vancouver, B.C. 53 pp.

Williams, G.L. 1983. A survey of the marine benthic invertebrates and vegetation at the proposed Transp. Can. barge loading facility at Campbell River (Middle Pt.) B.C. unpublished report to Public Works Candada. 30 pp.

RESPONDENT: Williams; G.L. WIlliams and Associates, Ltd.

Polychaeta (unid.)

GROUP:

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: cobble with Fucus

TEMPERATURE:

SALINITY: >25 ppt

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: mean = 9,705 +/- 6,484 (study area); mean = 8,678 +/- 4,174 (control); range 3,036 to 19,249 m-2; included in total epibenthos

BIOMASS LEVELS:

SEASONALITY: sampled once only, August 24, 1983

SAMPLING METHODOLOGY

TECHNIQUES: 0.164 m2 underwater suction (benthic/epibenthic) sampler modified from Gale & Thompson (1975); powered by submerged bilge pump run by battery from boat; samples retained in 295 um Nitex mesh

DESIGN: lower intertidal for control and for development area along 1 transect (=tidal elevation); water depths 0.5 to 2.0 m; 1 min. suction/sample

REPLICATION: n=3 for each station; subsamples obtained by pooling replicates and elutriation process undertaken & 10 subsamples obtained using method from H. Muncie (PBS, Nanaimo)

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: data tables; figures (histogram)

STATISTICAL ANALYSIS: standardized to m-2; mean +/- std. deviation

GRAPHS AND FIGURES: abundance (m-2) vs. substrate

SOURCES

LOCATION: Duncan Bay barge terminal site, apx. 6.5 km north of Campbell River on Vancouver Island

REFERENCES:

Gale, W.F. and J.D. Thompson. 1975. A suction sampler for quantitatively sampling benthos on rocky substrate in rivers. Trans. Am. Fish. Soc. 104:398-405.

Waddell, B. and S. Markowski. 1983. Campbell River foreshore biophysical inventory. Water Use Unit, Habitat Management Division, Dept. of Fish and Oceans, Vancouver, B.C. 53 pp.

Williams, G.L. 1983. A survey of the marine benthic invertebrates and vegetation at the proposed Transp. Can. barge loading facility at Campbell River (Middle Pt.), B.C. unpublished report to Public Works, Canada. 30 pp.

RESPONDENT: Williams; G.L. WIlliams and Associates, Ltd.

Polychaeta (unid.)

GROUP:

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: in mixed cobble sediments

TEMPERATURE: unknown

SALINITY: apx. 28-30 ppt

FOOD: unknown

OTHER: Corophium acherusicum

OCCURENCE

ABUNDANCE LEVELS:

BIOMASS LEVELS: +0.9 m MLLW: 8-24 gm m-2 (6-36 gm m-2 with 95% confidence); 0 m MLLW: 8-24 gm m-2 (0-40 gm m-2 with 95% confidence)

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: 0.25 m2 quadrat; 30 cm deep; seived through 6 mm mesh screen for bivalves and large infauna; 31.2 cm2 surface area core, 15 cm deep seived thri a 1.0 mm screen for small infauna

DESIGN: stratified random samples by habitat type and tide height (0, +0.9, +1.8 m above MLLW)

REPLICATION: 2 reps for 0.25 m2 samples; 4 reps for cores at each station

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: hard copy; species abundance and distribution by tide height, season, habitat

STATISTICAL ANALYSIS: species area curves; cluster analysis; regression; "T" tests; discriminant analysis

GRAPHS AND FIGURES:

SOURCES

LOCATION: 5 central Puget Sound beaches: Alki; Carkeek; Lincoln Park; Richmond; West Point

REFERENCES:

Armstrong, J. 1977. The impact of subtidal sewage outfalls on the intertidal macrofauna of several central Puget Sound beaches. PhD Dissertation, University of Washington. 183 pp. and Appendices.

RESPONDENT: Armstrong,; Environmental Protection Agency

Polychaeta (unid.)

GROUP:

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: mud-sand; sedentaria on cobbles, boulders, and rock walls

TEMPERATURE: 9-10 C

SALINITY: 30-32 ppt

FOOD: C,N

OTHER: amount of wood debris can affect food supply by increasing C/N; shift in feeding guilds of polychaetes documented

OCCURENCE

ABUNDANCE LEVELS: see reference; 1000-5000 m-2

BIOMASS LEVELS: see reference; 0.5-2.0 g m-2 dry weight

SEASONALITY: see feference; dissolved oxygen seemed to overide seasonal effects

SAMPLING METHODOLOGY

TECHNIQUES: 1) if within SCUBA, quadrat & airlift/suction sampler or corer in appropriate sediment; 2) if beyond SCUBA, Smith-McIntyre grab is prefered device; mesh size of seives = 0.5mm

DESIGN: 1) if general survey, transects along depth gradient; 2) if point or diffuse pollution source, grid or concentric rings

REPLICATION: minimum n=3 per station; n=5 is preferred or number to be read asymptote of species-sample plot

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: SAS files; hard copy and microfiche for archiving

STATISTICAL ANALYSIS: univariate at first cut; frequently multivariate depending on objectives

GRAPHS AND FIGURES: spatial plots, histograms on transects, cluster diagrams

SOURCES

LOCATION: Albernit Inlet, B.C. (west coast Vancouver Island)

REFERENCES:
Levings C.D., et al. 1983. (review of subtidal benthos in Strait of Georgia) Can. J. Fish. Aquat. Sci. 40:1120-1141.
Levings C.D., et al. 1985. p. 131-158 in Ketchum et al. (editors). Wastes in the Oceans, Volume 6. Wiley, Toronto.

RESPONDENT: Levings; Department of Fisheries and Oceans

Polychaeta (unid.)

GROUP:

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silty sand with occassional rocks and cobble; clayey silts with common wood dibris

TEMPERATURE:

SALINITY:

FOOD:

OTHER: water currents 50-290 ft hr-1 during ebb and flood tides

OCCURENCE

ABUNDANCE LEVELS: 2000-5300 m-2

BIOMASS LEVELS:

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: hydraulic lift; Ventari suction device; sampling 0.05 m2 x 100 mm core; sieved through a 0.5 mm mesh bag

DESIGN: five stations sampled withinn project area, one in a nearby dredged area; elevations were +0.4 to -10.7 ft; all sampled on 19 October 1983 (1320-1430)

REPLICATION: none

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: simple numerical summaries

STATISTICAL ANALYSIS: none

GRAPHS AND FIGURES: none

SOURCES

LOCATION: Gig Harbor near Donkey Creek, at site of now constructed 'Murphy's Landing', a 90 slip marina where 5 acres of intertidal/subtidal bottom area were developed

REFERENCES:

Cheney, D., C. Cheney, M. Jordan, and M. Kyte. 1983. Turner Marina, Gig Harbor, Washington. Supplemental Environmental Information.

RESPONDENT: Cheney; BioAquatics International

Pontogeneia rostrata

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silt-sand w/ some gravel beneath surface

TEMPERATURE: 8.0 degrees C (March) to 24 degrees C (July)

SALINITY: greater than 25 ppt

FOOD:

OTHER: dense Zostera marina

OCCURENCE

ABUNDANCE LEVELS: juveniles and adults combined: mean=9.3 +/- 1 s.d. =21.3 m-2; range: 0-55.6 m-2

BIOMASS LEVELS: juveniles and adults combined: mean=17 +/- 1 s.d.=60 mg m-2; range: 11-272 mg m-2

SEASONALITY: maxima in mid-March

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: permanent sampling points established randomly along transect line through eelgrass meadow at same tidal elevation

REPLICATION: n=5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Drayton Harbor, Washington; mid-intertidal (0.6 m MLLW) eelgrass meadow east of Blaine Marina

REFERENCES:

Thom, R. M., C. A. Simenstad, J. R. Cordell, and E. O. Salo 1989. Fish and their epibenthic prey in a marine and adjacent mudflats and eelgrass meadow in a small estuarine bay FRI-UW-8901, Final Rep. prep. for The Port of Bellingham, Fish. Res. Inst., Univ. Wash., Seattle, WA. 27 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Pontogeneia rostrata

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: coarse sand w/ gravel, some silt patches; thick Zostera marina growth; +0.5 ft. MLLW tidal elevation

TEMPERATURE: 23.0 degrees C

SALINITY: 28-29 ppt

FOOD:

OTHER: weather sunny, no wave disturbance

OCCURENCE

ABUNDANCE LEVELS: juveniles: mean=62.5 +/- 1 s.d.=62.5 m-2 (no other life history stages found)

BIOMASS LEVELS: juveniles: mean=29.0 +/- 1 s.d.=5.0 mg m-2 (no other life history stages found)

SEASONALITY: no data other than for early May

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/130-um mesh on intake ports; sieved through 130-um screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: randomly selected sites within same tidal elevation along "established" research transect in PBNERR;sampled with 0.5 to 1.5 m water depth

REPLICATION: n=5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5 as modified by FRI; archived on 9-tract tape at UW ACC (Cyber); all NODC codes used

STATISTICAL ANALYSIS: standardized to density and standing crop m-2; log transformed for statistical comparisons; ANOVA used if uniform variance dist., otherwise Kruskal-Wallis non-parametric

GRAPHS AND FIGURES: line plots, histograms, etc. using Statgraphics

SOURCES

LOCATION: Padilla Bay National Estuarine Research Reserve; established littoral flat gradient research transect; flat just off "Gun Club marsh"

REFERENCES:

Simenstad, C. A., J. R. Cordell, R. C. Wissmar, K. L. Fresh, S. L. Schroder, M. Carr, G. Sanborn, and M. E. Burg 1988. Assemblage structure, microhabitat distribution, and food web linkages of epibenthic crustaceans in Padilla Bay National Estuarine Research Reserve, Washington FRI-UW-8813, Fish. Res. Inst., Univ. Wash., Seattle, WA. 60 pp. (also NOAA Tech. Rep. Series OCRM/MEMD)

RESPONDENT: Simenstad; Fisheries Research Institute

Pontogeneia rostrata

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: coarse sand

TEMPERATURE:

SALINITY:

FOOD:

OTHER: dense Zostera marina meadow

OCCURENCE

ABUNDANCE LEVELS: juveniles: mean = 104.0 +/- 1. s.d. = 104.3 m-2; range: 120-240 m-2; combined adults: mean = 184.0 +/- 1 s.d. = 282.4 m-2; range: 280-640 m-2

BIOMASS LEVELS: juveniles: mean = 41 +/- 1 s.d. = 40 mg m-2; range: 56-84 mg m-2; combined adults: mean = 162 +/- 1 s.d. = 240 mg m-2; range: 148-508 mg m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.10-m2 epibenthic suction pump (FRI macropump); gas engine powered; w/ 130-um mesh on ports; organisms filtered through nested 500-um, 253-um, and 130-um mesh nets; pumped for 45 sec.

DESIGN: random samples from discrete substrate and tidal elevation; sampled on one occasion (early July)

REPLICATION: n = 5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archieved on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2

GRAPHS AND FIGURES: (data not processed beyond tabulation)

SOURCES

LOCATION: Alki Point (Seattle), central Puget Sound

REFERENCES:
Simenstad, C. A., and J. R. Cordell. 1984. n.a. Unpubl. data.

RESPONDENT: Simenstad; Fisheries Research Institute

Pontogeneia rostrata

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: coarse sand w/ gravel, some silt patches; thick Zostera marina growth; +0.5 ft. MLLW tidal elevation

TEMPERATURE: 23.0 degrees C

SALINITY: 28-29 ppt

FOOD:

OTHER: weather sunny, no wave disturbance

OCCURENCE

ABUNDANCE LEVELS: adults: mean=0.2 +/- 1 s.d.=0.7 100-cm2; juveniles: mean= 5.0 +/- 1 s.d.=7.8 100-cm2, for high epiphyte plant

BIOMASS LEVELS: adults: mean=0.01 +/- 1 s.d.=0.01 mg 100-cm2; juveniles: mean=3.9 +/- 1 s.d.=7.7 mg 100-cm2, for high epiphyte plant

SEASONALITY: no data other than for early May

SAMPLING METHODOLOGY

TECHNIQUES: Zostera marina plants collected intact, or as 10-cm segments, without disturbance of epiphytes (e.g., in situ); in laboratory, animals washed out of epiphytes and sieved to 253 um

DESIGN: randomly selected plants within same tidal elevation along "established" research transect in PBNERR;sampled with 0.5 to 1.5 m water depth

REPLICATION: n=2 plants

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5 as modified by FRI; archived on 9-tract tape at UW ACC (Cyber); all NODC codes used

STATISTICAL ANALYSIS: standardized to density and standing crop 100-cm2 surface area of blade; log transformed for statistical comparisons; ANOVA used if uniform variance dist., otherwise Kruskal-Wallis non-parametri

GRAPHS AND FIGURES: line plots, histograms, etc. using Statgraphics

SOURCES

LOCATION: Padilla Bay National Estuarine Research Reserve; established littoral flat gradient research transect; flat just off "Gun Club marsh"

REFERENCES:

Simenstad, C. A., J. R. Cordell, R. C. Wissmar, K. L. Fresh, S. L. Schroder, M. Carr, G. Sanborn, and M. E. Burg 1988. Assemblage structure, microhabitat distribution, and food web linkages of epibenthic crustaceans in Padilla Bay National Estuarine Research Reserve, Washington FRI-UW-8813, Fish. Res. Inst., Univ. Wash., Seattle, WA. 60 pp. (also NOAA Tech. Rep. Series OCRM/MEMD)

RESPONDENT: Simenstad; Fisheries Research Institute

Pugettia gracilis

GROUP: evasive macroepifauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: on cobble, under cobble, in mixed sediments, at 0 m MLLW

TEMPERATURE: unknown

SALINITY: apx. 28-30 ppt

FOOD: unknown

OTHER:

OCCURENCE

ABUNDANCE LEVELS: 2-100 m-2

BIOMASS LEVELS:

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: 100 cm2 quadrats; all organisms identified

DESIGN: stratified random samples by habitat type and tide height (0, +0.9, +1.8 m above MLLW)

REPLICATION: 8 reps per station

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: hard copy; species abundance and distribution by tide height, season, habitat

STATISTICAL ANALYSIS: species area curves; cluster analysis; regression; "T" tests; discriminant analysis

GRAPHS AND FIGURES:

SOURCES

LOCATION: 5 central Puget Sound beaches: Alki; Carkeek; Lincoln Park; Richmond; West Point

REFERENCES:

Armstrong, J. 1977. The impact of subtidal sewage outfalls on the intertidal macrofauna of several central Puget Sound beaches. PhD Dissertation, University of Washington. 183 pp. and Appendices.

RESPONDENT: Armstrong,; Environmental Protection Agency

Scirpus americanus

GROUP: rooted vascular plants

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: sand to clay

TEMPERATURE: soil temp = 12-16 C in May

SALINITY: 0-12 ppt

FOOD:

OTHER: redox. (+)155-(-)435 mV

OCCURENCE

ABUNDANCE LEVELS:

BIOMASS LEVELS: 600 g dry weight m-2

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: vegetation transects; continuous presence/absence data; added to 16 environmental stations; sampled weekly at environmental plots for phenology, growth, salinity, temperature

DESIGN: sampled production at end of season

REPLICATION: n=5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: only reduced data available

STATISTICAL ANALYSIS: multivariate techniques: regression, binary discriminate analysis, PCA, decorana

GRAPHS AND FIGURES: numerous, in dissertation and journals

SOURCES

LOCATION: Skagit Bay, intertidal marsh between Freshwater Slough and North Fork

REFERENCES:

Ewing, K. 1982. Plant response to environmental variation in the Skagit marsh. PhD dissertation, University of Washington.
Ewing, K. 1983. Environmental controls in Pacific Northwest intertidal plant communities. Can. J. Bot. 61:1105-1116.
Ewing, K. 1986. Plant growth and productivity along complex gradients in a Pacific northwest brackish intertidal marsh. Estuaries 9:49-62.
Ewing, K. 1989. (manuscript)

RESPONDENT: Ewing; Range Science Department

Scirpus maritimus

GROUP: rooted vascular plants

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE:

TEMPERATURE:

SALINITY:

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS:

BIOMASS LEVELS: Deschampsia assemblage 500-1580 g dry wt m-2

SEASONALITY: all seasons - peak live material in August.

SAMPLING METHODOLOGY

TECHNIQUES: standing stock: 0.25 or 1.0 m2 quadrats

DESIGN: random samples within strata

REPLICATION: 2-30

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: "Statgraphics" data files; "Lotus" files

STATISTICAL ANALYSIS: summary statistics per unit area (usually m2)

GRAPHS AND FIGURES: line plots of spatial-temporal variation

SOURCES

LOCATION: Grays Harbor, Drayton Harbor

REFERENCES:

Thom, R.M. 1981. Primary productivity and carbon input to Grays Harbor estuary. Seattle District, U.S. Army Corps of Engineers, Seattle, Washington.

Thom, R.M., C.A. Simenstad, J.R. Cordell, and E.O. Salo. 1988. Fisheries mitigation plan for expansion of moorage at Blaine Marina, Blaine, Washington. FRI-UW-8817. Fisheries Research Institute, University of Washington, Seattle.

RESPONDENT: Thom; Fisheries Research Institute

Scirpus maritimus

GROUP: rooted vascular plants

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: sand to clay

TEMPERATURE: soil temp = 12-16 C in May

SALINITY: 0-12 ppt

FOOD:

OTHER: redox. (+)155-(-)435 mV

OCCURENCE

ABUNDANCE LEVELS:

BIOMASS LEVELS: 425 g dry weight m-2

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: vegetation transects; continuous presence/absence data; added to 16 environmental stations; sampled weekly at environmental plots for phenology, growth, salinity, temperature

DESIGN: sampled production at end of season

REPLICATION: n=5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: only reduced data available

STATISTICAL ANALYSIS: multivariate techniques: regression, binary discriminate analysis, PCA, decorana

GRAPHS AND FIGURES: numerous, in dissertation and journals

SOURCES

LOCATION: Skagit Bay, intertidal marsh between Freshwater Slough and North Fork

REFERENCES:

Ewing, K. 1982. Plant response to environmental variation in the Skagit marsh. PhD dissertation, University of Washington.
Ewing, K. 1983. Environmental controls in Pacific Northwest intertidal plant communities. Can. J. Bot. 61:1105-1116.
Ewing, K. 1986. Plant growth and productivity along complex gradients in a Pacific northwest brackish intertidal marsh. Estuaries 9:49-62.
Ewing, K. 1989. (manuscript)

RESPONDENT: Ewing; Range Science Department

Scirpus validus

GROUP: rooted vascular plants

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: sand silt

TEMPERATURE:

SALINITY: 0 ppt (freshwater)

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS:

BIOMASS LEVELS:

SEASONALITY: one sampling only; Sept. 1987

SAMPLING METHODOLOGY

TECHNIQUES: Braun-Blonquet sociability classes (1 to 5); abundance & coverage (+,1-6)

DESIGN: 10 plots; 1 m2 plots; to obtain natural marsh coverage data at marina development site prior to construction; compensation site monitoring: species i.d.; 1 m2 plots (n=15); aerial color photographs

REPLICATION: n=10-15

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: raw data; not processed; compensation monitoring on going

STATISTICAL ANALYSIS: data will be processed this fall

GRAPHS AND FIGURES: data will be processed this fall

SOURCES

LOCATION: Bridge Pont Harbour Market site North Arm (immediately below Oak St. Bridge in Richmond); compensation site on south side of Mitchell Island (immediately downstream of Arrow Transfer)

REFERENCES:

Williams, G.L. 1985. Outline of habitat compensation for proposed Bridge Point Harbour Market development, Richmond, B.C. unpubl. report for North Fraser Harbour Commission, Richmond. 35 pp.
Williams, G.L. 1989. Final report on marsh construction.

RESPONDENT: Williams; G.L. WIlliams and Associates, Ltd.

Scirpus validus

GROUP: rooted vascular plants

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: sand to clay

TEMPERATURE: soil temp = 12-16 C in May

SALINITY: 0-12 ppt

FOOD:

OTHER: redox. (+)155-(-)435 mV

OCCURENCE

ABUNDANCE LEVELS:

BIOMASS LEVELS:

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: vegetation transects; continuous presence/absence data; added to 16 environmental stations; sampled weekly at environmental plots for phenology, growth, salinity, temperature

DESIGN: sampled production at end of season

REPLICATION: n=5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: only reduced data available

STATISTICAL ANALYSIS: multivariate techniques: regression, binary discriminate analysis, PCA, decorana

GRAPHS AND FIGURES: numerous, in dissertation and journals

SOURCES

LOCATION: Skagit Bay, intertidal marsh between Freshwater Slough and North Fork

REFERENCES:

Ewing, K. 1982. Plant response to environmental variation in the Skagit marsh. PhD dissertation, University of Washington.
Ewing, K. 1983. Environmental controls in Pacific Northwest intertidal plant communities. Can. J. Bot. 61:1105-1116.
Ewing, K. 1986. Plant growth and productivity along complex gradients in a Pacific northwest brackish intertidal marsh. Estuaries 9:49-62.
Ewing, K. 1989. (manuscript)

RESPONDENT: Ewing; Range Science Department

Tanaidacea (unid.)

GROUP:

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silty sand with occassional rocks and cobble; clayey silts with common wood dibris

TEMPERATURE:

SALINITY:

FOOD:

OTHER: water currents 50-290 ft hr-1 during ebb and flood tides

OCCURENCE

ABUNDANCE LEVELS: 280-13,860 m-2

BIOMASS LEVELS:

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: hydraulic lift; Ventari suction device; sampling 0.05 m2 x 100 mm core; sieved through a 0.5 mm mesh bag

DESIGN: five stations sampled withinn project area, one in a nearby dredged area; elevations were +0.4 to -10.7 ft; all sampled on 19 October 1983 (1320-1430)

REPLICATION: none

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: simple numerical summaries

STATISTICAL ANALYSIS: none

GRAPHS AND FIGURES: none

SOURCES

LOCATION: Gig Harbor near Donkey Creek, at site of now constructed 'Murphy's Landing', a 90 slip marina where 5 acres of intertidal/subtidal bottom area were developed

REFERENCES:

Cheney, D., C. Cheney, M. Jordan, and M. Kyte. 1983. Turner Marina, Gig Harbor, Washington. Supplemental Environmental Information.

RESPONDENT: Cheney; BioAquatics International

Tellina spp.

GROUP: sedentary infauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: mixed cobble sediments at approximately 0 m MLLW

TEMPERATURE: unknown

SALINITY: apx. 28-30 ppt

FOOD: unknown

OTHER:

OCCURENCE

ABUNDANCE LEVELS: rare (<1 m-2)

BIOMASS LEVELS:

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: 0.25 m2 quadrat; 30 cm deep; seived through 6 mm mesh screen for bivalves and large infauna; 31.2 cm2 surface area core, 15 cm deep seived thri a 1.0 mm screen for small infauna

DESIGN: stratified random samples by habitat type and tide height (0, +0.9, +1.8 m above MLLW)

REPLICATION: 2 reps for 0.25 m2 samples; 4 reps for cores at each station

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: hard copy; species abundance and distribution by tide height, season, habitat

STATISTICAL ANALYSIS: species area curves; cluster analysis; regression; "T" tests; discriminant analysis

GRAPHS AND FIGURES:

SOURCES

LOCATION: 5 central Puget Sound beaches: Alki; Carkeek; Lincoln Park; Richmond; West Point

REFERENCES:

Armstrong, J. 1977. The impact of subtidal sewage outfalls on the intertidal macrofauna of several central Puget Sound beaches. PhD Dissertation, University of Washington. 183 pp. and Appendices.

RESPONDENT: Armstrong,; Environmental Protection Agency

Tisbe spp.

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: silt-sand w/ some gravel beneath surface

TEMPERATURE: 8.0 degrees C (March) to 24 degrees C (July)

SALINITY: greater than 25 ppt

FOOD:

OTHER: dense Zostera marina

OCCURENCE

ABUNDANCE LEVELS: all adults and juveniles:mean=32752.7 +/- 1 s.d.=56834.7 m-2; range: 125-207777.8 m-2

BIOMASS LEVELS: all adults and juveniles:mean=677 +/- 1 s.d.=1030 mg m-2; range: 6-3222 mg m-2

SEASONALITY: maxima in late April

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 130-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: permanent sampling points established randomly along transect line through eelgrass meadow at same tidal elevation

REPLICATION: n=5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2; log transformed for statistical comparisons; ANOVA used if homogeneous variance, otherwise Kruskel-Wallis non-parametric

GRAPHS AND FIGURES: chronological line figures, histograms, 2-d and 3-d plots, etc. using Statgraphics

SOURCES

LOCATION: Drayton Harbor, Washington; mid-intertidal (0.6 m MLLW) eelgrass meadow east of Blaine Marina

REFERENCES:

Thom, R. M., C. A. Simenstad, J. R. Cordell, and E. O. Salo 1989. Fish and their epibenthic prey in a marine and adjacent mudflats and eelgrass meadow in a small estuarine bay FRI-UW-8901, Final Rep. prep. for The Port of Bellingham, Fish. Res. Inst., Univ. Wash., Seattle, WA. 27 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Tisbe spp.

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: compacted silt at edge of emergent marsh; approximate tidal elevation +2 m MLLW

TEMPERATURE:

SALINITY:

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: adult: mean=125.0 +/- 1 s.d.= 62.5 m2; range: 62.5-187.5 m-2; copepodids: mean=25.0 +/- 1 s.d.=34.2; range: 0-62.5

BIOMASS LEVELS: adult: mean=6 +/- 1 s.d.=1 mg m-2; range: 0-6 mg m-2; copepodids: mean=3 +/- 1 s.d.=1 mg m-2; range: 0-6 mg m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 150-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.

DESIGN: Random samples collected from same tidal elevation and substrate characteristics; sampled on one occasion (early March)

REPLICATION: n=5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2

GRAPHS AND FIGURES: microcomputer-generated histrograms

SOURCES

LOCATION: Swinomish Channel; salt marsh adjacent to bingo parlor just west of railroad bridge crossing of channel

REFERENCES:

Cordell, J. R. 1986. Swinomish Boat Basin site epibenthic zooplankton, 1 March, 1986. Unpubl. rep. to URS, Inc., 43 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Tisbe spp.

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: in tidal channel draining lagoon behind dredge spoil islands; sandy at 0.0 m MLLW

TEMPERATURE:

SALINITY:

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: all adults combined: mean= 100.0 +/- 1 s.d.=223.7 m2; range: 62.5-312.5 m-2; copepodids: mean=87.5 +/- 1 s.d.=71.3; range: 62.5-187.5 m-2

BIOMASS LEVELS: all adults combined: mean=3 +/- 1 s.d.=1 mg m-2; range: 0-6 mg m-2; copepodids: mean=5 +/- 1 s.d.=less than 1 mg m-2; range: 0-6 mg m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 150-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.

DESIGN: Random samples collected from same tidal elevation and substrate characteristics; sampled on one occasion (early March)

REPLICATION: n=5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2

GRAPHS AND FIGURES: microcomputer-generated histrograms

SOURCES

LOCATION: Swinomish Channel; tidal channel in mudflat emptying lagoon just north of railroad bridge on west dredge spill islands

REFERENCES:
Cordell, J. R. 1986. Swinomish Boat Basin site epibenthic zooplankton, 1 March, 1986. Unpubl. rep. to URS, Inc., 43 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Tisbe spp.

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: on promontory just across channel from dredge spoil island, at outer edge of salt marsh; mud at +1.5 m MLLW

TEMPERATURE:

SALINITY:

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: adults: mean=37.5 +/- 1 s.d.=55.9 m2; range: 62.5-125.0 m-2; copepodids: mean=37.5 +/- 1 s.d.=83.9; range: 0-187.5 m-2

BIOMASS LEVELS: adults: mean=3 +/- 1 s.d.=1 mg m-2; range: 0-6 mg m-2; copepodids: mean=1 +/- 1 s.d.=less than 1 mg m-2; range: 0-6 mg m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/ 150-um mesh on intake ports; sieved through 130-um mesh screen; pumped for 15 sec.

DESIGN: Random samples collected from same tidal elevation and substrate characteristics; sampled on one occasion (early March)

REPLICATION: n=5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archived on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2

GRAPHS AND FIGURES: microcomputer-generated histrograms

SOURCES

LOCATION: Swinomish Channel; mud at margin of saltmarsh north of railroad bridge on west dredge spill islands

REFERENCES:
Cordell, J. R. 1986. Swinomish Boat Basin site epibenthic zooplankton, 1 March, 1986. Unpubl. rep. to URS, Inc., 43 pp.

RESPONDENT: Simenstad; Fisheries Research Institute

Tisbe spp.

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: coarse sand w/ gravel, some silt patches; thick Zostera marina growth; +0.5 ft. MLLW tidal elevation

TEMPERATURE: 23.0 degrees C

SALINITY: 28-29 ppt

FOOD:

OTHER: weather sunny, no wave disturbance

OCCURENCE

ABUNDANCE LEVELS: adult: mean=1625.0 +/- 1 s.d.=1701.3 m-2; egg-c females: mean=83.3 +/- 1 s.d.=95.5 m-2; copepodids: mean=1291.7 +/- 1 s.d.=1592.6 m-2

BIOMASS LEVELS: adult: mean=23.0 +/- 1 s.d.=30 mg m-2; egg-c females: mean=4.0 +/- 1 s.d.=0 mg m-2; copepodids: mean=8.0 +/- 1 s.d.=0 mg m-2

SEASONALITY: no data other than for early May

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/130-um mesh on intake ports; sieved through 130-um screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: randomly selected sites within same tidal elevation along "established" research transect in PBNERR;sampled with 0.5 to 1.5 m water depth

REPLICATION: n=5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5 as modified by FRI; archived on 9-tract tape at UW ACC (Cyber); all NODC codes used

STATISTICAL ANALYSIS: standardized to density and standing crop m-2; log transformed for statistical comparisons; ANOVA used if uniform variance dist., otherwise Kruskal-Wallis non-parametric

GRAPHS AND FIGURES: line plots, histograms, etc. using Statgraphics

SOURCES

LOCATION: Padilla Bay National Estuarine Research Reserve; established littoral flat gradient research transect; flat just off "Gun Club marsh"

REFERENCES:

Simenstad, C. A., J. R. Cordell, R. C. Wissmar, K. L. Fresh, S. L. Schroder, M. Carr, G. Sanborn, and M. E. Burg 1988. Assemblage structure, microhabitat distribution, and food web linkages of epibenthic crustaceans in Padilla Bay National Estuarine Research Reserve, Washington FRI-UW-8813, Fish. Res. Inst., Univ. Wash., Seattle, WA. 60 pp. (also NOAA Tech. Rep. Series OCRM/MEMD)

RESPONDENT: Simenstad; Fisheries Research Institute

Tisbe spp.

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: mud-fine sand; no surface organics

TEMPERATURE: 23.0 degrees C

SALINITY: 28-29 ppt

FOOD:

OTHER: weather sunny, no wave disturbance

OCCURENCE

ABUNDANCE LEVELS: mean=20.8, 1 s.d.=36.1 for juv. (no adults found)

BIOMASS LEVELS: mean=6.0 mg, 1 s.d.=0.0, damped wet weight for juv. (no adults found)

SEASONALITY: no data other than for early May

SAMPLING METHODOLOGY

TECHNIQUES: 0.018-m2 epibenthic pump (FRI mesopump); battery powered; w/130-um mesh on intake ports; sieved through 130-um screen; pumped for 15 sec.; sieved to 253 um in laboratory

DESIGN: randomly selected sites within same tidal elevation along "established" research transect in PBNERR;sampled with 0.5 to 1.5 m water depth

REPLICATION: n=5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5 as modified by FRI; archived on 9-tract tape at UW ACC (Cyber); all NODC codes used

STATISTICAL ANALYSIS: standardized to density and standing crop m-2; log transformed for statistical comparisons; ANOVA used if uniform variance dist., otherwise Kruskal-Wallis non-parametric

GRAPHS AND FIGURES: line plots, histograms, etc. using Statgraphics

SOURCES

LOCATION: Padilla Bay National Estuarine Research Reserve; established littoral flat gradient research transect; flat just off "Gun Club marsh"

REFERENCES:

Simenstad, C. A., J. R. Cordell, R. C. Wissmar, K. L. Fresh, S. L. Schroder, M. Carr, G. Sanborn, and M. E. Burg 1988. Assemblage structure, microhabitat distribution, and food web linkages of epibenthic crustaceans in Padilla Bay National Estuarine Research Reserve, Washington FRI-UW-8813, Fish. Res. Inst., Univ. Wash., Seattle, WA. 60 pp. (also NOAA Tech. Rep. Series OCRM/MEMD)

RESPONDENT: Simenstad; Fisheries Research Institute

Tisbe spp.

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: coarse sand

TEMPERATURE:

SALINITY:

FOOD:

OTHER: dense Zostera marina meadow

OCCURENCE

ABUNDANCE LEVELS: juveniles and adults combined: mean=2688.0 +/- 1. s.d.=1043.6 m-2; range: 1520-4160 m-2

BIOMASS LEVELS: juveniles and adults combined: mean=48 +/- 1 s.d.=30 mg m-2; range: 24-80 mg m-2

SEASONALITY: n.a.

SAMPLING METHODOLOGY

TECHNIQUES: 0.10-m2 epibenthic suction pump (FRI macropump); gas engine powered; w/ 130-um mesh on ports; organisms filtered through nested 500-um, 253-um, and 130-um mesh nets; pumped for 45 sec.

DESIGN: random samples from discrete substrate and tidal elevation; sampled on one occasion (early July)

REPLICATION: n=5

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5; archieved on 9-track mag. tape @ UW ACC (Cyber); uses all NODC codes

STATISTICAL ANALYSIS: density and standing crop (damped wet weight) standardized to m-2

GRAPHS AND FIGURES: (data not processed beyond tabulation)

SOURCES

LOCATION: Alki Point (Seattle), central Puget Sound

REFERENCES:
Simenstad, C. A., and J. R. Cordell. 1984. n.a. Unpubl. data.

RESPONDENT: Simenstad; Fisheries Research Institute

Tisbe spp.

GROUP: epibenthic plankters

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: coarse sand w/ gravel, some silt patches; thick Zostera marina growth; +0.5 ft. MLLW tidal elevation

TEMPERATURE: 23.0 degrees C

SALINITY: 28-29 ppt

FOOD:

OTHER: weather sunny, no wave disturbance

OCCURENCE

ABUNDANCE LEVELS: adults: mean=7.8 +/- 1 s.d.=6.9 100-cm2; egg-c females: mean= 3.6 +/- 1 s.d.=4.8 100-cm2; copepodids: mean=18.5 +/- 1 s.d.=27.5 100-cm2, for high epiphyte plant

BIOMASS LEVELS: adults: mean=0.3 +/- 1 s.d.=0.4 mg 100-cm2; egg-c females: mean=0.3 +/- 1 s.d.=0.4 mg 100-cm2; copepodids: mean=0.3 +/- 1 s.d.=0.4, for high epiphyte plant

SEASONALITY: no data other than for early May

SAMPLING METHODOLOGY

TECHNIQUES: Zostera marina plants collected intact, or as 10-cm segments, without disturbance of epiphytes (e.g., in situ); in laboratory, animals washed out of epiphytes and sieved to 253 um

DESIGN: randomly selected plants within same tidal elevation along "established" research transect in PBNERR;sampled with 0.5 to 1.5 m water depth

REPLICATION: n=2 plants

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: NODC format 100, file type 5 as modified by FRI; archived on 9-tract tape at UW ACC (Cyber); all NODC codes used

STATISTICAL ANALYSIS: standardized to density and standing crop 100-cm2 surface area of blade; log transformed for statistical comparisons; ANOVA used if uniform variance dist., otherwise Kruskal-Wallis non-parametri

GRAPHS AND FIGURES: line plots, histograms, etc. using Statgraphics

SOURCES

LOCATION: Padilla Bay National Estuarine Research Reserve; established littoral flat gradient research transect; flat just off "Gun Club marsh"

REFERENCES:

Simenstad, C. A., J. R. Cordell, R. C. Wissmar, K. L. Fresh, S. L. Schroder, M. Carr, G. Sanborn, and M. E. Burg 1988. Assemblage structure, microhabitat distribution, and food web linkages of epibenthic crustaceans in Padilla Bay National Estuarine Research Reserve, Washington FRI-UW-8813, Fish. Res. Inst., Univ. Wash., Seattle, WA. 60 pp. (also NOAA Tech. Rep. Series OCRM/MEMD)

RESPONDENT: Simenstad; Fisheries Research Institute

Typha spp.

GROUP: rooted vascular plants

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: clay/mud

TEMPERATURE:

SALINITY: 0.0 ppt

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: percent cover up to 100%

BIOMASS LEVELS:

SEASONALITY: summer max. cover

SAMPLING METHODOLOGY

TECHNIQUES: 1.0 m2 quadrat for percent cover

DESIGN: systematic samples along elevation gradient

REPLICATION:

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: "Statgraphics" data files; "Lotus" files

STATISTICAL ANALYSIS: summary statistics per unit area (usually m2)

GRAPHS AND FIGURES: line plots of spatial-temporal variation

SOURCES

LOCATION: Puyallup River estuary

REFERENCES:

Thom, R.M., C.A. Simenstad, and E.O. Salo. 1987. The Lincoln Street wetland system in the Puyallup River estuary, Washington. Phase I report: Construction and initial monitoring, July 1985-December 1986.

Thom, R.M., C.A. Simenstad, D.K. Shreffler, J.R. Cordell, and E.O. Salo. 1988. The Lincoln Street wetland system in the Puyallup River estuary, Washington. Phase II report: Year two monitoring, January-December 1987. Fisheries Research Institute, University of Washington, Seattle. FRI-UW-8812.

RESPONDENT: Thom; Fisheries Research Institute

Ulva spp.

GROUP: benthic macroalgae

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: cobble/gravel

TEMPERATURE: 8-28 C

SALINITY: 15-31 ppt

FOOD: N/A

OTHER:

OCCURENCE

ABUNDANCE LEVELS:

BIOMASS LEVELS: in excess of 30 g dry wt m-2; net primary productivity apx. 200 g C m-2 yr-1

SEASONALITY: spring-summer maximum biomass

SAMPLING METHODOLOGY

TECHNIQUES: 0.06 m2; 0.10 m2; 0.25 m2 quadrats. 1) standing stock (a) % cover @ spp. (b) remove above ground part, dry, & weigh. 2) primary productivity; light & dark growth bottels w/ DO flux

DESIGN: standing stock: random samples within depth and/or habitat strata. primary productivity: calculate rates based on standing stock estimates and incubations

REPLICATION: depends upon complexity; range = 3-30 samples

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: "Statgraphics" data files; "Lotus" files

STATISTICAL ANALYSIS: summary stats. per unit area (usually sq. m)

GRAPHS AND FIGURES: line plots of spatial & temporal variation

SOURCES

LOCATION: Drayton Harbor; Cherry Point; Padilla Bay; Seahurst Bight; Tramp Harbor; Lincoln Park; Skiff Point; Grays Harbor; Elliott Bay; Neah Bay, and central Puget Sound beaches

REFERENCES:

Shapiro and Associates, with Ardea Enterprises. 1988. Results of 1988 Biological and chemical monitoring in the southeast Georgia Strait for the Mobil Oil Ferndal Refinery.

Simenstad, C.A., R.M. Thom, J.R. Cordell, K.A. Kuzis, and D.K. Shreffler. 1988. Nearshore community studies of Neah Bay, Washington. FRI-UW-8811, Fisheries Research Institue, University of Washington, Seattle.

Thom, R.M. (in prep.) Effects of depth and season on plant standing stock and primary production in a temperate seagrass system. Marine Biology.

Thom, R.M. 1981. Primary productivity and carbon input to Grays Harbor estuary. Seattle District, U.S. Army Corp of Engineers, Seattle, Washington.

Thom, R.M. 1983. Compostition, habitats, seasonal changes and productivity of the macro algea in Grays Harbor estuary, Washington. Estuaries 7:51-60.

Thom, R.M. 1988. Benthic primary production in the eelgrass meadow at the Padilla Bay National Estuarine Research Reserve. NOAA Tech. Rept. Series OCRM/MEMD. Fisheries Research Institute, Univiversity of Washington, Seattle. FRI-UW-8808.

Thom, R.M. 1988. Lincoln Park eelgrass baseline study. Final report, Seattle District, U.S. Army Corp of Engineers. Seattle, Washington.

Thom, R.M. and R.E. Albright. (in prep.) Relationship between temporal variations in benthic vegetation standing stock, irradiance, and water properties in the nearshore zone of central Puget Sound.

Thom, R.M., C.A. Simenstad, J.R. Cordell, and E.O. Salo. (in prep.) Fish and their prey in a marina and adjacent mudflats and eelgrass meadow in a small estuarine harbor.

Thom, R.M., K.K. Chew, D. Crisostomo, B. Dumbauld, A. Escofet, C. Falmagne, J. Hampel, C. Law, J. Orensanz, and D. Waunmanndepinet. 1979. Habitats, abundance, and diversity of the intertidal benthic biota of Skiff Point, Bainbridge Island, Washington. A report prepared in cooperation with the Municipality of Metropolitan Seattle. 61 pp.

Thom, R.M., R. Albright, and E.O. Salo. 1984. Intertidal and shallow subtidal benthic ecology. Chap. 4, pp. 87-139 in Q.J. Stober and K. Chew, Principal Investigators, Renton Sewage Treatment Plant Project: Duwamish Head. Publ. FRI-UW-8417, Fish. Res. Inst., Univ. of Wash. 177 pp.

RESPONDENT: Thom; Fisheries Research Institute

Ulva spp.

GROUP: benthic macroalgae

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: mud-cobble

TEMPERATURE:

SALINITY:

FOOD: N/A

OTHER:

OCCURENCE

ABUNDANCE LEVELS: variable

BIOMASS LEVELS: variable

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: 0.06 m2; 0.10 m2; 0.25 m2 quadrats. 1) standing stock (a) % cover @ spp. (b) remove above ground part, dry, & weigh. 2) primary productivity; light & dark growth bottels w/ DO flux

DESIGN: standing stock: random samples within depth and/or habitat strata. primary productivity: calculate rates based on standing stock estimates and incubations

REPLICATION: depends upon complexity; range = 3-30 samples

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: "Statgraphics" data files; "Lotus" files

STATISTICAL ANALYSIS: summary stats. per unit area (usually sq. m)

GRAPHS AND FIGURES: line plots of spatial & temporal variation

SOURCES

LOCATION: Drayton Harbor; Cherry Point; Padilla Bay; Seahurst Bight; Tramp Harbor; Lincoln Park; Skiff Point; Grays Harbor; Elliott Bay; Neah Bay, and central Puget Sound beaches

REFERENCES:

Shapiro and Associates, with Ardea Enterprises. 1988. Results of 1988 Biological and chemical monitoring in the southeast Georgia Strait for the Mobil Oil Ferndal Refinery.

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Thom, R.M. 1988. Benthic primary production in the eelgrass meadow at the Padilla Bay National Estuarine Research Reserve. NOAA Tech. Rept. Series OCRM/MEMD. Fisheries Research Institute, Univiversity of Washington, Seattle. FRI-UW-8808.

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Thom, R.M., K.K. Chew, D. Crisostomo, B. Dumbauld, A. Escofet, C. Falmagne, J. Hampel, C. Law, J. Orensanz, and D. Waunmanndepinet. 1979. Habitats, abundance, and diversity of the intertidal benthic biota of Skiff Point, Bainbridge Island, Washington. A report prepared in cooperation with the Municipality of Metropolitan Seattle. 61 pp.

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RESPONDENT: Thom; Fisheries Research Institute

Ulva spp.

GROUP: benthic macroalgae

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: on or closely associated with eelgrass shoots

TEMPERATURE: 8-30 C

SALINITY: 15-33 ppt

FOOD: N/A

OTHER:

OCCURENCE

ABUNDANCE LEVELS: 0-100% cover. production rates apx. 200-300 g c/sq. m/yr

BIOMASS LEVELS: 0-40 g dry wt/sq. m

SEASONALITY: year round; most abundant in May-September

SAMPLING METHODOLOGY

TECHNIQUES: 0.06 m2; 0.10 m2; 0.25 m2 quadrats. 1) standing stock (a) % cover @ spp. (b) remove above ground part, dry, & weigh. 2) primary productivity; light & dark growth bottels w/ DO flux

DESIGN: standing stock: random samples within depth and/or habitat strata. primary productivity: calculate rates based on standing stock estimates and incubations

REPLICATION: depends upon complexity; range = 3-30 samples

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: "Statgraphics" data files; "Lotus" files

STATISTICAL ANALYSIS: summary stats. per unit area (usually sq. m)

GRAPHS AND FIGURES: line plots of spatial & temporal variation

SOURCES

LOCATION: Drayton Harbor; Cherry Point; Padilla Bay; Seahurst Bight; Tramp Harbor; Lincoln Park; Skiff Point; Grays Harbor; Elliot Bay; Neah Bay

REFERENCES:

Shapiro and Associates, with Ardea Enterprises. 1988. Results of 1988 Biological and chemical monitoring in the southeast Georgia Strait for the Mobil Oil Ferndal Refinery.

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Thom, R.M., C.A. Simenstad, J.R. Cordell, and E.O. Salo. (in prep.) Fish and their prey in a marina and adjacent mudflats and eelgrass meadow in a small estuarine harbor.

Thom, R.M., K.K. Chew, D. Crisostomo, B. Dumbauld, A. Escofet, C. Falmagne, J. Hampel, C. Law, J. Orensanz, and D. Waunmanndepinet. 1979. Habitats, abundance, and diversity of the intertidal benthic biota of Skiff Point, Bainbridge Island, Washington. A report prepared in cooperation with the Municipality of Metropolitan Seattle. 61 pp.

Thom, R.M., R. Albright, and E.O. Salo. 1984. Intertidal and shallow subtidal benthic ecology. Chap. 4, pp. 87-139 in Q.J. Stober and K. Chew, Principal Investigators, Renton Sewage Treatment Plant Project: Duwamish Head. Publ. FRI-UW-8417, Fish. Res. Inst., Univ. of Wash. 177 pp.

RESPONDENT: Thom; Fisheries Research Institute

Ulva spp.

GROUP: benthic macroalgae

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: cobble/gravel

TEMPERATURE: 8-28 C

SALINITY: 15-31 ppt

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS:

BIOMASS LEVELS: in excess of 30 g dry wt m-2; net primary productivity apx. 200 g C m-2 yr-1

SEASONALITY: spring-summer max. biomass

SAMPLING METHODOLOGY

TECHNIQUES: 0.06 m2; 0.10 m2; 0.25 m2 quadrats; 1) standing stock: a) % cover of each species; b) remove above ground part, dry, and weigh. 2) primary productivity; light & dark bottle incubations with DO flux

DESIGN: standing stock: random samples within depth and/or habitat strata; primary productivity: calculate rates based on standing stock estimates and incubations

REPLICATION: depends on complexity; range 3-30 samples

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: "Statgraphics" data files; "Lotus" files

STATISTICAL ANALYSIS: summary statistics per unit area (usually m2)

GRAPHS AND FIGURES: line plots of spatial-temporal variation

SOURCES

LOCATION: Drayton Harbor; Cherry Point; Padilla Bay; Seahurst Bight; Tramp Harbor; Lincoln Park; Skiff Point; Grays Harbor; Elliott Bay; Neah Bay; central Puget Sound beaches

REFERENCES:

Armstrong, J.W., C.P. Staude, R.M. Thom, and K.K. Chew. 1976. Habitats and relative abundance of the intertidal macrofauna on five Puget Sound beaches in the Seattle area. Syesis 9:277-290.

Shapiro and Associates, with Ardea Enterprises. 1988. Results of 1988 biological and chemical monitoring in the southeast Georgia Strait for the Mobil Oil Ferndal refinery.

Thom, R.M. 1978. The compostion, growth, seasonal periodicity, and habitats of benthic algae on the eastern shore of central Puget Sound, with special reference to sewage pollution. PhD dissertation, University of Washington, Seattle, Washington. 237 pp.

Thom, R.M. 1980. Seasonality of low intertidal benthic marine algal communities in central Puget Sound, Washington. U.S.A. Botanica Marina 23:7-11.

Thom, R.M. 1985. An oceanographic analysis of odorous beach conditions in Fauntleroy Cove, West Seattle. Submitted to the City of Seattle, Washington.

Thom, R.M. 1988. Lincoln Park eelgrass baseline study. Final report, Seattle District, U.S. Army Corp of Engineers. Seattle, Washington.

Thom, R.M., J.W. Armstrong, C.P. Staude, and K.K. Chew. 1977. Impact of sewage on benthic marine flora of the Seattle, Washington, area. pages 200-220 in The use, study, and management of Puget Sound. Washington Sea Grant Publ. WSG-WO 77-1.

Thom, R.M., J.W. Armstrong, C.P. Staude, K.K. Chew, and R.E. Norris. 1976. A survey of the attached marine flora at five beaches in the Seattle, Washington, area. Syesis 9:267-275.

RESPONDENT: Thom; Fisheries Research Institute

Ulva spp.

GROUP: benthic macroalgae

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: mud-cobble

TEMPERATURE:

SALINITY:

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: variable

BIOMASS LEVELS: variable

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: 0.06 m2; 0.10 m2; 0.25 m2 quadrats; 1) standing stock: a) % cover of each species; b) remove above ground part, dry, and weigh. 2) primary productivity; light & dark bottle incubations with DO flux

DESIGN: standing stock: random samples within depth and/or habitat strata; primary productivity: calculate rates based on standing stock estimates and incubations

REPLICATION: depends on complexity; range 3-30 samples

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: "Statgraphics" data files; "Lotus" files

STATISTICAL ANALYSIS: summary statistics per unit area (usually m2)

GRAPHS AND FIGURES: line plots of spatial-temporal variation

SOURCES

LOCATION: Drayton Harbor; Cherry Point; Padilla Bay; Seahurst Bight; Tramp Harbor; Lincoln Park; Skiff Point; Grays Harbor; Elliott Bay; Neah Bay; central Puget Sound beaches

REFERENCES:

Armstrong, J.W., C.P. Staude, R.M. Thom, and K.K. Chew. 1976. Habitats and relative abundance of the intertidal macrofauna on five Puget Sound beaches in the Seattle area. Syesis 9:277-290.

Shapiro and Associates, with Ardea Enterprises. 1988. Results of 1988 biological and chemical monitoring in the southeast Georgia Strait for the Mobil Oil Ferndal refinery.

Thom, R.M. 1978. The compostion, growth, seasonal periodicity, and habitats of benthic algae on the eastern shore of central Puget Sound, with special reference to sewage pollution. PhD dissertation, University of Washington, Seattle, Washington. 237 pp.

Thom, R.M. 1980. Seasonality of low intertidal benthic marine algal communities in central Puget Sound, Washington. U.S.A. Botanica Marina 23:7-11.

Thom, R.M. 1985. An oceanographic analysis of odorous beach conditions in Fauntleroy Cove, West Seattle. Submitted to the City of Seattle, Washington.

Thom, R.M. 1988. Lincoln Park eelgrass baseline study. Final report, Seattle District, U.S. Army Corp of Engineers, Seattle, Washington.

Thom, R.M., J.W. Armstrong, C.P. Staude, and K.K. Chew. 1977. Impact of sewage on benthic marine flora of the Seattle, Washington, area. pages 200-220 in The use, study, and management of Puget Sound. Washington Sea Grant Publ. WSG-WO 77-1.

Thom, R.M., J.W. Armstrong, C.P. Staude, K.K. Chew, and R.E. Norris. 1976. A survey of the attached marine flora at five beaches in the Seattle, Washington, area. Syesis 9:267-275.

RESPONDENT: Thom; Fisheries Research Institute

Ulva spp.

GROUP: benthic macroalgae

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: cobble/gravel

TEMPERATURE: 8-28 C

SALINITY: 15-31 ppt

FOOD: N/A

OTHER:

OCCURENCE

ABUNDANCE LEVELS:

BIOMASS LEVELS: in excess of 30 g dry wt m-2; net primary productivity apx. 200 g C m-2 yr-1

SEASONALITY: spring-summer maximum biomass

SAMPLING METHODOLOGY

TECHNIQUES: 0.06 m2; 0.10 m2; 0.25 m2; quadrats. 1) standing stock (a) % cover @ spp. (b) remove above ground part, dry, & weigh. 2) primary productivity; light & dark growth bottels w/ DO flux

DESIGN: standing stock: random samples within depth and/or habitat strata. primary productivity: calculate rates based on standing stock estimates and incubations

REPLICATION: depends upon complexity; range = 3-30 samples

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: "Statgraphics" data files; "Lotus" files

STATISTICAL ANALYSIS: summary stats. per unit area (usually sq. m)

GRAPHS AND FIGURES: line plots of spatial & temporal variation

SOURCES

LOCATION: Drayton Harbor; Cherry Point; Padilla Bay; Seahurst Bight; Tramp Harbor; Lincoln Park; Skiff Point; Grays Harbor; Elliott Bay; Neah Bay, and central Puget Sound beaches

REFERENCES:

Thom, R.M. 1984. Primary Production in Grays Harbor estuary, Washington. Bull. Southern California Acad. Sciences 83:99-105.

Thom, R.M., R. Albright, C. Simenstad, J. Hampel, J. Cordell, and K. Chew. 1984. Intertidal and shallow subtidal benthic ecology. Vol. IV, Section 5, in Q.J. Stober and K. Chew, Principal Investigators, Renton Sewage Treatment Plant Project: Duwamish Head. Publ. FRI-UW-8417, Fish. Res. Inst., Univ. of Wash. 177 pp.

RESPONDENT: Thom; Fisheries Research Institute

Ulva spp.

GROUP: benthic macroalgae

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: mud-cobble

TEMPERATURE:

SALINITY:

FOOD: N/A

OTHER:

OCCURENCE

ABUNDANCE LEVELS: variable

BIOMASS LEVELS: variable

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: 0.06 m2; 0.10 m2; 0.25 m2; quadrats. 1) standing stock (a) % cover @ spp. (b) remove above ground part, dry, & weigh. 2) primary productivity; light & dark growth bottels w/ DO flux

DESIGN: standing stock: random samples within depth and/or habitat strata. primary productivity: calculate rates based on standing stock estimates and incubations

REPLICATION: depends upon complexity; range = 3-30 samples

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: "Statgraphics" data files; "Lotus" files

STATISTICAL ANALYSIS: summary stats. per unit area (usually sq. m)

GRAPHS AND FIGURES: line plots of spatial & temporal variation

SOURCES

LOCATION: Drayton Harbor; Cherry Point; Padilla Bay; Seahurst Bight; Tramp Harbor; Lincoln Park; Skiff Point; Grays Harbor; Elliott Bay; Neah Bay, and central Puget Sound beaches

REFERENCES:

Thom, R.M. 1984. Primary Production in Grays Harbor estuary, Washington. Bull. Southern California Acad. Sciences 83:99-105.

Thom, R.M., R. Albright, C. Simenstad, J. Hampel, J. Cordell, and K. Chew. 1984. Intertidal and shallow subtidal benthic ecology. Vol. IV, Section 5, in Q.J. Stober and K. Chew, Principal Investigators, Renton Sewage Treatment Plant Project: Duwamish Head. Publ. FRI-UW-8417, Fish. Res. Inst., Univ. of Wash. 177 pp.

RESPONDENT: Thom; Fisheries Research Institute

Ulva spp.

GROUP: benthic macroalgae

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: on or closely associated with eelgrass shoots

TEMPERATURE: 8-30 C

SALINITY: 15-33 ppt

FOOD: N/A

OTHER:

OCCURENCE

ABUNDANCE LEVELS: 0-100% cover. production rates apx. 200-300 g c/sq. m/yr

BIOMASS LEVELS: 0-40 g dry wt/sq. m

SEASONALITY: year round; most abundant in May-September

SAMPLING METHODOLOGY

TECHNIQUES: 0.06 m2; 0.10 m2; 0.25 m2; quadrats. 1) standing stock (a) % cover @ spp. (b) remove above ground part, dry, & weigh. 2) primary productivity; light & dark growth bottels w/ DO flux

DESIGN: standing stock: random samples within depth and/or habitat strata. primary productivity: calculate rates based on standing stock estimates and incubations

REPLICATION: depends upon complexity; range = 3-30 samples

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: "Statgraphics" data files; "Lotus" files

STATISTICAL ANALYSIS: summary stats. per unit area (usually sq. m)

GRAPHS AND FIGURES: line plots of spatial & temporal variation

SOURCES

LOCATION: Drayton Harbor; Cherry Point; Padilla Bay; Seahurst Bight; Tramp Harbor; Lincoln Park; Skiff Point; Grays Harbor; Elliot Bay; Neah Bay

REFERENCES:

Thom, R.M. 1984. Primary Production in Grays Harbor estuary, Washington. Bull. Southern California Acad. Sciences 83:99-105.

Thom, R.M., R. Albright, C. Simenstad, J. Hampel, J. Cordell, and K. Chew. 1984. Intertidal and shallow subtidal benthic ecology. Vol. IV, Section 5, in Q.J. Stober and K. Chew, Principal Investigators, Renton Sewage Treatment Plant Project: Duwamish Head. Publ. FRI-UW-8417, Fish. Res. Inst., Univ. of Wash. 177 pp.

RESPONDENT: Thom; Fisheries Research Institute

Veneropsis japonica

GROUP: sedentary infauna

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: coarse sand/gravel with abundant shell debris

TEMPERATURE:

SALINITY:

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: produciton bed: range = 50-1580 m-2; mean = 738 m-2; SD 348; natural bed: range = 30-900 m-2; mean = 198 m-2; SD = 167 m-2

BIOMASS LEVELS: production bed: range = 0.9-21.6 kg m-2; mean = 11.7 kg m-2; DS = 5.5 kg m-2; natural bed: range = 0.5-9.3 kg m-2; mean = 3.0 kg m-2; SD = 2.3

SEASONALITY: greatest abundance of 6 to 20 mm in summer/fall

SAMPLING METHODOLOGY

TECHNIQUES: 0.25 or 0.10 m2 quadrat; samplint to 20 cm; sieved to 3-5 mm, sorted by species, counted, measured (to nearest mm), and weighed (net weight, whole)

DESIGN: fixed sampled points within a 5 to 100 acres area with randomly selected stations in a 100 m2 area around each point; sampled from -1 to +2 (MLLW); 15-30 samples/sample period

REPLICATION: usually none; sampling pepeated quarterly to annually; ocasional station with 3-5 replicates

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: 'Lotus' spreadsheets

STATISTICAL ANALYSIS: basic statistical summaries, length/weight curves fitted

GRAPHS AND FIGURES: length frequncies; length vs. weight and estimated age, total abundance (density); vs. sample period and age (size) group

SOURCES

LOCATION: Little Skookum Inlet, soth Puget Sound near Lynch Creek

REFERENCES:
BioAquatics 1988. Report to Little Skookum shellfish growers, September 1988.

RESPONDENT: Cheney; BioAquatics International

Zostera japonica

GROUP: rooted vascular plants

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: fine sand-coarse sand

TEMPERATURE: 7-28 C

SALINITY: 15-32 ppt

FOOD: N/A

OTHER:

OCCURENCE

ABUNDANCE LEVELS: 0-4000 shoots m-2; 0-250 g dry wt m-2; net productivity = 50 g C m-2 yr-1

BIOMASS LEVELS: 0-250 g dry wt m-2

SEASONALITY: spring & summer annual; some plants overwinter

SAMPLING METHODOLOGY

TECHNIQUES: 0.1 m2 quadrat; standing stock: a) % cover; b) remove above ground parts, count shhots, dry, & weigh; productivity: a) bimomass changes by repeated harvest; b) DO flux in light & dark chambers

DESIGN: standing stock: random samples stratified by elevation; productivity: calculate rates based on standing stock estimates & incubations

REPLICATION: 3-5 replicates

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: "Statgraphics" data files; "Lotus" files

STATISTICAL ANALYSIS: summary statistics by unit area (usually sq. m)

GRAPHS AND FIGURES: line plots & scatter plots by space & time

SOURCES

LOCATION: Grays Harbor; Neah Bay; Padilla Bay

REFERENCES:

Simenstad, C.A., R.M. Thom, J.R. Cordell, K.A. Kuzis, and D.K. Shreffler 1988. Nearshore community studies of Neah Bay, Washington. Pages 504-514 in Proceedings of the First Annual Meeting on Research in Puget Sound. Puget Sound Water Quality Authority, Seattle, Washington.

Thom, R.M. (in prep.) Effects of depth and season on plant standing stock and primary production in a temperate seagrass system. Marine Biology.

Thom, R.M. (in prep.) Plant standing stock and productivity on tidal flats and gravel in Padilla Bay, Washington: a temperate North Pacific estuarine embayment.

Thom, R.M. 1981. Primary productivity and carbon input to Grays Harbor estuary. Seattle District, U.S. Army Corps of Engineers, Seattle, Washington.

Thom, R.M. 1984. Primary production in Grays Harbor estuary, Washington. Bull. Southern California Acad. Sciences 83:99-105.

RESPONDENT: Thom; Fisheries Research Institute

Zostera japonica

GROUP: rooted vascular plants

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: soft sediments; mud & sand

TEMPERATURE: 6-25 C

SALINITY: 24-28 ppt

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: 2825-5125 shoots m-2

BIOMASS LEVELS:

SEASONALITY: minimum winter, maximum summer

SAMPLING METHODOLOGY

TECHNIQUES: take 16 cm diameter apx. 30 cm into sediment; wash sediments from plants; count shoots/core; seperate above ground from below ground biomass; remove epiphytes by hand; dry <90 C, weigh

DESIGN: 5 randomly selected m2 areas on 150 m long x 4 m wide transect within 1 tidal elevation

REPLICATION: 3 cores/m2 plot every 2 months

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: 'Lotus', 'Excel', or 'Cricket' spreadsheets

STATISTICAL ANALYSIS:

GRAPHS AND FIGURES:

SOURCES

LOCATION: Padilla Bay intertidal sediments

REFERENCES:
Williams, S.L. (unpubl.)

RESPONDENT: Williams,; Friday Harbor Laboratories

Zostera marina

GROUP: rooted vascular plants

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: coarse sand to mud

TEMPERATURE: 7-32 C

SALINITY: 15-35 ppt

FOOD: N/A

OTHER:

OCCURENCE

ABUNDANCE LEVELS: up to 900 shoots m-2; productivity = 200 - 400 g C/m2/yr

BIOMASS LEVELS: up to 300 g dry wt m-2

SEASONALITY: maximum biomass in summer; minimum in winter

SAMPLING METHODOLOGY

TECHNIQUES: 0.1 m2 quadrat; standing stock: a) % cover; b) remove above ground parts, count shoots, dry, & weigh; primary productivity: a) biomass changes by repeated harvest; b) DO flux in light & dark chambers

DESIGN: standing stock: random samples stratified by elevation; primary productivity: calculate rates based on standing stock estimates and incubations

REPLICATION: depends on complexity; range = 3-30 samples

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: "Statgraphic" data files; "Lotus" files

STATISTICAL ANALYSIS: summary stats. by unit area (usually m-2)

GRAPHS AND FIGURES: live plots & scatter plots by space & time

SOURCES

LOCATION: Neah Bay, Grays Harbor, Drayton Harbor, Padilla Bay, Skiff Pt., several beaches in central Puget Sound, Cherry Pt.

REFERENCES:

Shapiro and Associates, with Ardea Enterprises. 1988. Results of 1988 biological and chemical monitoring in the southeast Georgia Strait for the Mobil Oil Ferndal Refinery.

Simenstad, C.A., R.M. Thom, J.R. Cordell, K.A. Kuzis, and D.K. Shreffler. 1988. Nearshore community studies of Neah Bay, Washington. FRI-UW-8811, Fisheries Research Institute, University of Washington, Seattle.

Thom, R.M. (in prep.) Effects of depth and season on plant standing stock and primary production in a temperate seagrass system. Marine BIology.

Thom, R.M. (in prep.) Plant standing stock and productivity in tidal flats and gravel in Padilla Bay, Washington: a temperate North Pacific estuarine embayment.

Thom, R.M. 1978. The composition, growth, seasonal periodicity, and habitats of benthic algea on the eastern shore of central Puget Sound, with special reference to sewage pollution. PhD dissertation, University of Washington, Seattle, Washington. 237 pp.

Thom, R.M. 1981. Primary productivity and carbon input to Grays Harbor estuary. Seattle District, U.S. Army Corps of Engineers, Seattle, Washington.

Thom, R.M. 1984. Primary production in Grays Harbor estuary, Washington. Bull. Southern California Acad. Sciences 83:99-105.

Thom, R.M. 1988. Benthic primary production in the eelgrass meadow at the Padilla Bay National Estuarine Research Reserve. NOAA Tech. Rept. Series OCRM/MEMD. Fisheries Research Intitute, University of Washington, Seattle. FRI-UW-8808.

Thom, R.M. 1988. Lincoln Park eelgrass baseline study. Final report, Seattle District, U.S. Army Corp of Engineers. Seattle, Washington.

Thom, R.M. and R.E. Albright. (in prep.) Relationship between temporal variations in benthic vegetation standing stock, irradiance and water properties in the nearshore zone of central Puget Sound.

Thom, R.M., A.E. Copping, and R.G. Albright. 1988. Nearshore primary productivity in central Puget Sound: A case for nutrient limitation in the nearchore systems of Puget Sound. Pages 378-391 in Proceedings of the First Annual Meetin on Research in Puget Sound. Puget Sound Water Quality Authority, Seattle, Washington.

Thom, R.M., C.A. Simenstad, J.R. Cordell, and E.O. Salo. (in prep.) Fish and their prey in a marina and adjacent mudflats and eelgrass meadow in a small estuarine harbor.

Thom, R.M., C.A. Simenstad, J.R. Cordell, and E.O. Salo. 1988. Fisheries mitigation plan for expansion of moorage at Blaine Marina, Blaine Washington. FRI-UW-8817, Fisheries Research Institute, University of Washington, Seattle.

Thom, R.M., J.W. Armstrong, C.P. Staude, K.K. Chew, and R.E. Norris. 1976. A survey of the attached marine folora at five beaches in the Seattle, Washington, area. Syesis 9:267-275.

Thom, R.M., K.K. Chew, D. Crisostomo, B. Dumbauld, A. Escofet, C. Falmagne, J. Hampel, C. Law, J. Orensanz, and D. Waunmanndepinet. 1979. Habits, abundance, and diversity of the intertidal benthic biota of Skiff Point, Bainbridge Island, Washington. A report prepared in cooperation with the Municipality of Metropolitan Seattle. 61 pp.

Thom, R.M., R. Albright, C. Simenstad, J. Hampel, and K. Chew. 1984. Intertidal and shallow subtidal benthic ecology. Vol. IV, Sec. 5, in Q.J. Stober and K. Chew, Principal Investigators, Renton Sewage Treatment Plant Project: Seahurst Baseline Study. Publ. FRI-UW-8413, FRI., Univ. of Wash., Seattle, Wash. 177pp.

RESPONDENT: Thom; Fisheries Research Institute

Zostera marina

GROUP: rooted vascular plants

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: sand

TEMPERATURE:

SALINITY: winter: 25 ppt; summer: 31.1

FOOD: sunlight, nutrients

OTHER: current less than 0.25 knots

OCCURENCE

ABUNDANCE LEVELS: 1977-1979; width: mean = 1.9-3.1 mm; length: mean = 91-269 mm; leaf area index: mean = 12.7-78.6

BIOMASS LEVELS:

SEASONALITY: maximum width spring-fall; maximum length spring-fall; maximum leaf area index spring-fall

SAMPLING METHODOLOGY

TECHNIQUES: 0.25 m2 quadrats

DESIGN: common garden plots; random samples along depth gradient from intertidal to subtidal

REPLICATION: n> =3

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: ASCii file on tape compatible with University of Washington Cyber mainframe; printed tables

STATISTICAL ANALYSIS: ANOVA, profile analysis

GRAPHS AND FIGURES: chronological line plots

SOURCES

LOCATION: intertidal at Young's Beach at Butte Point (47 40 N/122 36 W)

REFERENCES:

Backman, Thomas W.H. 1984. Phenotypic expressions of Zostera marina L. ecotypes in Puget Sound, Washington. PhD Dissertation, University of Washington.

RESPONDENT: Backman; U.S. Fish & Wildlife Service (POF)

Zostera marina

GROUP: rooted vascular plants

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: sand

TEMPERATURE:

SALINITY: winter: 25 ppt; summer: 31.1

FOOD: sunlight, nutrients

OTHER: current up to 1 knot; secchi 4-6 m

OCCURENCE

ABUNDANCE LEVELS: 1977-1979; width: mean=2.0-3.6 mm; length: mean=157-428 mm; leaf area index: mean=4.3-61.5

BIOMASS LEVELS:

SEASONALITY: maximum width spring-fall; maximum length spring-fall; maximum leaf area index summer

SAMPLING METHODOLOGY

TECHNIQUES: 0.25 m2 quadrats

DESIGN: common garden plots; random samples along depth gradient from intertidal to subtidal

REPLICATION: n> =3

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: ASCii file on tape compatible with University of Washington Cyber mainframe; printed tables

STATISTICAL ANALYSIS: ANOVA, profile analysis

GRAPHS AND FIGURES: chronological line plots

SOURCES

LOCATION: intertidal just north of Bangor on Hood Canal (47 42 N/122 43 W)

REFERENCES:

Backman, Thomas W.H. 1984. Phenotypic expressions of Zostera marina L. ecotypes in Puget Sound, Washington. PhD Dissertation, University of Washington.

RESPONDENT: Backman; U.S. Fish & Wildlife Service (POF)

Zostera marina

GROUP: rooted vascular plants

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: sand

TEMPERATURE:

SALINITY: winter: 25 ppt; summer: 31.1

FOOD: sunlight, nutrients

OTHER: current at least 1.0 knots

OCCURENCE

ABUNDANCE LEVELS: 1977-1979; width: mean=4.6-7.7 mm; length: mean=416-811 mm; leaf area index: mean=11.0-83.9

BIOMASS LEVELS:

SEASONALITY: maximum width summer-fall; maximum length summer-fall; maximum leaf area index summer-fall

SAMPLING METHODOLOGY

TECHNIQUES: 0.25 m2 quadrats

DESIGN: common garden plots; random samples along depth gradient from intertidal to subtidal

REPLICATION: n> =3

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: ASCii file on tape compatible with University of Washington Cyber mainframe; printed tables

STATISTICAL ANALYSIS: ANOVA, profile analysis

GRAPHS AND FIGURES: chronological line plots

SOURCES

LOCATION: subtidal at Manchester (47 34 N/122 32 W)

REFERENCES:

Backman, Thomas W.H. 1984. Phenotypic expressions of Zostera marina L. ecotypes in Puget Sound, Washington. PhD Dissertation, University of Washington.

RESPONDENT: Backman; U.S. Fish & Wildlife Service (POF)

Zostera marina

GROUP: rooted vascular plants

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: sand

TEMPERATURE:

SALINITY: winter: 25 ppt; summer: 31.1

FOOD: sunlight, nutrients

OTHER: current less than 0.25 knots

OCCURENCE

ABUNDANCE LEVELS: 1977-1979; width: mean = 2.5-6.9 mm; length: mean = 138-444 mm; leaf area index: mean = 5.8-36.1

BIOMASS LEVELS:

SEASONALITY: maximum width spring-fall; maximum length spring-fall; maximum leaf area index spring-fall

SAMPLING METHODOLOGY

TECHNIQUES: 0.25 m2 quadrats

DESIGN: common garden plots; random samples along depth gradient from intertidal to subtidal

REPLICATION: n> =3

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: ASCii file on tape compatible with University of Washington Cyber mainframe; printed tables

STATISTICAL ANALYSIS: ANOVA, profile analysis

GRAPHS AND FIGURES: chronological line plots

SOURCES

LOCATION: subtidal at Young's Beach at Butte Point (47 40 N/122 36 W)

REFERENCES:

Backman, Thomas W.H. 1984. Phenotypic expressions of Zostera marina L. ecotypes in Puget Sound, Washington. PhD Dissertation, University of Washington.

RESPONDENT: Backman; U.S. Fish & Wildlife Service (POF)

Zostera marina

GROUP: rooted vascular plants

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: sand

TEMPERATURE:

SALINITY: winter: 25 ppt; summer: 31.1

FOOD: sunlight, nutrients

OTHER: current up to 1 knot; secchi 4-6 m

OCCURENCE

ABUNDANCE LEVELS: 1977-1979; width: mean = 4.0-8.4 mm; length: mean = 209-918 mm; leaf area index: mean = 4.3-81.4

BIOMASS LEVELS:

SEASONALITY: maximum width spring-fall; maximum length summer-fall; maximum leaf area index fall

SAMPLING METHODOLOGY

TECHNIQUES: 0.25 m2 quadrats

DESIGN: common garden plots; random samples along depth gradient from intertidal to subtidal

REPLICATION: n> =3

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: ASCii file on tape compatible with University of Washington Cyber mainframe; printed tables

STATISTICAL ANALYSIS: ANOVA, profile analysis

GRAPHS AND FIGURES: chronological line plots

SOURCES

LOCATION: subtidal just north of Bangor on Hood Canal (47 42 N/122 43 W)

REFERENCES:

Backman, Thomas W.H. 1984. Phenotypic expressions of Zostera marina L. ecotypes in Puget Sound, Washington. PhD Dissertation, University of Washington.

RESPONDENT: Backman; U.S. Fish & Wildlife Service (POF)

Zostera marina

GROUP: rooted vascular plants

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: sand and silty mixed

TEMPERATURE: 6-12 C

SALINITY: 28-30 ppt

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS:

BIOMASS LEVELS:

SEASONALITY: reproductive periodicity shown to be related to factors associated with lattitude (esp. temperature)

SAMPLING METHODOLOGY

TECHNIQUES: collect 50 shoots haphazardly monthly for 4 yrs from 4 different locations in Puget Sound; analyze for 3 stages of sexual development: 1) visible flowers; 2) visible anthesis ; 3) visible fruits

DESIGN: in each case, the first date of these events was desired; recorded water temperature and salinity at time of each plant collection; phenology evaluated

REPLICATION: n=50 shoots/location

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: voucher specimens preserved; deposited at herbarium

STATISTICAL ANALYSIS: ANOVA for site differences; linear regressions for differences due to lattitude and ocean; latter performed if ANOVA indicated significant site variation; three linear predictive models const.

GRAPHS AND FIGURES:

SOURCES

LOCATION: Edmonds, Hood Canal, Alki Points, Bainbridge Island

REFERENCES:

Phillips, R.C., C. McMillan, and K.W. Bridges. 1983. Phenology of eelgrass, Zostera Marina L., along lattitudinal gradients in North America. Aquatic Botany 15:145-156.

RESPONDENT: Phillips; Department of Natural and Mathematical Sciences

Zostera marina

GROUP: rooted vascular plants

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: soft sediments; mud & sand

TEMPERATURE: 6-25 C

SALINITY: 24-28 ppt

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: 1250-5063 shoots m-2

BIOMASS LEVELS: summer leaves (above ground) 46-175 g dry m-2, roots/rhizome 39-115 g dry m-2

SEASONALITY: minimum winter, maximum summer

SAMPLING METHODOLOGY

TECHNIQUES: take 16 cm diameter apx. 30 cm into sediment; wash sediments from plants; count shoots/core; seperate above ground from below ground biomass; remove epiphytes by hand; dry <90 C, weigh

DESIGN: 5 randomly selected m2 areas on 150 m long x 4 m wide transect within 1 tidal elevation

REPLICATION: 3 cores/m2 plot every 2 months

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: 'Lotus', 'Excel', or 'Cricket' spreadsheets

STATISTICAL ANALYSIS:

GRAPHS AND FIGURES:

SOURCES

LOCATION: Padilla Bay intertidal sediments

REFERENCES:
Williams, S.L. (unpubl.)

RESPONDENT: Williams,; Friday Harbor Laboratories

Zostera spp.

GROUP: rooted vascular plants

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: mud-cobble

TEMPERATURE:

SALINITY:

FOOD: N/A

OTHER:

OCCURENCE

ABUNDANCE LEVELS: variable

BIOMASS LEVELS: variable

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: 0.06 m2; 0.10 m2; 0.25 m2 quadrats. 1) standing stock (a) % cover @ spp. (b) remove above ground part, dry, & weigh. 2) primary productivity; light & dark growth bottels w/ DO flux

DESIGN: standing stock: random samples within depth and/or habitat strata. primary productivity: calculate rates based on standing stock estimates and incubations

REPLICATION: depends upon complexity; range = 3-30 samples

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: "Statgraphics" data files; "Lotus" files

STATISTICAL ANALYSIS: summary stats. per unit area (usually sq. m)

GRAPHS AND FIGURES: line plots of spatial & temporal variation

SOURCES

LOCATION: Drayton Harbor; Cherry Point; Padilla Bay; Seahurst Bight; Tramp Harbor; Lincoln Park; Skiff Point; Grays Harbor; Elliott Bay; Neah Bay, and central Puget Sound beaches

REFERENCES:

Shapiro and Associates, with Ardea Enterprises. 1988. Results of 1988 Biological and chemical monitoring in the southeast Georgia Strait for the Mobil Oil Ferndal Refinery.

Simenstad, C.A., R.M. Thom, J.R. Cordell, K.A. Kuzis, and D.K. Shreffler. 1988. Nearshore community studies of Neah Bay, Washington. FRI-UW-8811, Fisheries Research Institue, University of Washington, Seattle.

Thom, R.M. (in prep.) Effects of depth and season on plant standing stock and primary production in a temperate seagrass system. Marine Biology.

Thom, R.M. 1981. Primary productivity and carbon input to Grays Harbor estuary. Seattle District, U.S. Army Corp of Engineers, Seattle, Washington.

Thom, R.M. 1983. Compostition, habitats, seasonal changes and productivity of the macro algea in Grays Harbor estuary, Washington. Estuaries 7:51-60.

Thom, R.M. 1988. Benthic primary production in the eelgrass meadow at the Padilla Bay National Estuarine Research Reserve. NOAA Tech. Rept. Series OCRM/MEMD. Fisheries Research Institute, Univiversity of Washington, Seattle. FRI-UW-8808.

Thom, R.M. 1988. Lincoln Park eelgrass baseline study. Final report, Seattle District, U.S. Army Corp of Engineers. Seattle, Washington.

Thom, R.M. and R.E. Albright. (in prep.) Relationship between temporal variations in benthic vegetation standing stock, irradiance, and water properties in the nearshore zone of central Puget Sound.

Thom, R.M., C.A. Simenstad, J.R. Cordell, and E.O. Salo. (in prep.) Fish and their prey in a marina and adjacent mudflats and eelgrass meadow in a small estuarine harbor.

Thom, R.M., K.K. Chew, D. Crisostomo, B. Dumbauld, A. Escofet, C. Falmagne, J. Hampel, C. Law, J. Orensanz, and D. Waunmanndepinet. 1979. Habitats, abundance, and diversity of the intertidal benthic biota of Skiff Point, Bainbridge Island, Washington. A report prepared in cooperation with the Municipality of Metropolitan Seattle. 61 pp.

Thom, R.M., R. Albright, and E.O. Salo. 1984. Intertidal and shallow subtidal benthic ecology. Chap. 4, pp. 87-139 in Q.J. Stober and K. Chew, Principal Investigators, Renton Sewage Treatment Plant Project: Duwamish Head. Publ. FRI-UW-8417, Fish. Res. Inst., Univ. of Wash. 177 pp.

RESPONDENT: Thom; Fisheries Research Institute

Zostera spp.

GROUP: rooted vascular plants

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: mud-cobble

TEMPERATURE:

SALINITY:

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS: variable

BIOMASS LEVELS: variable

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: 0.06 m2; 0.10 m2; 0.25 m2 quadrats; 1) standing stock: a) % cover of each species; b) remove above ground part, dry, and weigh. 2) primary productivity; light & dark bottle incubations with DO flux

DESIGN: standing stock: random samples within depth and/or habitat strata; primary productivity: calculate rates based on standing stock estimates and incubations

REPLICATION: depends on complexity; range 3-30 samples

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: "Statgraphics" data files; "Lotus" files

STATISTICAL ANALYSIS: summary statistics per unit area (usually m2)

GRAPHS AND FIGURES: line plots of spatial-temporal variation

SOURCES

LOCATION: Drayton Harbor; Cherry Point; Padilla Bay; Seahurst Bight; Tramp Harbor; Lincoln Park; Skiff Point; Grays Harbor; Elliott Bay; Neah Bay; central Puget Sound beaches

REFERENCES:

Armstrong, J.W., C.P. Staude, R.M. Thom, and K.K. Chew. 1976. Habitats and relative abundance of the intertidal macrofauna on five Puget Sound beaches in the Seattle area. Syesis 9:277-290.

Shapiro and Associates, with Ardea Enterprises. 1988. Results of 1988 biological and chemical monitoring in the southeast Georgia Strait for the Mobil Oil Ferndal refinery.

Thom, R.M. 1978. The compostion, growth, seasonal periodicity, and habitats of benthic algae on the eastern shore of central Puget Sound, with special reference to sewage pollution. PhD dissertation, University of Washington, Seattle, Washington. 237 pp.

Thom, R.M. 1980. Seasonality of low intertidal benthic marine algal communities in central Puget Sound, Washington. U.S.A. Botanica Marina 23:7-11.

Thom, R.M. 1985. An oceanographic analysis of odorous beach conditions in Fauntleroy Cove, West Seattle. Submitted to the City of Seattle, Washington.

Thom, R.M. 1988. Lincoln Park eelgrass baseline study. Final report, Seattle District, U.S. Army Corp of Engineers, Seattle, Washington.

Thom, R.M., J.W. Armstrong, C.P. Staude, and K.K. Chew. 1977. Impact of sewage on benthic marine flora of the Seattle, Washington, area. pages 200-220 in The use, study, and management of Puget Sound. Washington Sea Grant Publ. WSG-WO 77-1.

Thom, R.M., J.W. Armstrong, C.P. Staude, K.K. Chew, and R.E. Norris. 1976. A survey of the attached marine flora at five beaches in the Seattle, Washington, area. Syesis 9:267-275.

RESPONDENT: Thom; Fisheries Research Institute

Zostera spp.

GROUP: rooted vascular plants

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: mud-cobble

TEMPERATURE:

SALINITY:

FOOD: N/A

OTHER:

OCCURENCE

ABUNDANCE LEVELS: variable

BIOMASS LEVELS: variable

SEASONALITY:

SAMPLING METHODOLOGY

TECHNIQUES: 0.06 m2; 0.10 m2; 0.25 m2; quadrats. 1) standing stock (a) % cover @ spp. (b) remove above ground part, dry, & weigh. 2) primary productivity; light & dark growth bottels w/ DO flux

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REPLICATION: depends upon complexity; range = 3-30 samples

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: "Statgraphics" data files; "Lotus" files

STATISTICAL ANALYSIS: summary stats. per unit area (usually sq. m)

GRAPHS AND FIGURES: line plots of spatial & temporal variation

SOURCES

LOCATION: Drayton Harbor; Cherry Point; Padilla Bay; Seahurst Bight; Tramp Harbor; Lincoln Park; Skiff Point; Grays Harbor; Elliott Bay; Neah Bay, and central Puget Sound beaches

REFERENCES:

Thom, R.M. 1984. Primary Production in Grays Harbor estuary, Washington. Bull. Southern California Acad. Sciences 83:99-105.

Thom, R.M., R. Albright, C. Simenstad, J. Hampel, J. Cordell, and K. Chew. 1984. Intertidal and shallow subtidal benthic ecology. Vol. IV, Section 5, in Q.J. Stober and K. Chew, Principal Investigators, Renton Sewage Treatment Plant Project: Duwamish Head. Publ. FRI-UW-8417, Fish. Res. Inst., Univ. of Wash. 177 pp.

RESPONDENT: Thom; Fisheries Research Institute

Zostera spp.

GROUP: rooted vascular plants

HABITAT CHARACTERISTICS AND ECOLOGY

SUBSTRATE: sand and silty mixed

TEMPERATURE: 6-12 C

SALINITY: 28-30 ppt

FOOD:

OTHER:

OCCURENCE

ABUNDANCE LEVELS:

BIOMASS LEVELS:

SEASONALITY: reproductive periodicity shown to be related to factors associated with lattitude (esp. temperature)

SAMPLING METHODOLOGY

TECHNIQUES: collect 50 shoots haphazardly monthly for 4 yrs from 4 different locations in Puget Sound; analyze for 3 stages of sexual development: 1) visible flowers; 2) visible anthesis ; 3) visible fruits

DESIGN: in each case, the first date of these events was desired; recorded water temperature and salinity at time of each plant collection; phenology evaluated

REPLICATION: n=50 shoots/location

DATA MANAGEMENT, ANALYSIS, AND INTERPRETATION

DATA FORMAT: voucher specimens preserved; deposited at herbarium

STATISTICAL ANALYSIS: ANOVA for site differences; linear regressions for differences due to lattitude and ocean; latter performed if ANOVA indicated significant site variation; three linear predictive models const.

GRAPHS AND FIGURES:

SOURCES

LOCATION: Edmonds, Hood Canal, Alki Points, Bainbridge Island

REFERENCES:

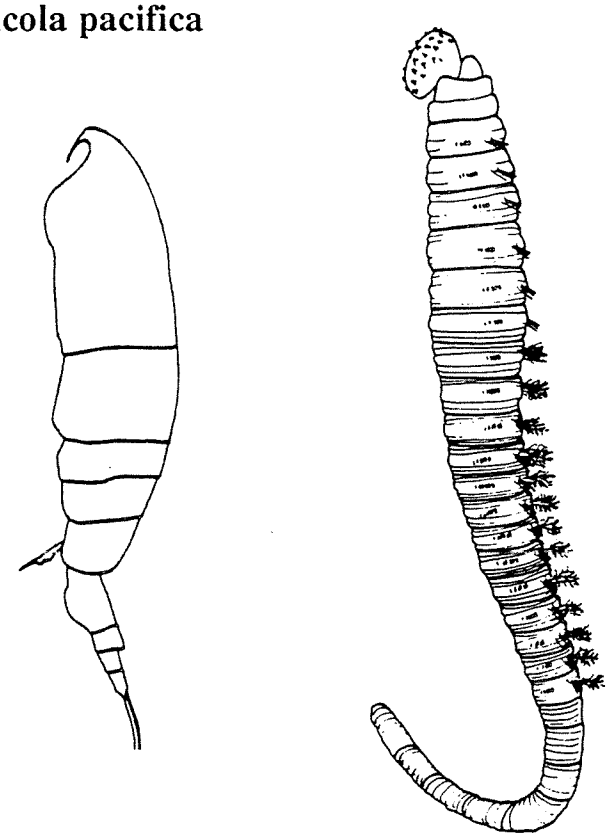
Phillips, R.C., C. McMillan, and K.W. Bridges. 1983. Phenology of eelgrass, Zostera Marina L., along lattitudinal gradients in North America. Aquatic Botany 15:145-156.

RESPONDENT: Phillips; Department of Natural and Mathematical Sciences

APPENDIX E: ATTRIBUTE DESCRIPTIONS

This appendix contains a description for each attribute utilized in the Protocol. These occur in alphabetical order and include: (1) an illustration, usually indicating a diagnostic characteristic; (2) its Attribute Group; (3) a general description, which indicates describes particularly distinguishing characteristics and life history aspects; (4) specific characteristics (e.g., microhabitats) of the estuarine habitat type in which it predominates; and (5) references associated with these descriptions.

Abarenicola pacifica



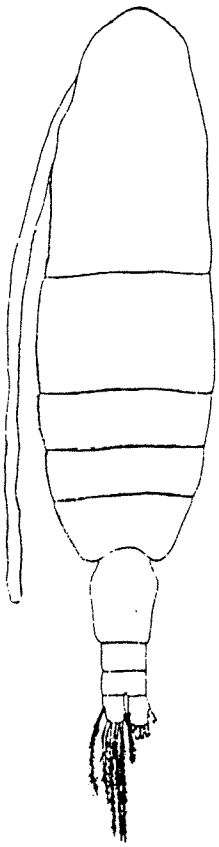
GROUP: sedentary infauna

DESCRIPTION: Lugworms; large sedentary polychaete worm (see pl. 8, Kosloff 1983) which leaves a characteristic casting on sediment surface (see fig. 328, ibid.); also see taxonomic reference for distinguishing characteristics.

HABITAT: Soft intertidal and subtidal sediments, e.g. muddy sand in higher, protected flats; live in j-shaped burrows.

REFERENCE(S): See Hobson and Banse (1981) for identification; figure from Fauchald (1977).

Acartia californiensis



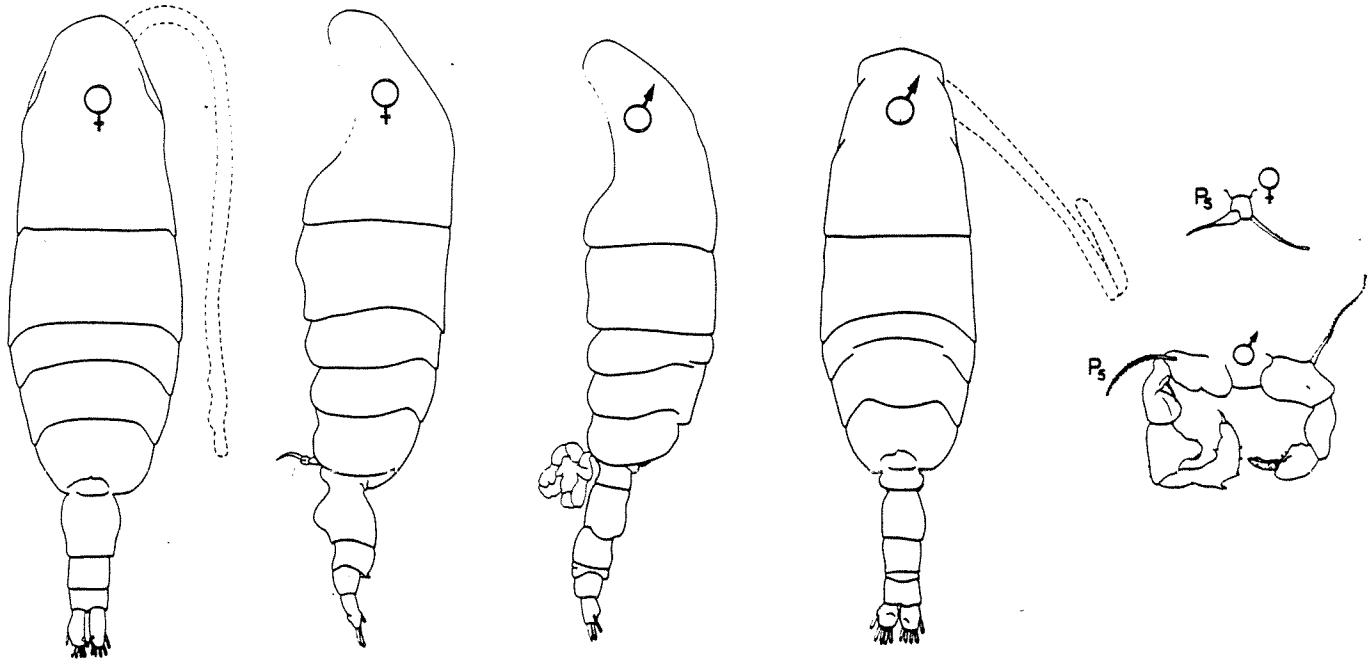
GROUP: pelagic zooplankton

DESCRIPTION: Several species, including some undescribed occur in the northeastern Pacific; see taxonomic reference for distinguishing characteristics.

HABITAT: Coastal planktonic.

REFERENCE(S): See Gardner and Szabo (1982) for identification; figure from Trinast (1976).

Acartia clausi



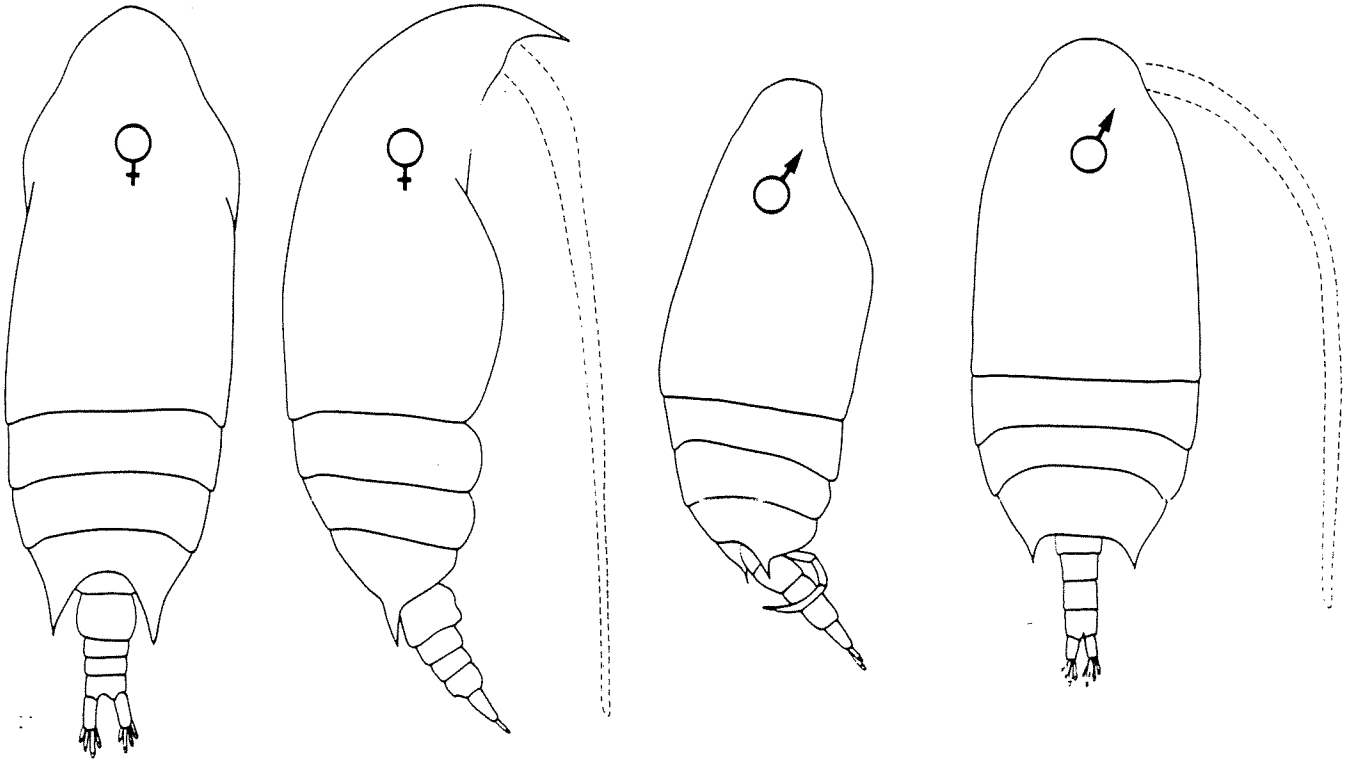
GROUP: pelagic zooplankton

DESCRIPTION: Several species, including some undescribed occur in the northeastern Pacific; see taxonomic reference for distinguishing characteristics.

HABITAT: Coastal planktonic, prominent in embayments.

REFERENCE(S): See Gardner and Szabo (1982) for identification and figure.

Aetidius spp.



GROUP: pelagic zooplankton

DESCRIPTION: Calanoid copepod.

HABITAT: Planktonic.

REFERENCE(S): See Gardner and Szabo (1982) for description and figure.

Agrostis alba



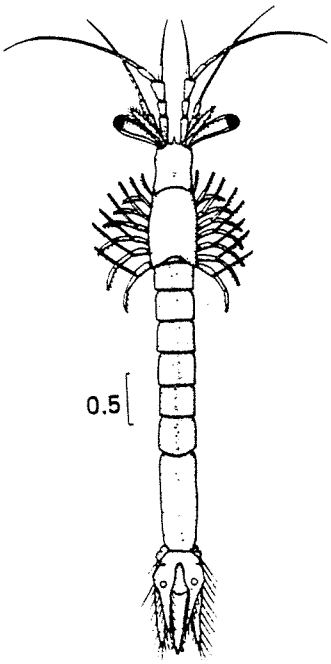
GROUP: rooted vascular plants

DESCRIPTION: Bentgrass forms extensive grassy meadows. It differs from Distichlis spicata in that the leaves are not bilaterally placed. This species is usually less than 30 cm tall.

HABITAT: Common meadow forming plant in mesohaline marshes, under partly enclosed conditions in sediments with high organic content.

REFERENCE(S): Description from WDNR (1989), figure from Hitchcock and Cronquist (1973).

Alienacanthomysis macropsis



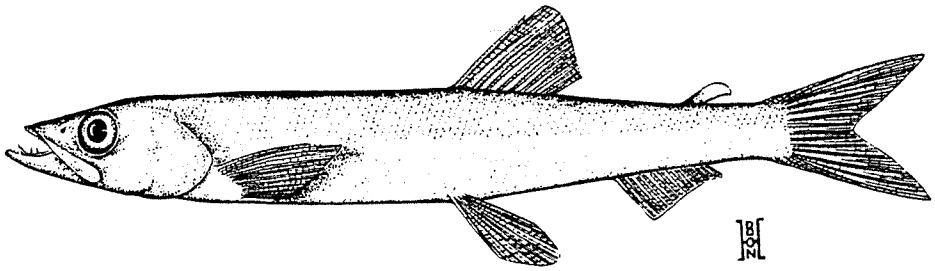
GROUP: evasive macroepifauna

DESCRIPTION: Mysid: see taxonomic reference for distinguishing characteristics.

HABITAT: Neritic; shallow water, may be epibenthic.

REFERENCE(S): See Kathmann et al. (1986) for identification; figure from Smith (1977).

Allosmerus elongatus



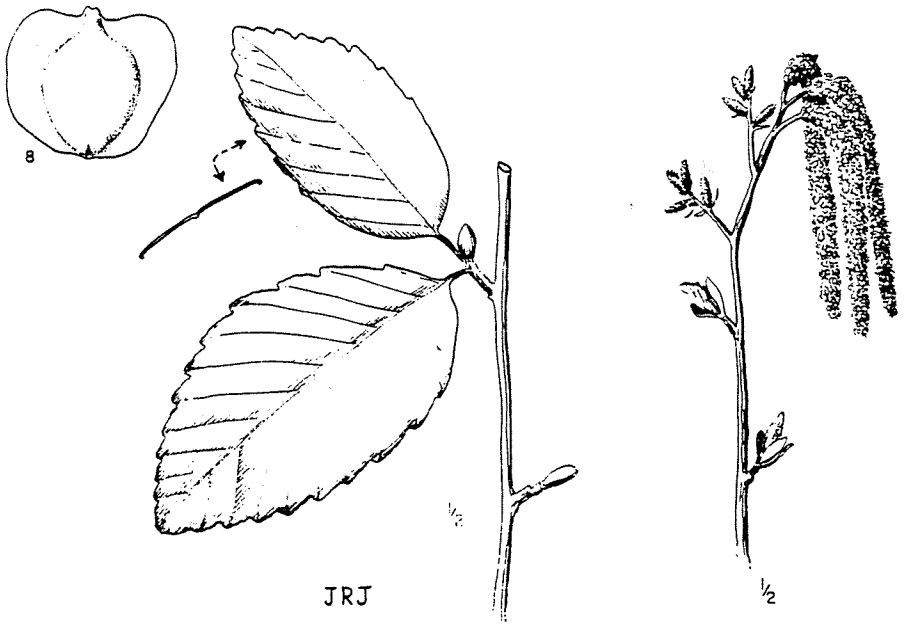
GROUP: motile fish

DESCRIPTION: The whitebait smelt is known for its long pointed snout, large eye, having dorsal fin placed well back on body, prominent canine tooth on vomer accompainied or not by one or two smaller canine teeth, and one or no pyloric caeca.

HABITAT: Almost exclusivly marine.

REFERENCE(S): Description and figure from Hart (1973).

Alnus rubra



GROUP: rooted vascular plants

DESCRIPTION: Under saturated soil conditions, red alder appears shrubby and stunted. Under drier conditions, alder grows to 25 m tall and over 35 cm in diameter. The bark is normally smooth and dirty gray in color, often appearing mottled with light patched. Leaves are 5 to 15 cm long and half as wide, usually dark green, heavily veined, alternate, and distinctively toothed or notched. Separate male and female catkins are produced in the spring prior to the appearance of the leaves. At first the catkins are green. Male catkins are cylindrical, about 5 mm in diameter and 2 to 5 cm long. Female catkins are more 'conelike' and shorter, to 2.5 cm. Later in summer, these clustered cones turn brown and are an obvious feature. Similar appearing species of alder occur in the Pacific Northwest; however, red alder is the most common.

HABITAT: Red alder is a very common, deciduous tree throughout lower elevations of the Pacific Northwest and occurs in both wetland and nonwetland situations. In wetlands, the species is typical of river-bottomlands, especially those west of the Cascades. These areas normally flood for short periods one or more times per year and the soils remain saturated or nearly co for much of the growing season. In its stunted, 'shrubby' form, alder often dominates in the shrub swamps of Pacific Northwest flood plains. Red alder is not considered to be tolerant of saline conditions, but does occur in tidally-influenced freshwater situations. It frequently is a component of the understory of spruce-dominated swamps. Common understory plants in red alder swamps include lady fern, sedges, and skunk cabbage.

REFERENCE(S): Identification from Weinman et al. 1984; figure from Hitchcock and Cronquist 1978. See Hitchcock, vol. 2 for descriptions of other Alnus species.

Ammodytes hexapterus



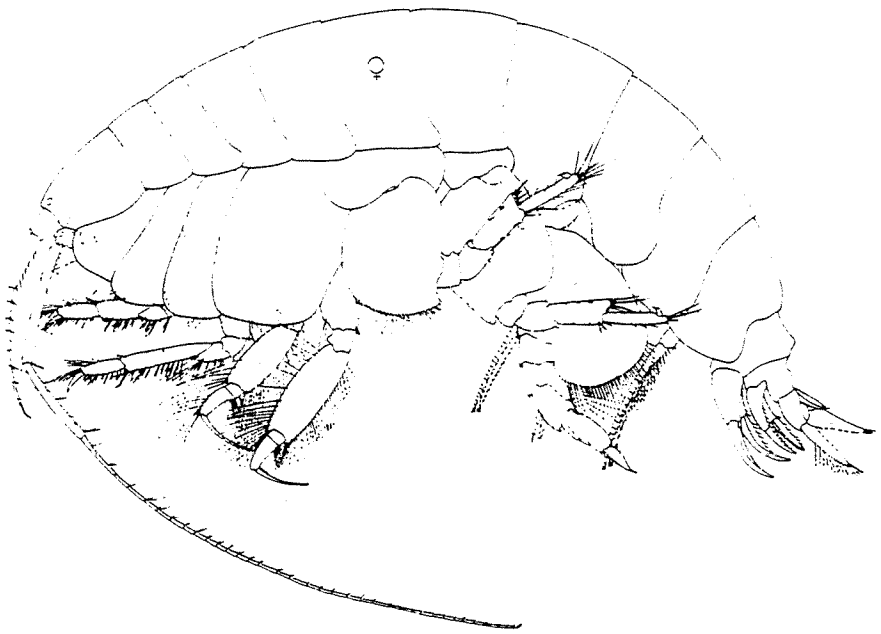
GROUP: motile fish

DESCRIPTION: Pacific sand lance, elongate and silvery with dark blue-green back; projecting lower jaw; long spineless dorsal fin; forked caudal (tail) fin.

HABITAT: Common schooling baitfish in surface waters or nearshore; often found buried in sand, apparently as antipredator strategy; very important as prey for larger fish, including salmon, diving seabirds, and marine mammals; planktivore.

REFERENCE(S): Figure from Eschmeyer et al. (1983)

Ampelisca agassizi



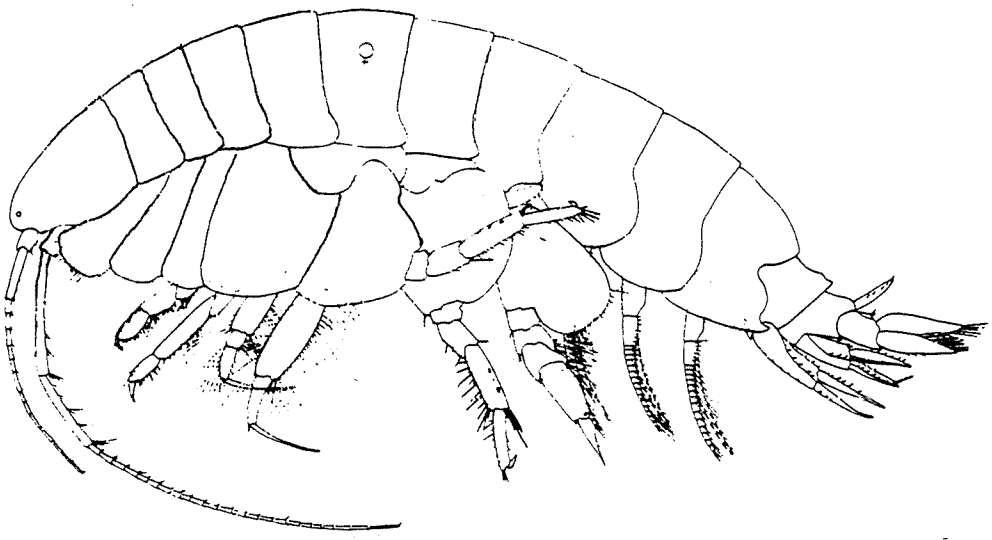
GROUP: surface epifauna

DESCRIPTION: Infaunal tube-dwelling gammarid amphipod.

HABITAT: Sand and mud bottoms.

REFERENCE(S): See Dickinson (1982) and Kozloff (1982).

Ampelisca careyi



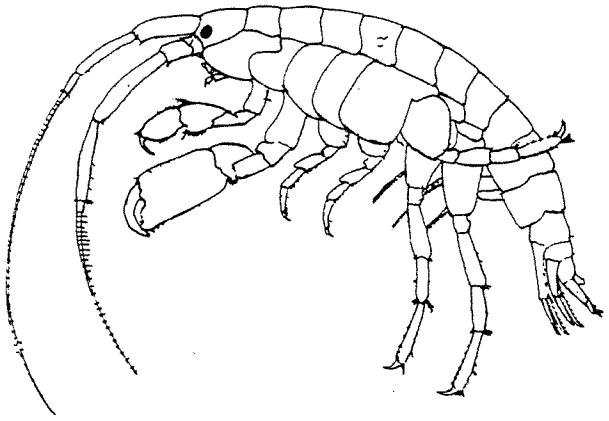
GROUP: sedentary infauna

DESCRIPTION: Infaunal tube-dwelling gammarid amphipod.

HABITAT: Sand and mud bottoms.

REFERENCE(S): See Dickinson (1982) and Kozloff (1987).

Ampithoe spp.



GROUP: epibenthic plankters

DESCRIPTION: Gammarid amphipods (Ampithoe and Perampithoe spp.) distinguished by the presence of two hooked spines on the outer ramus of the third uropod.

HABITAT: Self-constructed tubes on coastal algae.

REFERENCE(S): See Kozloff (1987) for identification; figure from Conlan and Bousfield (1982).

Anisogammarus pugettensis

GROUP: epibenthic plankters

DESCRIPTION: Gammarid amphipod notable for large tooth on second urosomal segment. Note: Figure unavailable.

HABITAT: Various substrates, but often associated with eelgrass, algae, and deposits of wood chips.

REFERENCE(S): See Kozloff (1987).

Anodonta spp.

GROUP: surface epifauna

DESCRIPTION: Palaeoheterodont bivalve of family Unionidae.

HABITAT:

REFERENCE(S): No reference or figure available.

Aoroides inermis



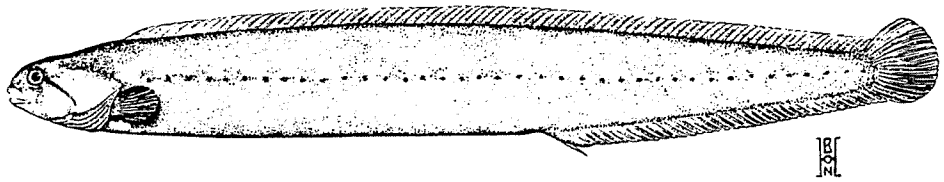
GROUP: epibenthic plankters

DESCRIPTION: Tube-dwelling gammarid amphipod.

HABITAT: Sand bottoms in the low intertidal and subtidal.

REFERENCE(S): See Conlan and Bousfield (1982) and Kozloff (1987).

Apodichthys flavidus



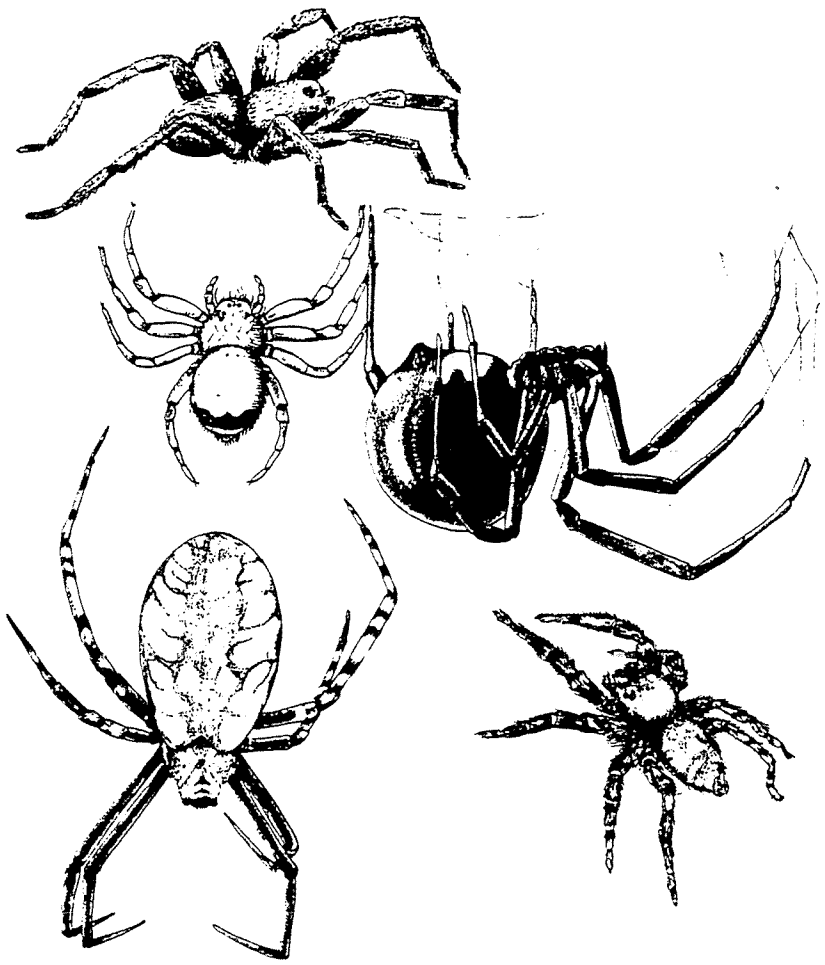
GROUP: sessile fish

DESCRIPTION: Penpoint gunnel; recognized by large, grooved (pen nib shaped) anal spine and absence of pelvic fins.

HABITAT: Intertidal, shallow subtidal sand-gravel; commonly found associated with macroalgae such as Ulva and often assuming corresponding color.

REFERENCE(S): Description and figure from Hart (1973).

Araneae (unid.)



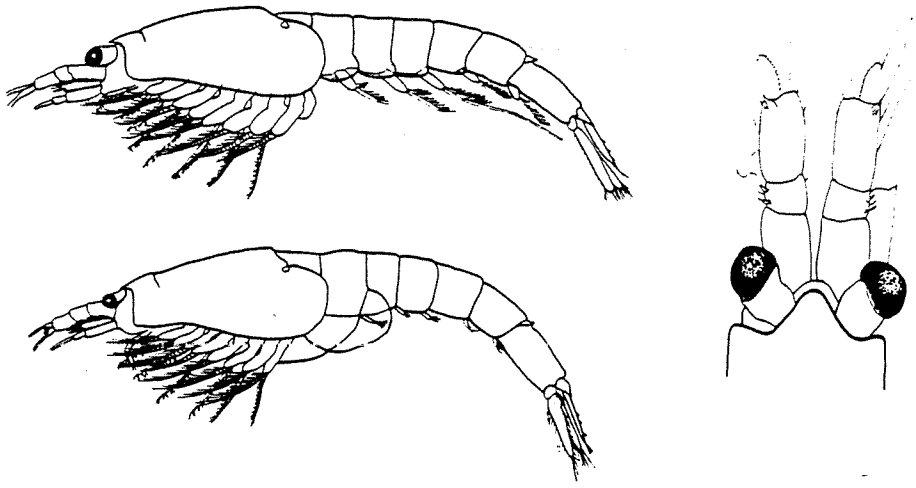
GROUP: neustonic and drift invertebrates

DESCRIPTION: Spiders, see any common invertebrate zoology text or guide (e.g. Borror and White 1970) for identification.

HABITAT: Predators in a variety of terrestrial and a few aquatic habitats.

REFERENCE(S): Figure from Meglitsch (1972).

Archaeomysis grebnitzkii



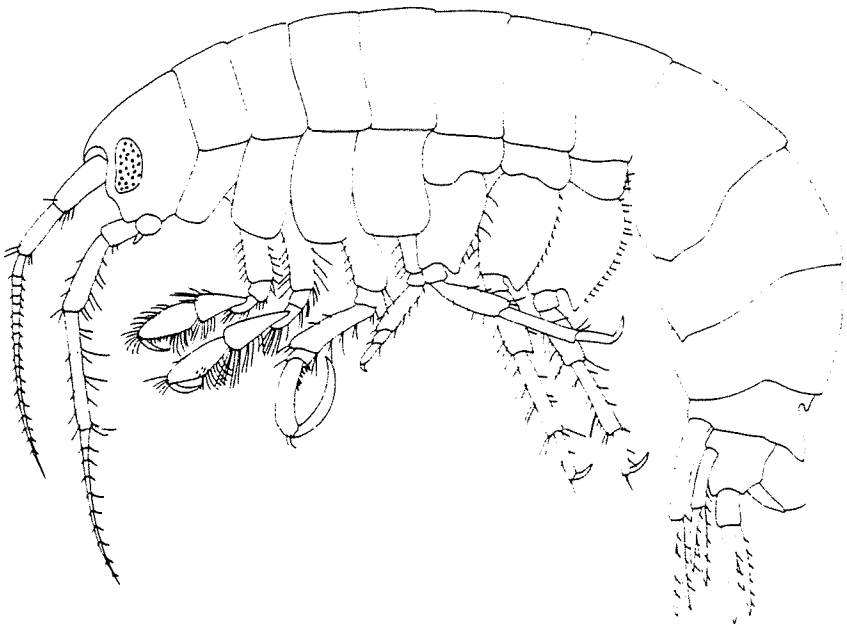
GROUP: evasive macroepifauna

DESCRIPTION: Mysid: see taxonomic reference for distinguishing characteristics.

HABITAT: Epibenthic or burrowing on sand, gravel, mud bottoms.

REFERENCE(S): See Kathmann et al. (1986) for identification and figure.

Atylus spp.



GROUP: epibenthic plankters

DESCRIPTION: Gammarid amphipod.

HABITAT: Low intertidal and subtidal on various substrata; occasionally pelagic.

REFERENCE(S): See Kozloff (1987).

Aves (unid.)

GROUP: avifauna

DESCRIPTION: General birds; see specific taxa.

HABITAT: All estuarine wetland and associated habitats.

REFERENCE(S): Any general field key for identification; Yates (1988) describes and includes basic natural history and ecology comments on most common taxa.

Balanus crenatus



GROUP: surface epifauna

DESCRIPTION: Smooth, almost purely white barnacle; similar to B. glandula.

HABITAT: Subtidal and lower intertidal hard substrate.

REFERENCE(S): Description and figure from Kozloff (1983).

Balanus glandula



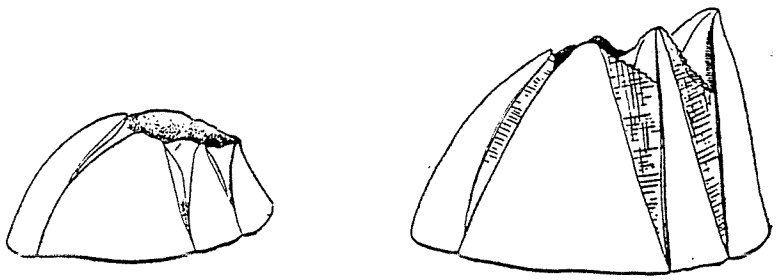
GROUP: surface epifauna

DESCRIPTION: Acorn barnacle; interior base of shell with numerous centripetal ridges and interior surface of scutum with a prominent adductor ridge.

HABITAT: Ubiquitous upper midlittoral of rocky and cobble beaches.

REFERENCE(S): Description from Kozloff (1983); figure from Yates (1988).

Balanus spp.



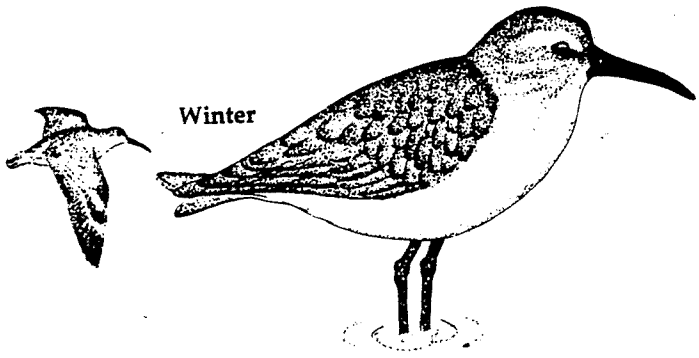
GROUP: surface epifauna

DESCRIPTION: Barnacles: see taxonomic reference for distinguishing characteristics.

HABITAT: Intertidal to shallow subtidal on rocks.

REFERENCE(S): See Kozloff (1987) for identification; figure from Pilsbry (1916).

Calidris alpina



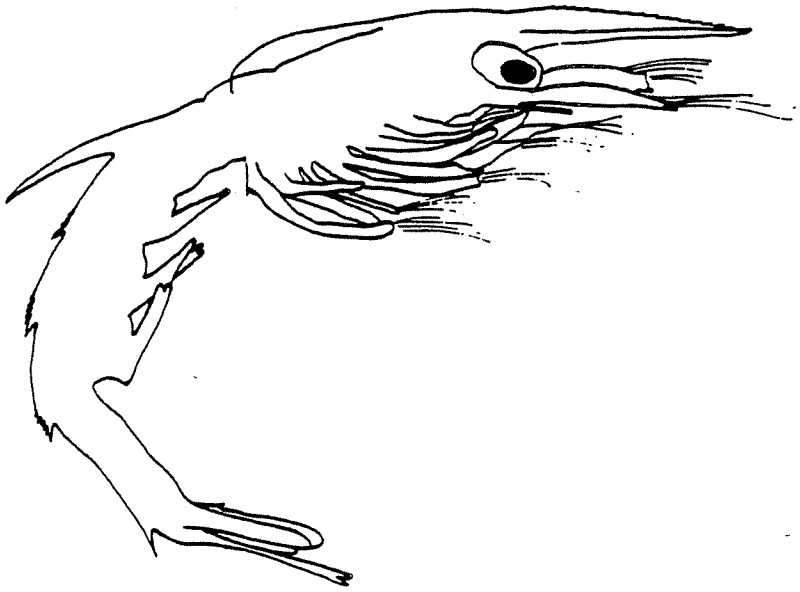
GROUP: avifauna

DESCRIPTION: Dunlin; sandpiper with longish dark bill with noticable broop at tip; thin white wing stripe, white line above eye in winter.

HABITAT: Sand/mudflats and gravel beaches; feed along water's edge.

REFERENCE(S): Description and figure from Yates (1988).

Callianassa californiensis (larvae)



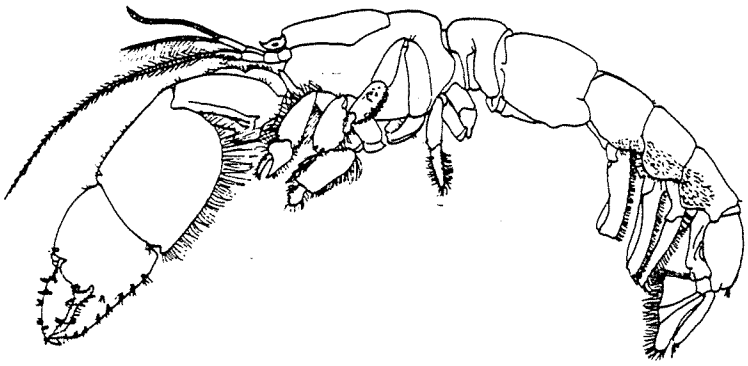
GROUP: pelagic zooplankton

DESCRIPTION: Ghost shrimp larvae; see taxonomic reference for distinguishing from other decapod larval forms.

HABITAT: Larvae planktonic in nearshore waters; epibenthic just before settling.

REFERENCE(S): See Hart (1971) for identification; figure modified from McCrow (1975).

Callianassa californiensis



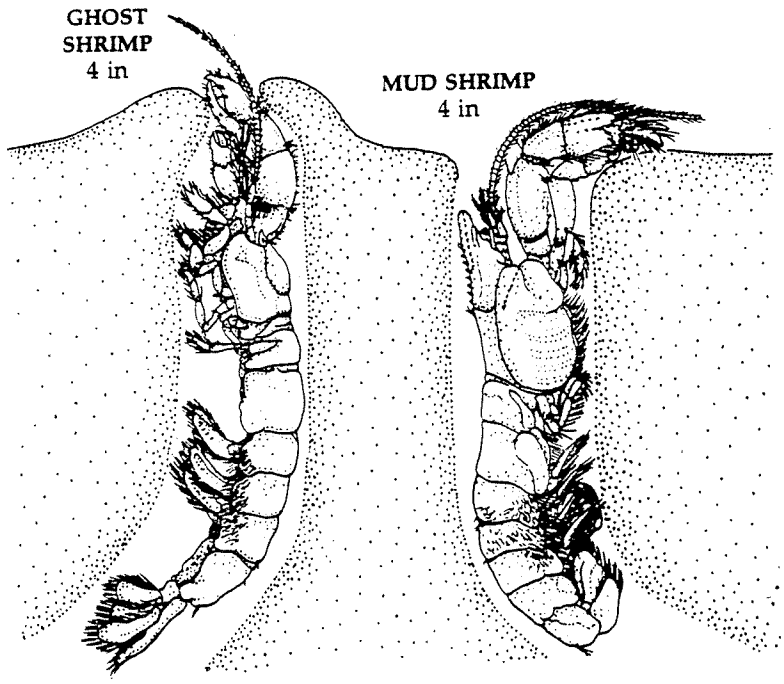
GROUP: active infauna

DESCRIPTION: Ghost shrimp, also includes C. gigas, a closely related spp.; the ghost shrimp is distinguishable from the other common mud shrimp, Upogebia, by its chelipeds, which are chelate and extremely unequal in size.

HABITAT: Occupies complex, multi-opening burrows in intertidal sand or sandy mud.

REFERENCE(S): See Kosloff (1987) for identification and figure.

Callianassidae (unid.)



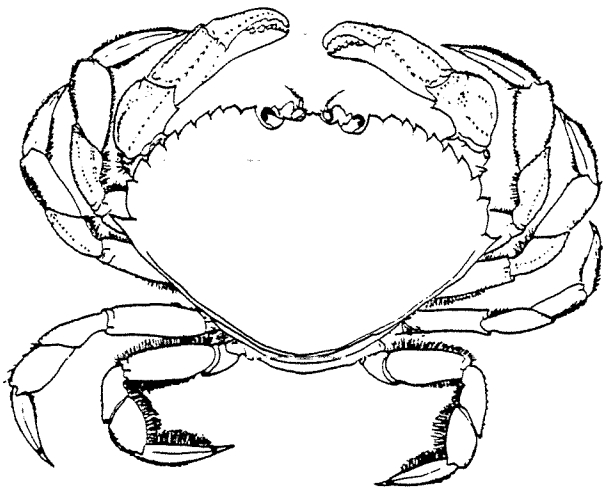
GROUP: active infauna

DESCRIPTION: Juvenile mud/ghost shrimp.

HABITAT: Sand and mud; intertidal to shallow subtidal.

REFERENCE(S): See Hart (1982); figure from Yates (1988).

Cancer magister



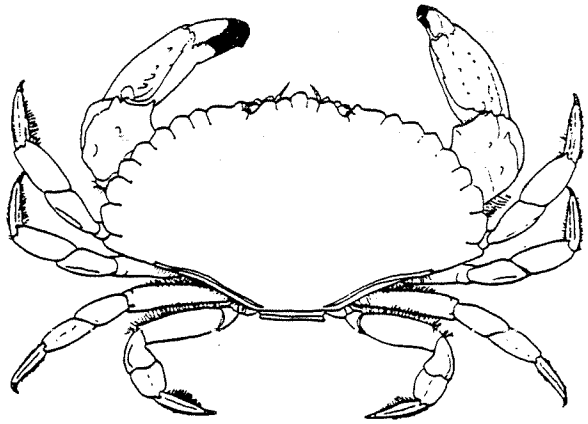
GROUP: evasive macroepifauna

DESCRIPTION: Dungeness crab; distingueshed from other Cancer spp. by dorsal surface and arrangement of spines on carapace, see taxonomic reference for identification.

HABITAT: Sand and eelgrass; intertidal (young-of-year juveniles) and shallow subtidal (larger juveniles, adults).

REFERENCE(S): See Hart (1982) for identification and figure.

Cancer productus



GROUP: evasive macroepifauna

DESCRIPTION: Red rock crab; distinguished by black tips of chelipeds and chelia with tubercles.

HABITAT: Rocky shores, under rocks, or partly buried under gravel or mud; low intertidal to subtidal.

REFERENCE(S): See Hart (1982) for identification and figure.

Cancer spp.

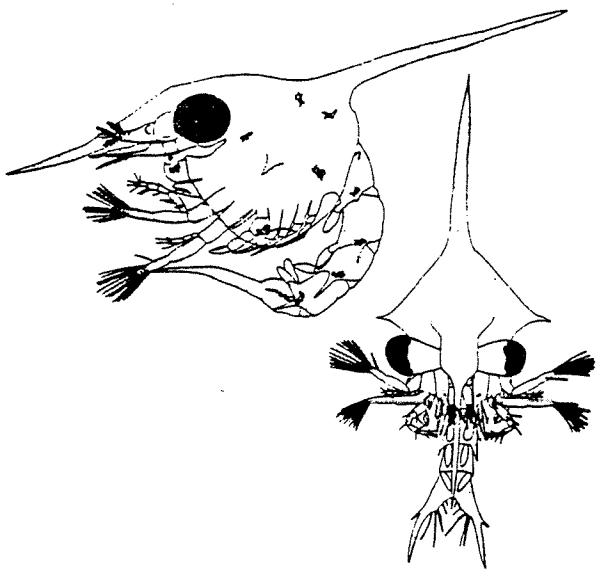
GROUP: evasive macroepifauna

DESCRIPTION: Crabs; see *Cancer magister* and *C. productus* for specific descriptions.

HABITAT: Various benthic habitats.

REFERENCE(S): See Kozloff (1987).

Cancer spp. (larvae)



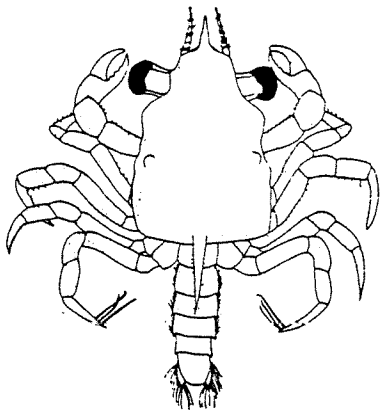
GROUP: pelagic zooplankton

DESCRIPTION: Crab zoeae are of distincive shape (see figure); megalopae resemble small adult crabs in which the abdomen has not completely folded under. See taxonomic reference for distinguishing among different species.

HABITAT: Planktonic; epibenthic megalopae shortly before settling.

REFERENCE(S): See Lough (1975) for identification; figures from Poole (1966).

Cancer spp. (megalops)



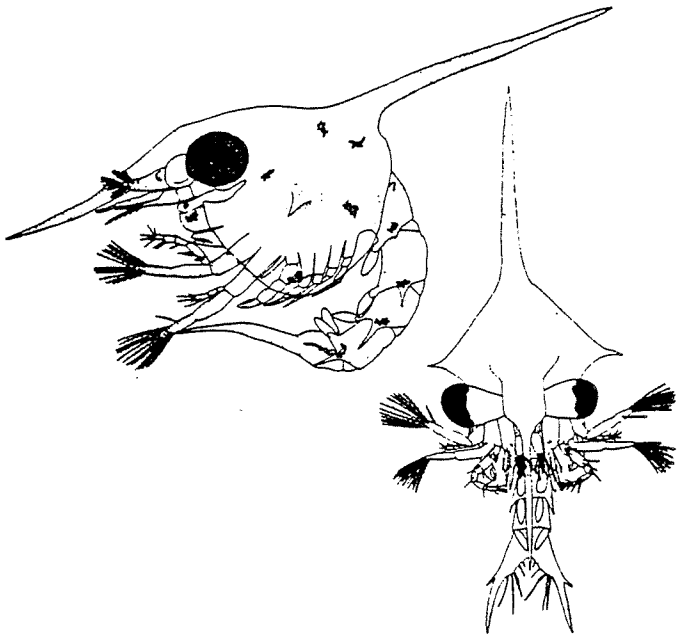
GROUP: pelagic zooplankton

DESCRIPTION: First larval stage which is crab-like; precedes first juvenile instar.

HABITAT: Water column to epibenthic boundary layer; sometimes found benthically.

REFERENCE(S): Lough (1975); figure from Poole (1966).

Cancer spp. (zoea)



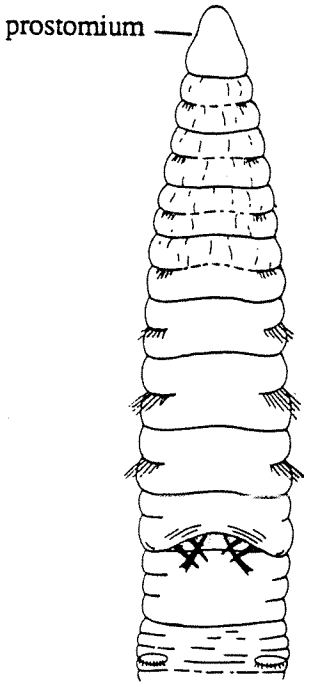
GROUP: pelagic zooplankton

DESCRIPTION: Crab larva with diagnostic rostral, dorsal and lateral spines.

HABITAT: Water column, often concentrated along tidal fronts.

REFERENCE(S): Lough (1975); figure from Poole (1966).

Capitellidae (unid.)



Capitellidae:
Capitella capitata,
male, dorsal view

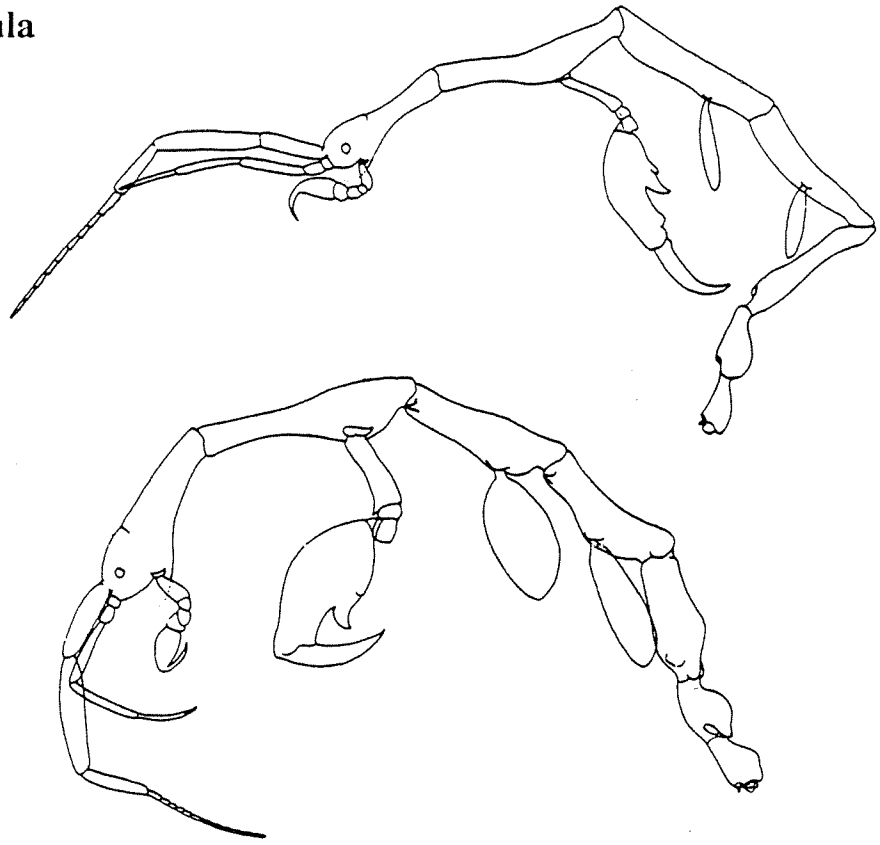
GROUP: sedentary infauna

DESCRIPTION: Family of slender polychaete worms; distinguished by conidal prostomium and setae consisting of capillary setae and hooded hooks; prominent capitellid in region is *Notomastus tenuis.*

HABITAT: Mudflats and emergent marshes.

REFERENCE(S): Description from Kozloff (1973); figure from Kozloff (1987).

Caprella laeviuscula



GROUP: epibenthic plankters

DESCRIPTION: Caprellid amphipod: see taxonomic reference for identification.

HABITAT: Intertidal to shallow subtidal; associated with macropyhtes and other structure.

REFERENCE(S): See Laubitz 1970 for identification and figure.

Carex lyngbei



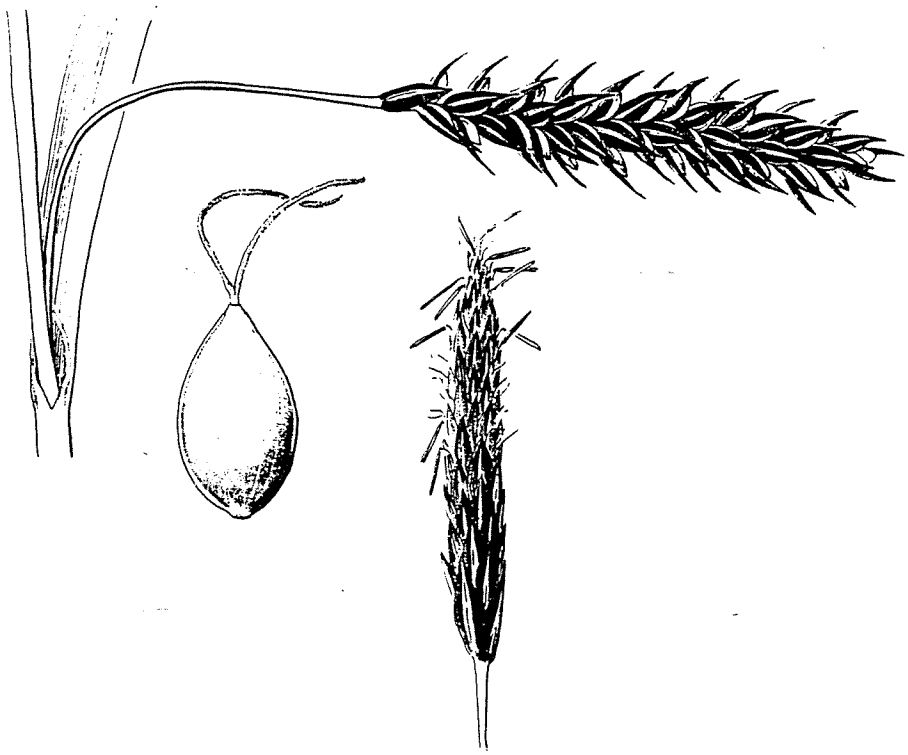
GROUP: rooted vascular plants

DESCRIPTION: Growing to 1 m in height, this species is very similar in appearance to Carex obnupta. They both have flat, deep green leaves, 2 to 6 mm wide and to 3 dm long, with an obvious channel running along the leaf's axis. In tidal situations, that portion of the plant above ground disappears during winter. New growth from the root mass begins in February and floral spikes appear in early spring. Each culm is triangular in cross section and bears three to seven pendulate floral spikes 1.5 to 5 cm long. The two species can be distinguished in the field by the spikes; on C. obnupta the spikes are more erect and sessile due to absence of a peduncle.

HABITAT: These sedges are extremely common wetland plants the Pacific Northwest. C. lyngbyei is most frequently associated with low and high brackish marshes in estuaries, although it has been reported in bogs, the understory of swamps, and shallow, freshwater marshes in both tidal and nontidal situations. While the distribution of the two species overlaps, C. obnupta is most common in shallow coastal fresh marshes and coastal swamps. True hydrophytes, these species are almost never found in nonwetland habitats, and then only under very unusual conditions.

REFERENCE(S): Identification from Weinman et al. 1984; figure from Hitchcock and Cronquist 1978.

Carex lyngbei (seeds)



GROUP: rooted vascular plants

DESCRIPTION: See *Carex lyngbei*

HABITAT: Emergent marsh; seeds may be also be seen in neuston samples.

REFERENCE(S): See figure in Hitchcock and Cronquist 1978.

Carex spp.

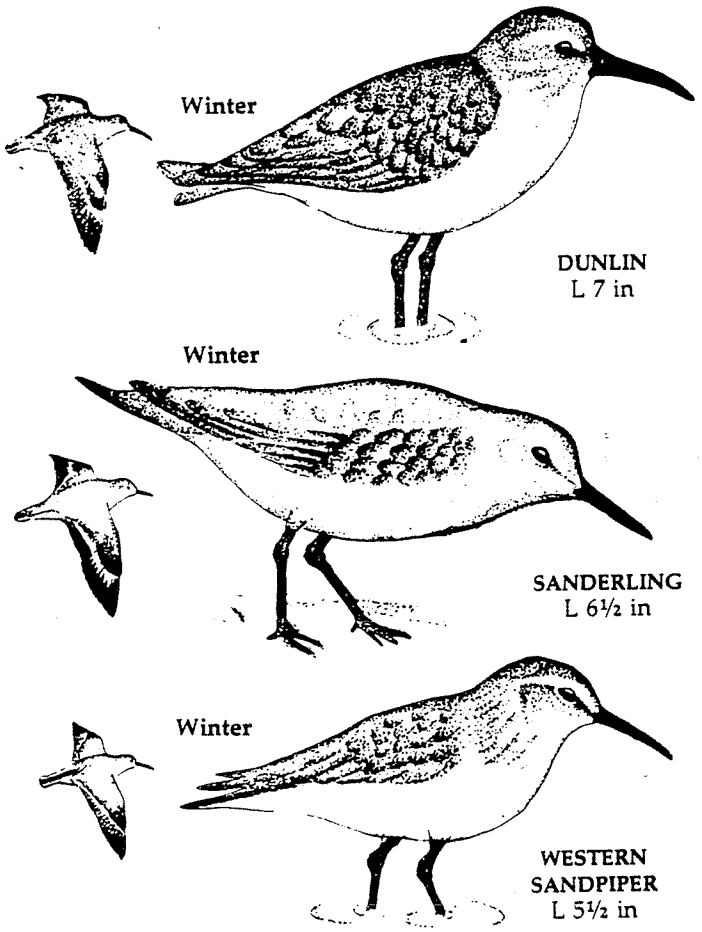
GROUP: rooted vascular plants

DESCRIPTION: Sedges; see *Carex lyngbyei*.

HABITAT: Both low and high brackish and coastal marshes, especially common as fringing marshes in estuaries.

REFERENCE(S): See Hitchcock and Cronquist 1978, vol. 1 for description of Carex species.

Chalidrae (unid.)



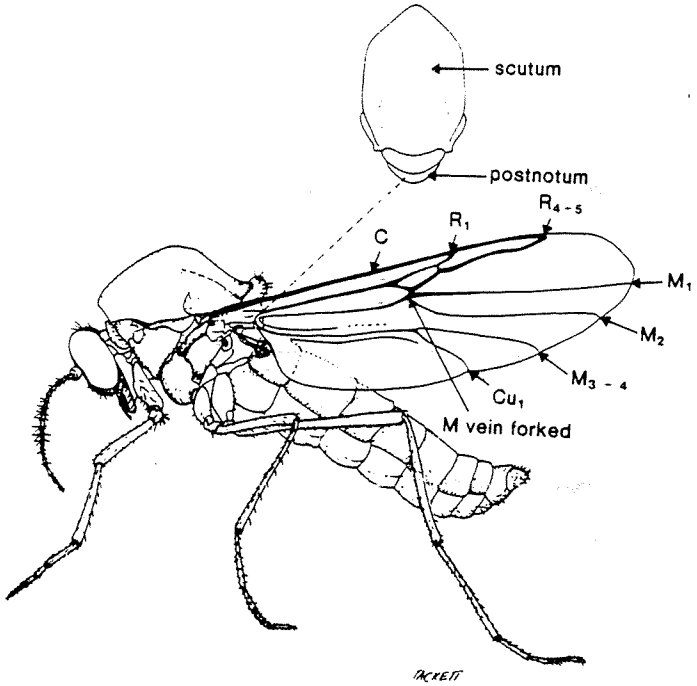
GROUP: avifauna

DESCRIPTION: Sandpipers; small shorebirds with slender, long bills; usually colored mottled grey.

HABITAT: Sand/mudflats and gravel beaches.

REFERENCE(S): Figure from Yates (1988).

Chironomidae (unid.)



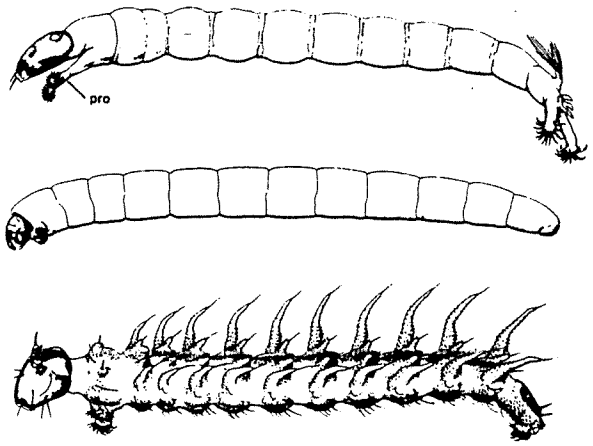
GROUP: neustonic and drift invertebrates

DESCRIPTION: Midges; see taxonomic reference for identification.

HABITAT: Midges are found in most wetland systems in a wide range of ecological conditions.

REFERENCE(S): See Merrit and Cummins (1984) for identification and figure.

Chironomidae, larvae/pupae



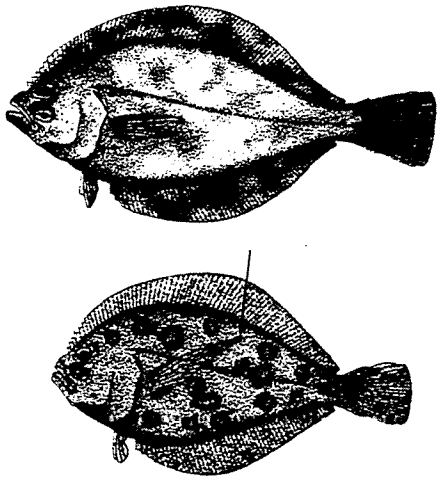
GROUP: surface epifauna

DESCRIPTION: Midges: see taxonomic reference for identification.

HABITAT: Larvae occur and feed ~~on a great variety of organic substrates; they~~ are found in most aquatic systems in a wide range of ecological conditions.

REFERENCE(S): See Merrit and Cummins (1984) for identification and figure.

Citharichthys spp.



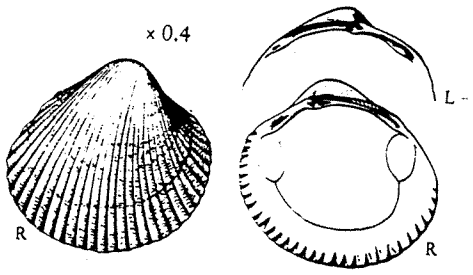
GROUP: sessile fish

DESCRIPTION: Sanddabs; small left-eyed flounder (eyes and color on left side); small left pectoral fin; two common species, larger, mottled Pacific sanddab, C. sordidus, and small, spotted speckled sanddab, C. stigmaeus.

HABITAT: Mostly found as juveniles on sandy bottoms; benthic feeder.

REFERENCE(S): Figure from Eschmeyer et al. (1983).

Clinocardium nutalli



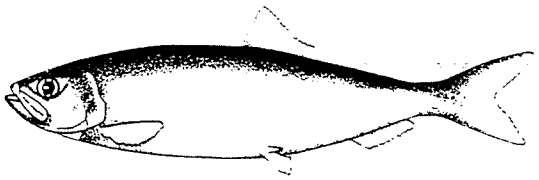
GROUP: surface epifauna

DESCRIPTION: Heart cockle; pronounced radial ribs; see taxonomic reference for other distinguishing characteristics.

HABITAT: Intertidal, shallow subtidal on sand and in eelgrass.

REFERENCE(S): See Kozloff (1987) for identification; figure from Keen and Coan (1974).

Clupea harengus pallasi



GROUP: motile fish

DESCRIPTION: Pacific herring; moderately small, spawning adults to 30-40 cm; compressed and silvery with no spots or striations on sides.

HABITAT: Exceedingly important schooling baitfish, sought commercially as bait and for roe; spawns in kelp and eelgrass beds in winter-spring; juveniles occupy shallow nursery habitats, especially estuaries and bays, through fall.

REFERENCE(S): Figure from Eschmeyer et al. (1983).

Clupea harengus pallasi (eggs)



GROUP: surface epifauna

DESCRIPTION: Eggs of Pacific herring; small, 1.2-1.5 mm diameter, cream to white eggs which adhere to substrate and each other; usually in clumps but, when sparse, arranged in rows on substrate.

HABITAT: Found on eelgrass, kelp, rockweed, and other macroalgae, and often debris, rocks, and pilings, from intertidal to shallow (10 m) subtidal during February thru June.

REFERENCE(S): Desription from Hart (1973); Phillips (1984).

Corbicula manilensis

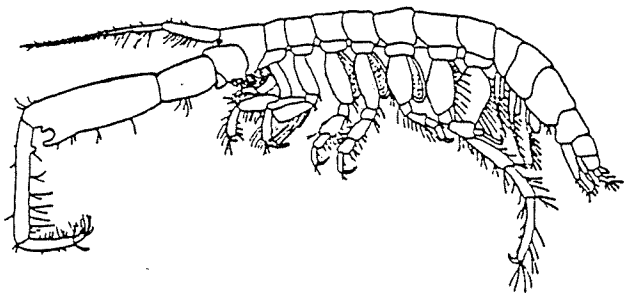
GROUP: surface epifauna

DESCRIPTION: Medium sized, surface-dwelling bivalve; Note: Figure not available.

HABITAT: Subsidiary channels and shallow subtidal habitats on brackish reaches of estuaries.

REFERENCE(S): See Keen and Coan (1974).

Corophium salmonis



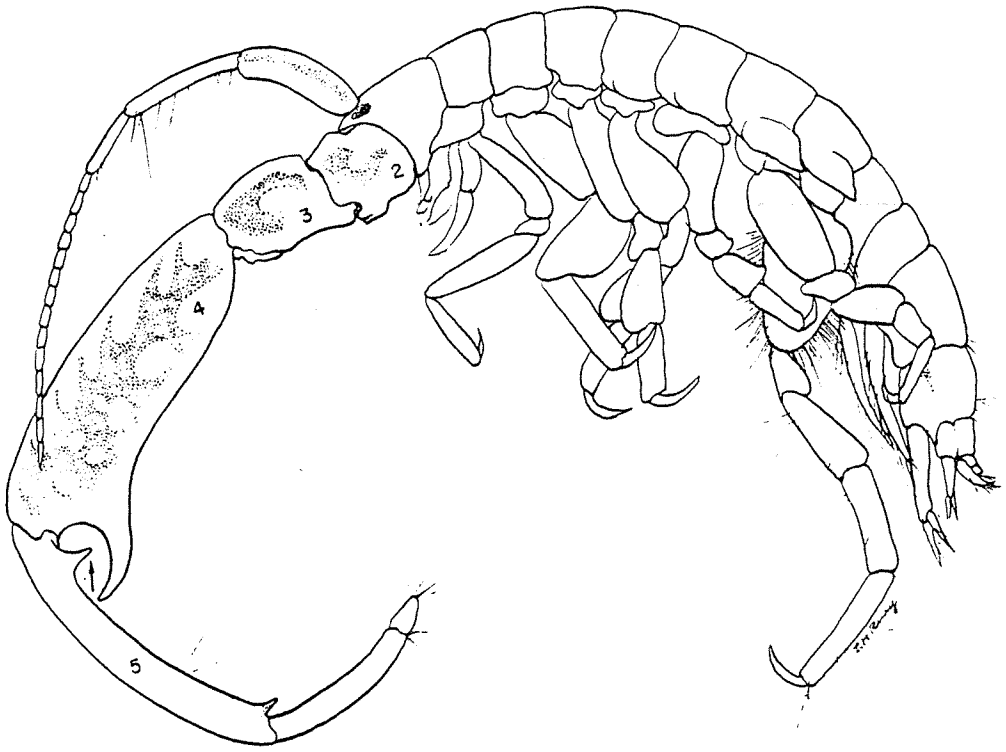
GROUP: epibenthic plankters

DESCRIPTION: Gammarid amphipods; distinguishable by greatly enlarged second antennae and somewhat dorsoventrally flattened body.

HABITAT: Tube-builders in intertidal to subtidal soft sediments; males and juveniles epibenthic.

REFERENCE(S): See Kozloff (1987) for identification and figure.

Corophium spinicorne



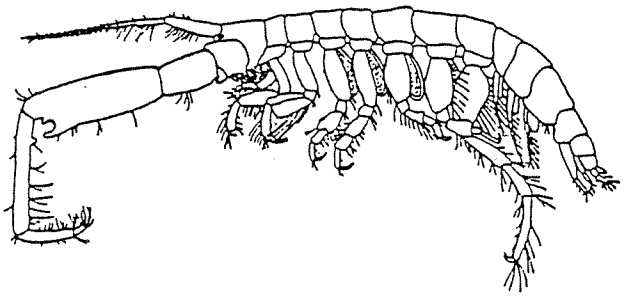
GROUP: epibenthic plankters

DESCRIPTION: Gammarid amphipods; distinguishable by greatly enlarged second antennae and somewhat dorsoventrally flattened body; Note: Figure not available; see *C. salmonis*.

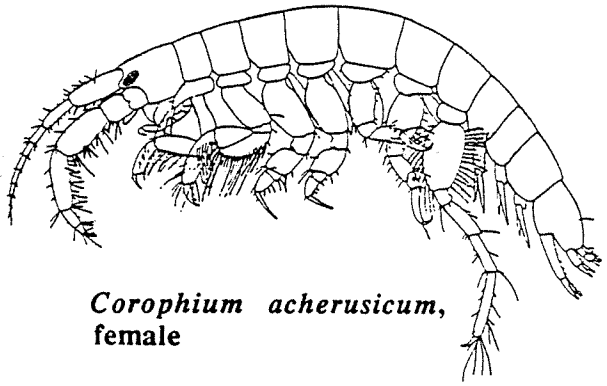
HABITAT: Tube builders in intertidal to subtidal soft sediments; males and juveniles epibenthic.

REFERENCE(S): See Kozloff (1987) for identification; figure from Rudy and Rudy (1983).

Corophium spp.



***Corophium salmonis*, male**



***Corophium acherusicum*, female**

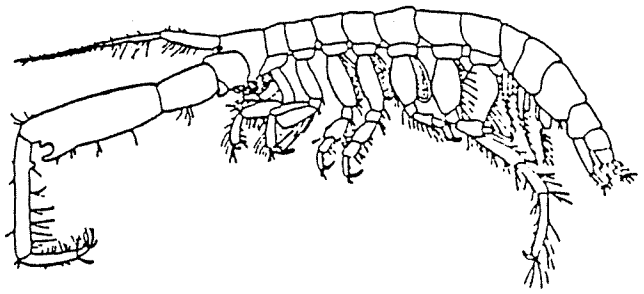
GROUP: epibenthic plankters

DESCRIPTION: Gammarid amphipods, distinguishable by greatly enlarged second antennae and somewhat dorsoventrally flattened body.

HABITAT: Tube builders in intertidal to subtidal soft sediments; males and juveniles epibenthic.

REFERENCE(S): See Kozloff (1987) for identification and figure.

Corophium spp. (males)



GROUP: epibenthic plankters

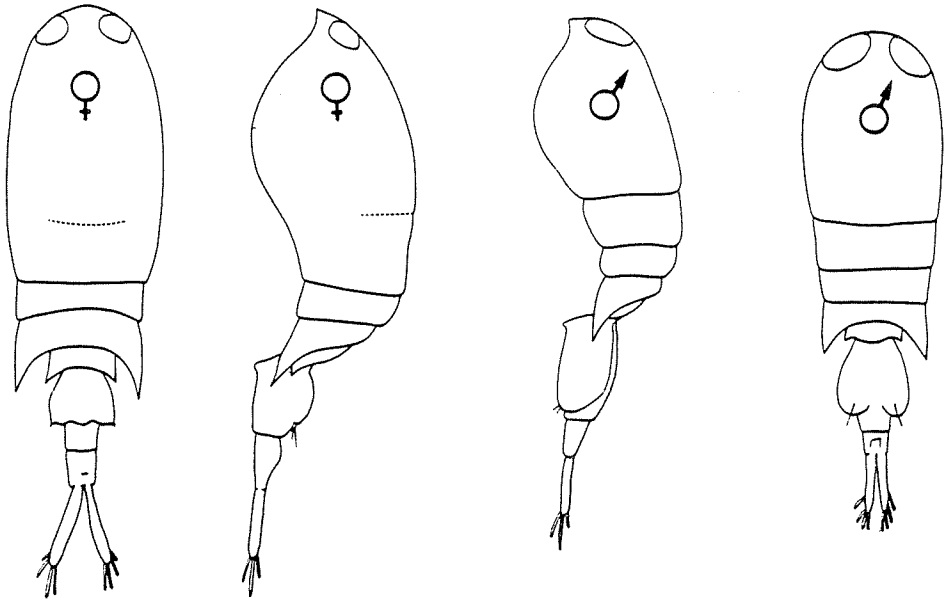
DESCRIPTION: Gammarid amphipods; distinguishable by greatly enlarged second antennae and somewhat dorsoventrally flattened body.

HABITAT: Tube builders in intertidal to subtidal soft sediments; males and juveniles epibenthic.

REFERENCE(S): See Kozloff (1987) for identification; figure of

C. salmonis male is from Kozloff (1987)..

Corycaeus anglicus



GROUP: pelagic zooplankton

DESCRIPTION: Cyclopoid copepod which is distinguishable by large eye 'lenses' and bluish-green color.

HABITAT: Planktonic.

REFERENCE(S): See Gardner and Szabo (1982) for identification and figure.

Corycaeus spp.

GROUP: pelagic zooplankton

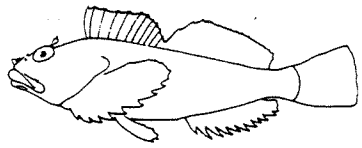
DESCRIPTION: Cyclopoid copepod; see *C. anglicus.*

HABITAT: Planktonic marine.

REFERENCE(S): See Gardner and Szabo (1982) for taxonomic differentiation.

Cottidae (unid.)

Anal spines absent; body scaleless or only partly scaled .....



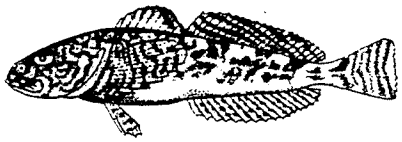
GROUP: sessile fish

DESCRIPTION: Sculpins; typically drab-colored; stout, almost round bodies; larger head with spines and knobs; often scaleless or partially scaled.

HABITAT: Found in all habitats; usually demersal, and often limited in movement from home range or tidepool; most feed on small benthic invertebrates.

REFERENCE(S): Figure from Miller and Lea (1972).

Cottus spp.



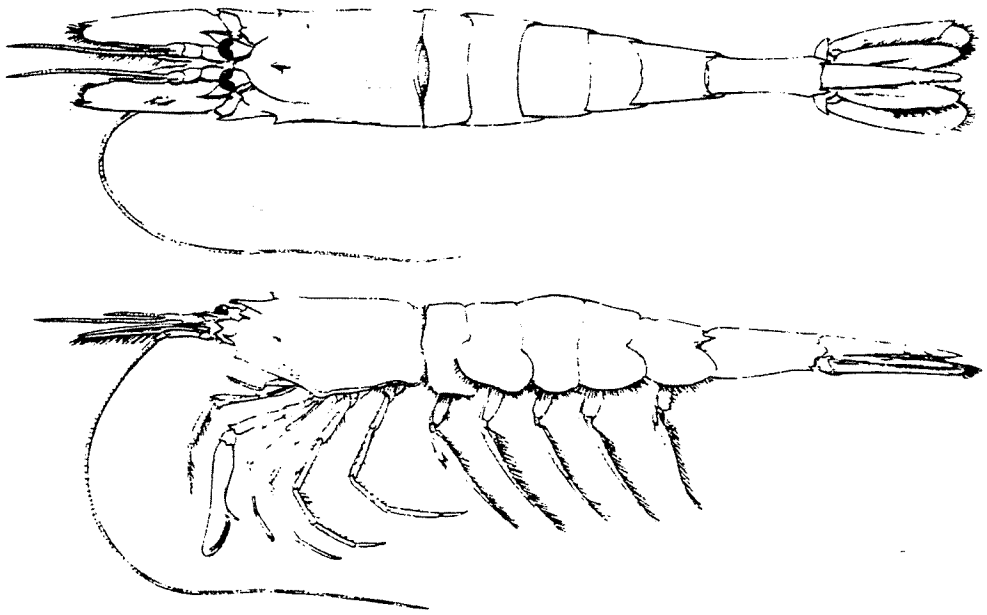
GROUP: sessile fish

DESCRIPTION: Small scaleless sculpin with uppermost preopercular spine without barbs; two most common species in estuarine habitats include prickly, C. asper, and coastrange, C. aleuticus.

HABITAT: Found in mainstream and tidal channels with sandy-gravel to mud substrates; found commonly in emergent marshes; juveniles feed on planktonic invertebrates, adults on benthic invertebrates.

REFERENCE(S): Figure of most common species, *C. asper*, from Eschmeyer et al. (1983).

Crangon franciscorum



GROUP: evasive macroepifauna

DESCRIPTION: Shrimp.

HABITAT: Euryhaline in sandy sediments.

REFERENCE(S): See Butler (1980), and Kozloff (1987).

Crangon spp.

GROUP: evasive macroepifauna

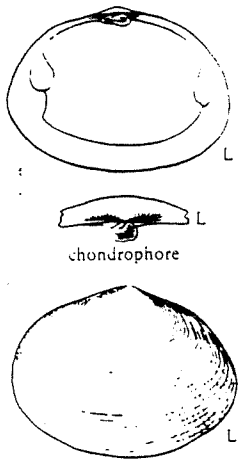
DESCRIPTION: Sand shrimps; see *C. franciscorum*.

HABITAT: Sandy sediments; intertidal to subtidal.

REFERENCE(S): See Butler (1980) for identification and illustrations.

Cryptomya californica





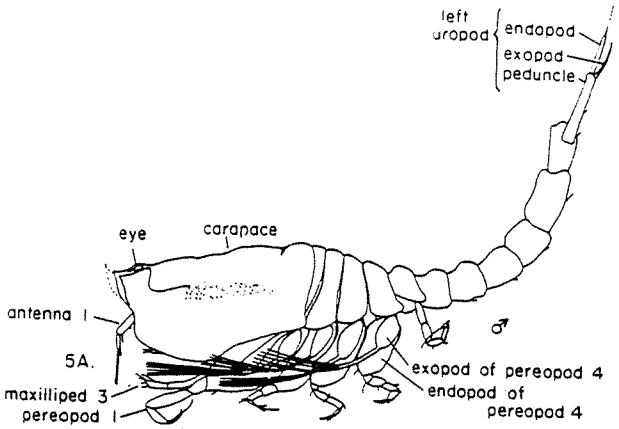
GROUP: sedentary infauna

DESCRIPTION: Medium sized bivalve; equal valves, thin and smooth with few radial striae.

HABITAT: Sand/mudflats; siphons open into burrows of Callianassa californiensis.

REFERENCE(S): Description and figure from Kozloff (1983); additional figure from Keen and Coan (1974).

Cumella vulgaris



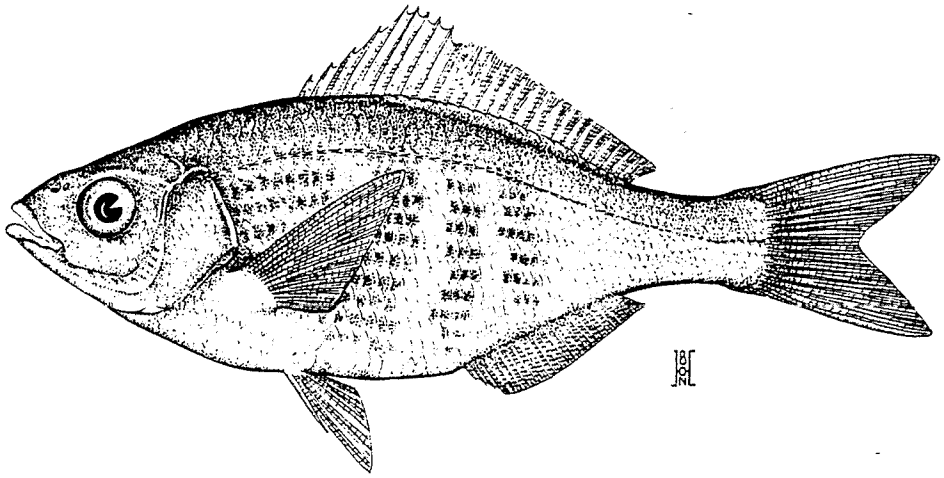
GROUP: epibenthic plankters

DESCRIPTION: Cumacean; see taxonomic reference for identification.

HABITAT: C. vulgaris is one of the most ~~common, abundant infaunal organisms of soft to~~ sandy sediments in embayments; males may occur in dense swarms in the water column or on the surface in shallow water.

REFERENCE(S): See Kozloff (1987) for identification, figure from Smith and Carlton (1975).

Cymatogaster aggregata



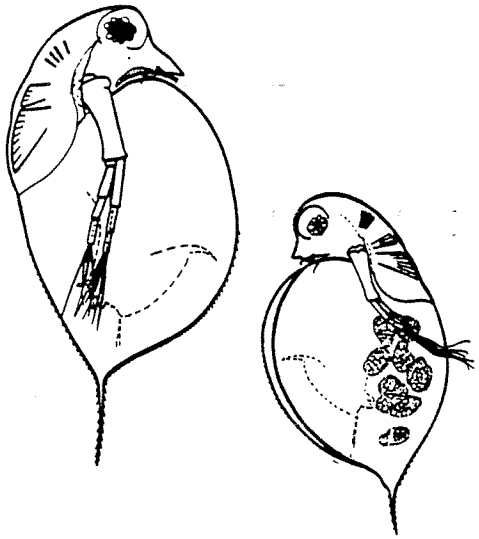
GROUP: motile fish

DESCRIPTION: Shiner perch; small seaperch with elliptical body shape, horizontal rows of dark spots on sides crossed by three yellow bars, and usually a black spot above the lip.

HABITAT: Extremely abundant surfperch, especially in eelgrass and gravel-cobble with macroalgae habitats; viviparous, with young born in spring and summer; typically found in aggregations.

REFERENCE(S): Figure from Hart (1973).

Daphnia spp.



GROUP: pelagic zooplankton

DESCRIPTION: Water fleas; most common of the freshwater cladocerans. See taxonomic references for distinguishing characters.

HABITAT: Planktonic freshwater or brackish water near river mouths.

REFERENCE(S): See Pennak (1978) for identification and figure.

Decapoda (larvae)

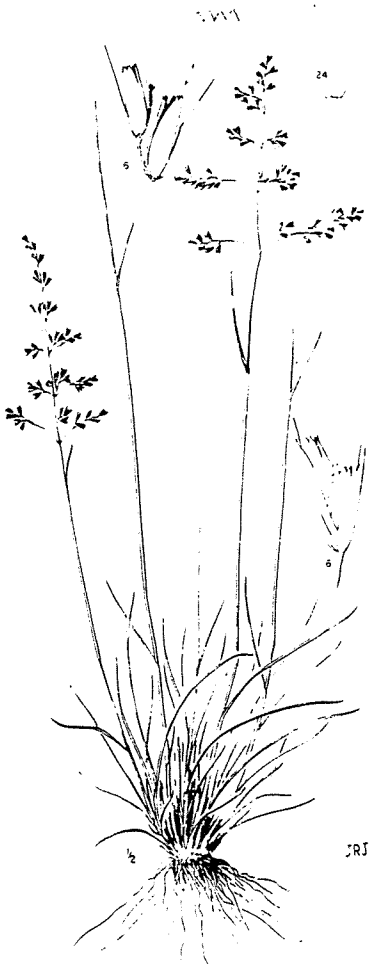
GROUP: pelagic zooplankton

DESCRIPTION: Various forms; see references for taxonomy and illustrations of diverse forms.

HABITAT: Marine planktonic.

REFERENCE(S): See Hart (1971), and Smith (1977).

Deschampsia cespitosa



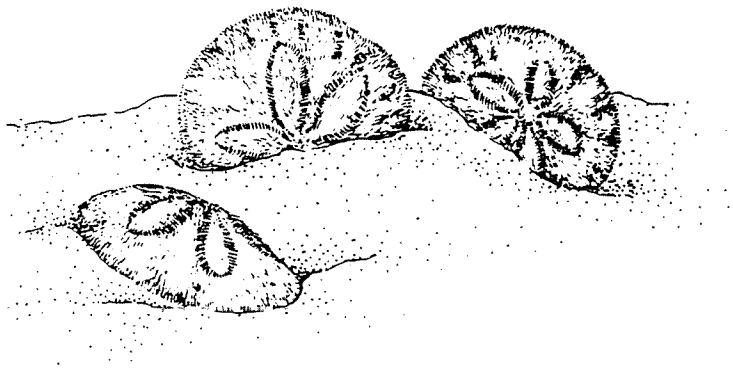
GROUP: rooted vascular plants

DESCRIPTION: Characteristically the tallest plant of the salt marsh, D. caespitosa is a perennial, with culms 2 to 12 dm tall. The leaves are very narrow (1.5 to 4 mm) and often folded or rolled. The panicle is 8 to 25 cm long and open rather than compressed. High salt marshes dominated by D. caespitosa are green in summer, then take on a distinctive golden-brown hue during late summer through fall. The above ground growth persists through much of the winter.

HABITAT: One of the most common components of Pacific Northwest salt marshes, D. caespitosa occurs in dense stands at or near mean higher high water. These stands become less dense at lower elevations, gradually being replaced by other salt marsh species in the lower marsh. It is commonly associated with Pacific silverweed in high salt marshes. D. caespitosa is widely distributed, but not common, in shallow freshwater marshes at all elevations.

REFERENCE(S): Identification from Weinman et al. (1984); figure from Hitchcock and Cronquist (1978).

Dendraster excentricus



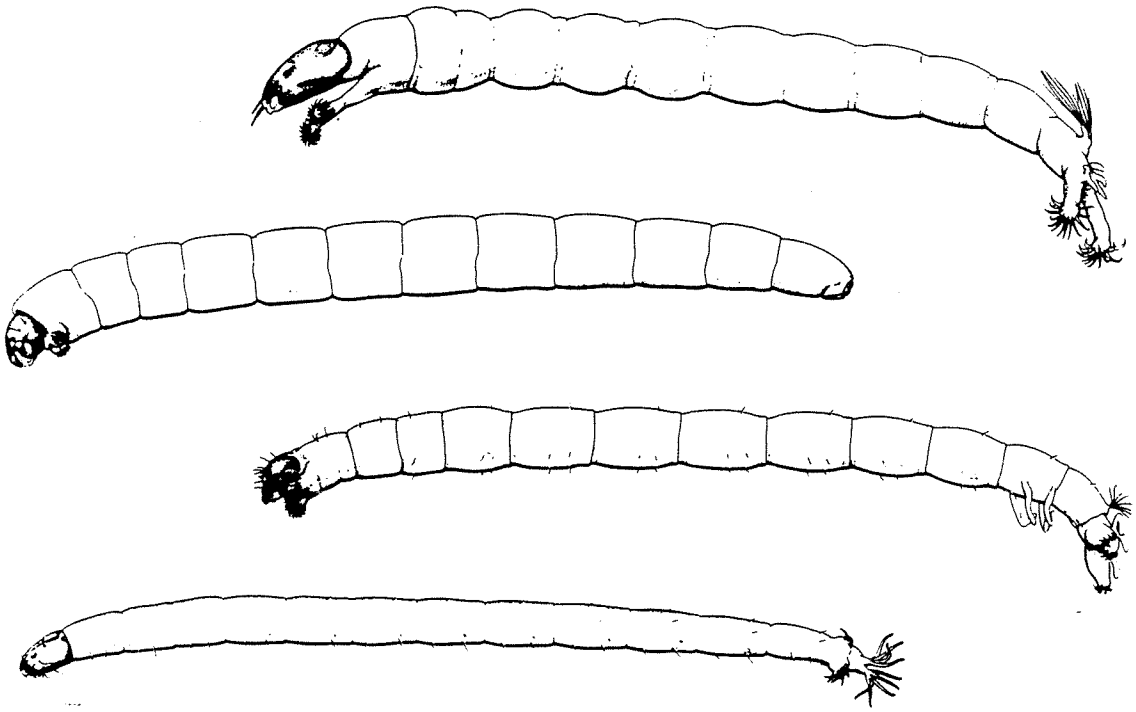
GROUP: surface epifauna

DESCRIPTION: Sand dollar; disk shaped echinoderm.

HABITAT: Intertidal, shallow subtidal (clean) sand.

REFERENCE(S): Figure from Yates (1988).

Diptera (larvae)



GROUP: surface epifauna

DESCRIPTION: Insect larvae; very diverse, such that only common distinguishing characteristic is the absence of jointed legs on all thoracic segments. Larval head structures modified; body usually soft and pliable and often covered with dense pubsecence or with scattered hairs; most common group in estuarine wetlands are of the family Chironomidae.

HABITAT: Usually living on or in surface layer of sediments or attached to rocks and plants in brackish marshes and mudflats.

REFERENCE(S): Description from Merritt and Cummins (1984); see reference for taxonomy, illustrations and life history comments.

Diptera (unid.)

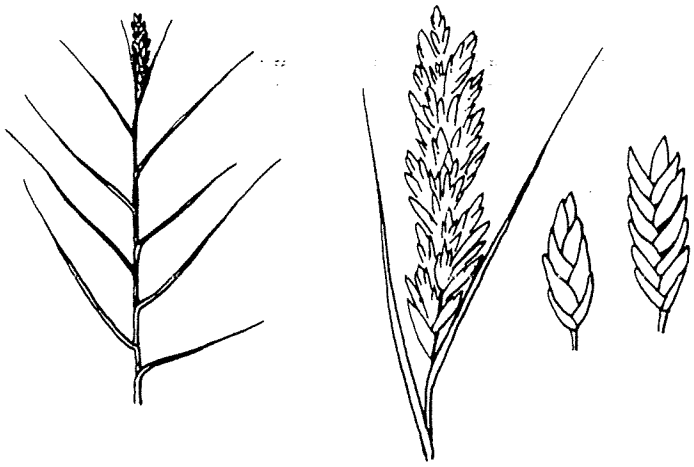
GROUP: surface epifauna

DESCRIPTION: Flies; see Chironomidae, Ephydridae, etc.

HABITAT: Common to all wetland habitats and typical of drift on surface of water column.

REFERENCE(S): See Merritt and Cummins (1984).

Distichlis spicata



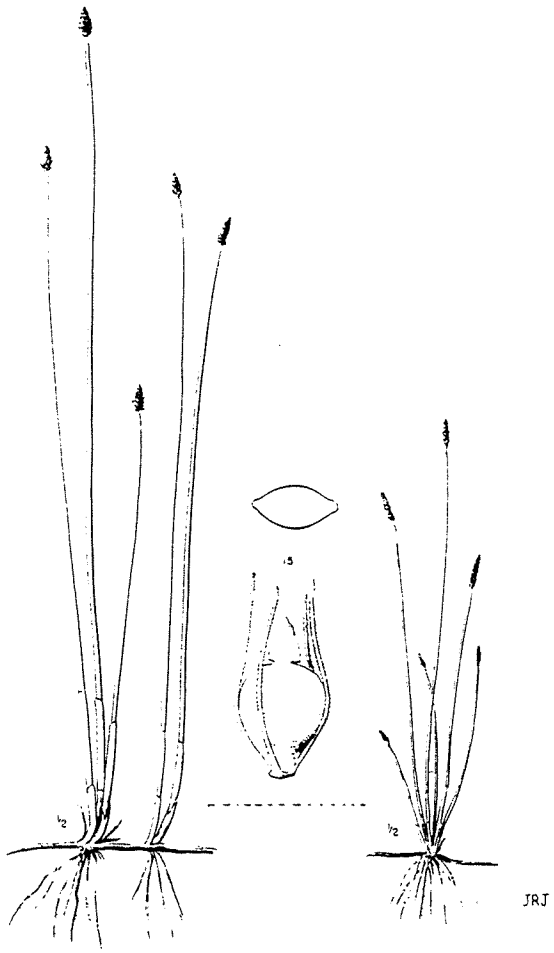
GROUP: rooted vascular plants

DESCRIPTION: This species, commonly called saltgrass, is usually less than 30 cm tall, and forms mats on the soil surface. A distinctive feature is the bilateral placement of the leaves in a single plane. The leaves are on the order of 5 cm long, and angle sharplyl from the stem. Flower bearing panicles are 3 to 8 cm in length, compressed, and are terminal on the culms. Floral heads appear purplish.

HABITAT: Common in high and low salt marshes. It can tolerate extremely high salinities, and occurs in salt pans. Frequently associated with Salicornia virginica.

REFERENCE(S): Description from Weinmann et al. (1986), see also Hitchcock and Cronquist (1973); figure from Hotchkiss (1972).

Eleocharis palustris



GROUP: rooted vascular plants

DESCRIPTION: See *Eleocharis* spp.

HABITAT: Brackish, wet meadows.

REFERENCE(S): Identification from Weinmann et al. (1984); figure from Hitchcock and Cronquist (1978).

Eleocharis spp.

GROUP: rooted vascular plants

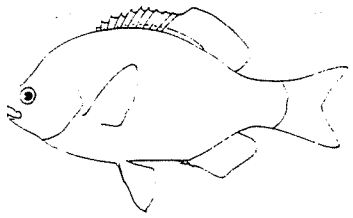
DESCRIPTION: The genus is easily identified by the terminal and solitary floral spikelets. Some species are diminutive, such as *E. parvula* (1 to 10 cm), while others are large and robust, such as *E. palustris* (to 1 m). See *E. palustris* for figure.

HABITAT: Several species are represented in the Pacific Northwest; habitats range from brackish marshes (E. parvula) to shallow freshwater marshes, wet meadows (E. palustris) ,and swamps. The species is apparently limited to wetland situations. Spike rush is often found in standing water in roadside ditches or the edges of ponds where it is frequently associated with duckweed, bullrushes and other marsh plants. Spike rush is also common in the wetter portion of meadows dominated by soft rush.

REFERENCE(S): Identification from Weinman et al. 1984. See Hitchcock, vol. 1 for further description of Eleocharis species.

Embiotocidae (unid.)

Anal soft-rays more than 10; maxillary fully exposed when mouth is closed .....



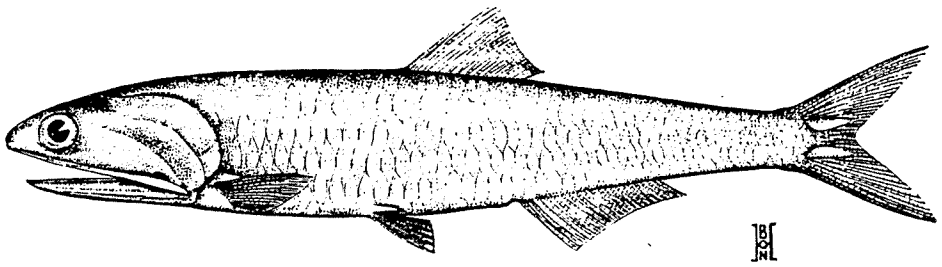
GROUP: motile fish

DESCRIPTION: Seaperches; perchlike, compressed, elliptical to oblong-shaped fishes with continuous dorsal (top) fin; usually bright colored.

HABITAT: Almost exclusively in nearshore habitats; (e.g. surf zone, kelp and eelgrass beds); some (e.g., shiner perch) school.

REFERENCE(S): See Eschmeyer et al (1983) for key to species.

Engraulis mordax



GROUP: motile fish

DESCRIPTION: Northern anchovy; small, silvery compressed (herring-like); overhanging snout and low jaw extending far posterior of eye.

HABITAT: Common, abundant baitfish in coastal estuaries; school in more saline surface waters; very important as forage fish for larger fishes and diving seabirds; planktivorous on copepods, euphausiids, and decapod larvae.

REFERENCE(S): Figure from Hart (1973).

Enteromorpha spp.



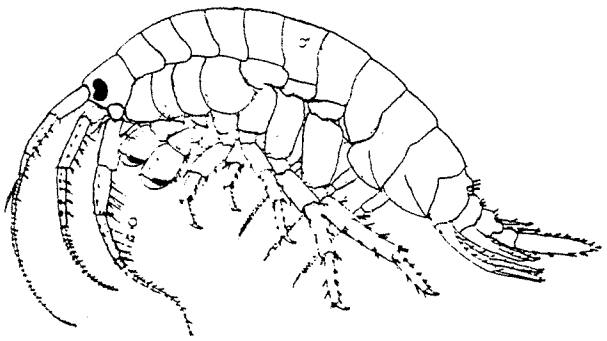
GROUP: benthic macroalgae

DESCRIPTION: See reference for descriptive key to species and figures

HABITAT: Mud- and sandflats and gravel-cobble beaches; particularly common around freshwater drainage areas on beaches.

REFERENCE(S): Identification and figures from Smith (1969).

Eogammarus confervicolus



GROUP: epibenthic plankters

DESCRIPTION: Gammarid amphipod; see taxonomic references for identification.

HABITAT: Estuarine intertidal and subtidal; especially associated with sedges, ellgrass, algae, and wood chip deposits.

REFERENCE(S): See Bousfield (1979), and Kozloff (1987).

Eogammarus spp.

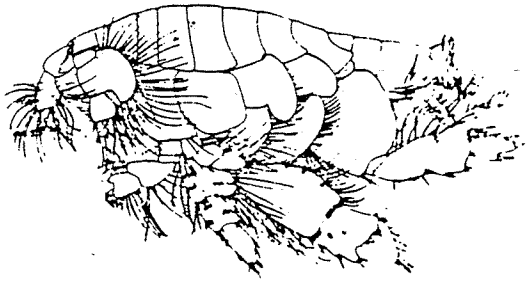
GROUP: epibenthic plankters

DESCRIPTION: Gammarid amphipod; two species commonly occur; *E. confervicolus* and *E. oclairi* and are separable by subtle characters such as telsonic spination (see see *E. confervicolus* for figure).

HABITAT: Brackish to estuarine; associated with detritus and macroalgae on fine sand-silt sediments.

REFERENCE(S): See Kozloff (1987) for identification; figure from Bousfield (1979).

Eohaustorius washingtonius



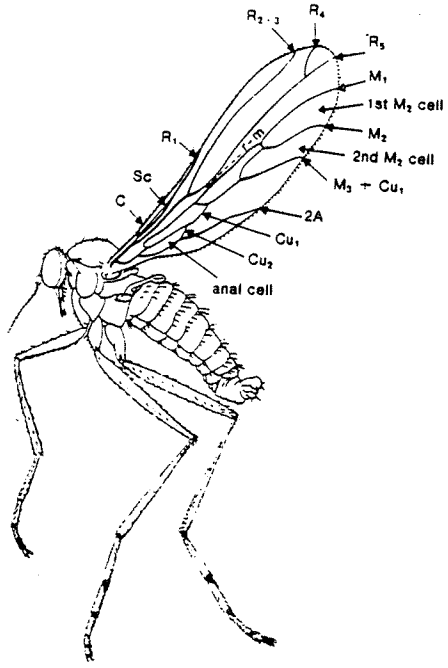
GROUP: epibenthic plankters

DESCRIPTION: Gammarid amphipod; see taxonomic reference for identifying characteristics.

HABITAT: Intertidal and shallow subtidal sand.

REFERENCE(S): See Kozloff (1987) for identification; figure from Smith and Carlton (1975).

Ephydridae (unid.)



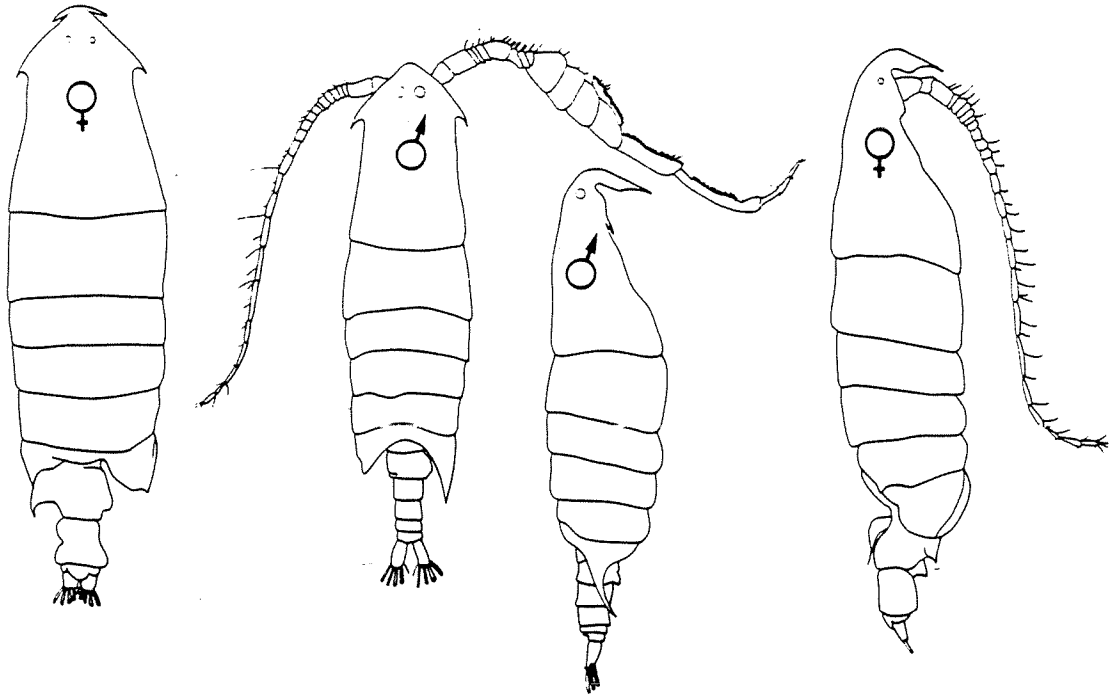
GROUP: neustonic and drift invertebrates

DESCRIPTION: Shore flies: see taxonomic reference for identification.

HABITAT: Littoral fringes of fresh and marine waters.

REFERENCE(S): See Merrit and Cummins (1984) for identification and figure.

Epilabidocera amphitrites



GROUP: pelagic zooplankton

DESCRIPTION: Large calanoid copepod, distinguished by distinctive head shape, eye 'lenses', and surface swarming behavior.

HABITAT: Marine planktonic, especially surface waters.

REFERENCE(S): See Gardner and Szabo (1982) for identification and figure.

Epilabidocera spp.

GROUP: pelagic zooplankton

DESCRIPTION: Calanoid copepod; see references and figure for *E. amphitrites*.

HABITAT: Planktonic marine, especially surface waters.

REFERENCE(S): See Gardner and Szabo (1982).

epiphytic algae/animals



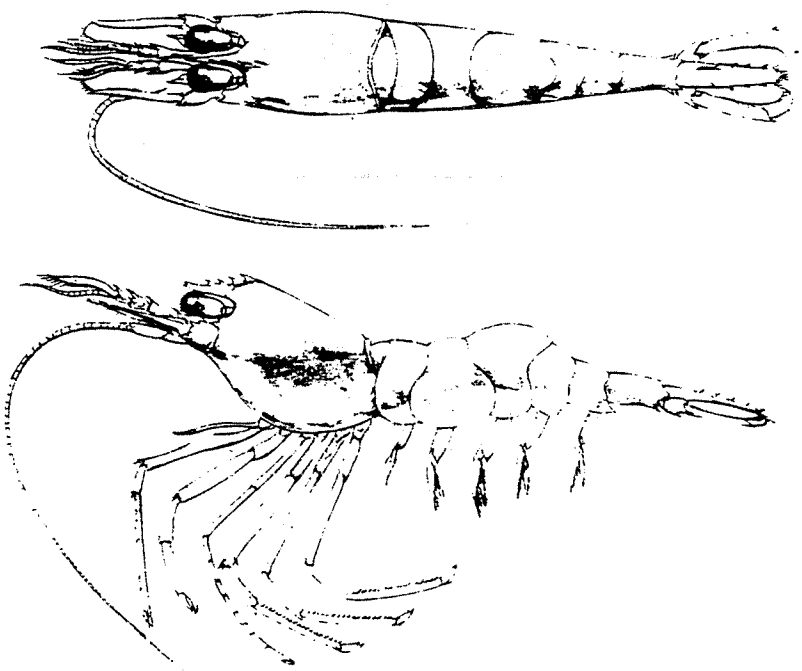
GROUP: benthic microbiota

DESCRIPTION: microalgae, small macroalgae, and small animals attached to eelgrass, kelps, seaweeds, and other plants.

HABITAT: Macrophytes.

REFERENCE(S): See Phillips (1984), and Seliskar and Gallagher (1983).

Eualus spp.



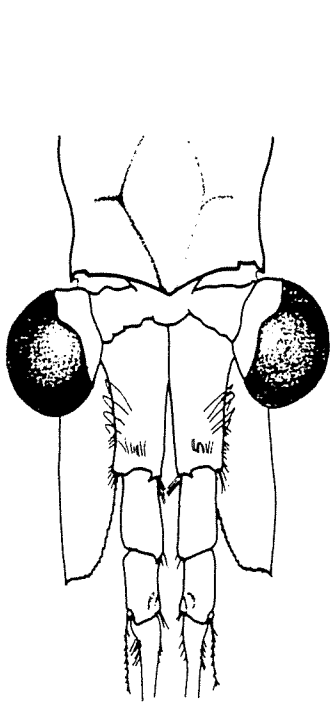
GROUP: evasive macroepifauna

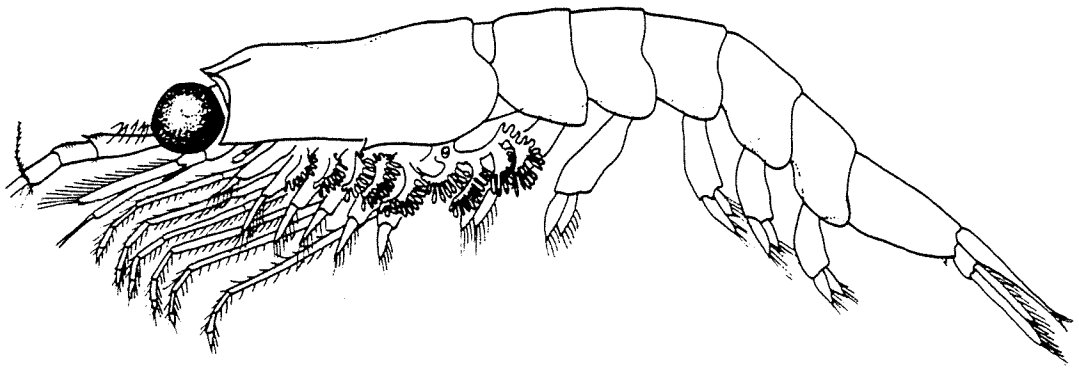
DESCRIPTION: Hippolytid shrimp.

HABITAT: Low intertidal to subtidal on various substrates.

REFERENCE(S): See Butler (1980), and Kozloff (1987).

Euphausia pacifica





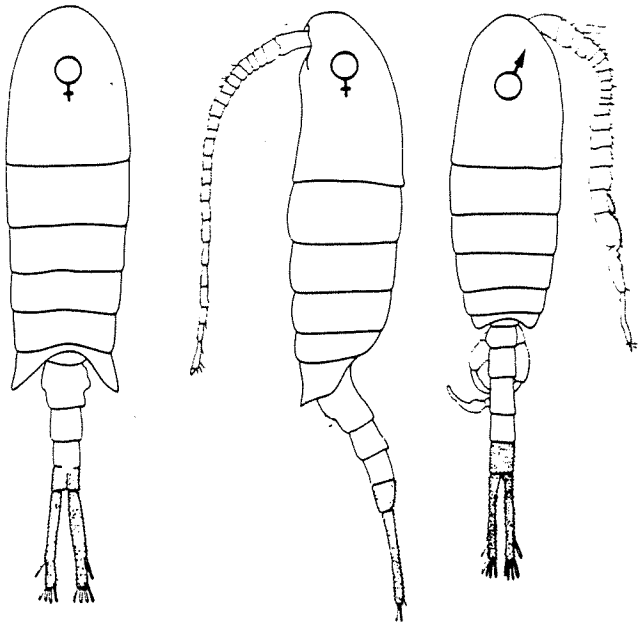
GROUP: pelagic zooplankton

DESCRIPTION: Euphausiid; see taxonomic reference for distinguishing characteristics.

HABITAT: Nektonic; strong vertical migrators.

REFERENCE(S): See Kathmann et al. (1986) for identification and figure.

Eurytemora affinis



GROUP: pelagic zooplankton

DESCRIPTION: Calanoid copepod; two species of *Eurytemora* are common in the northeastern Pacific coastal regions: *E. affinis* occurs in fresh to brackish water in rivers and their mouths; *E. americana* is more common in marine conditions. See taxonomic reference for distinguishing characteristics.

HABITAT: Freshwater to coastal marine planktonic; may be strongly epibenthic in behavior.

REFERENCE(S): See Gardner and Szabo (1982) for identification and figure.

Eusiroides spp.

GROUP: epibenthic plankters

DESCRIPTION: Gammarid amphipod; Note: figure not available.

HABITAT: Littoral, shallow subtidal?

REFERENCE(S): See Barnard (1969) for description of genus.

filamentous algae

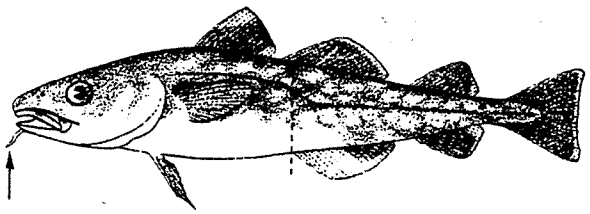
GROUP: benthic microbiota

DESCRIPTION: Algal growth where the cells comprising the body of the alga are arranged in a chain-like manner; Note: Figure not available.

HABITAT: Benthic or free floating in aquatic habitats.

REFERENCE(S): See Scagel (1972).

Gadus macrocephalus



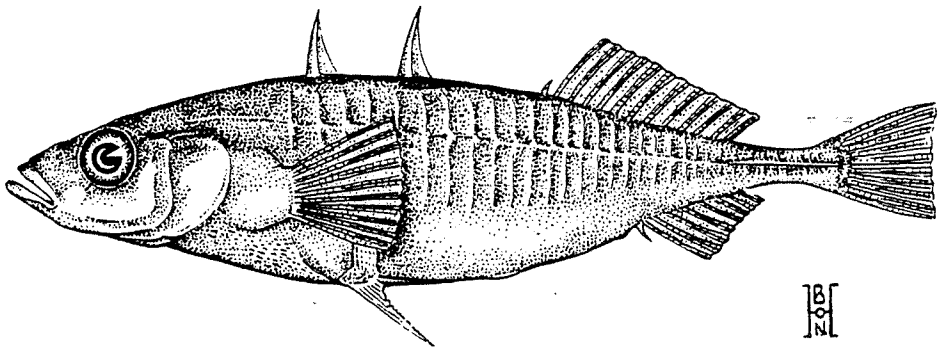
GROUP: motile fish

DESCRIPTION: Pacific cod; elongate codfish with prominent chin barbel and three dorsal fins, the first of which is approximately even with leading edge of the anal fin.

HABITAT: Demersal, in higher salinity waters; seasonal movement from offshore into shallow and estuarine waters in spring; diet is composed of both benthic and nektonic organisms.

REFERENCE(S): Figure from Eschmeyer (1983).

Gasterosteus aculeatus



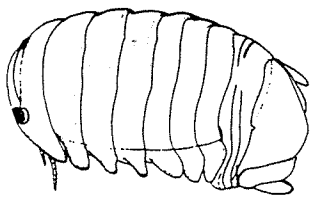
GROUP: motile fish

DESCRIPTION: Threespine stickleback; small compressed body; three isolated spines in front of dorsal; keeled, slender caudal peduncle; often has bony plates on side.

HABITAT: Ubiquitous; euryhaline; spawns in vegetation in freshwater; feeds on zooplankton.

REFERENCE(S): Figure from Hart (1973).

Gnorimosphaeroma oregonese



GROUP: epibenthic plankters

DESCRIPTION: Crustacean; dorsoventrally flattened. See taxonomic reference for identifying characteristics.

HABITAT: Intertidal under rocks or on floats, pilings, and around algae; a closely related species, G. insulare, is common in brackish water.

REFERENCE(S): See Kozloff (1987)for identification; figure from Smith and Carlton (1975).

Gonatidae (unid.)



GROUP: motile pelagic macroinvertebrates

DESCRIPTION: Pelagic squids; only common species in region is stubby squid, Gonatus fabricii, in which arms and tentacles are almost length of mantle and tail fins are broad.

HABITAT: Water column in deep mainstem channels and bays.

REFERENCE(S): Kozloff (1987) provides species list; figure from Yates (1988).

Grapsidae (unid.)

GROUP: evasive macroepifauna

DESCRIPTION: Shorecrabs; see *Hemigrapsis* spp.

HABITAT: Gravel-cobble and mudflat habitats.

REFERENCE(S): See Kozloff (1987) for taxonomy and illustrations of various species common to region.

Grindelia integrifolia



GROUP: rooted vascular plants

DESCRIPTION: The entire plant, especially the flower head, is sticky to the touch, hence the common name. Plants are up to 8 dm tall and often much branched. Blooming in spring and early summer, unopened flower buds are encased in scaly, gummy coverings. No other salt marsh plant has similar, large (2 to 4 cm in diameter) yellow sunflower-like flowers.

HABITAT: Gumweed is a common inhabitant of high salt marshes and occasionally occurs in adjacent nonwetlands as well as wet meadows. At times it will be found on the waterward slope of primary sand dunes, a nonwetland situation. Common associates include saltgrass and tufted hairgrass.

REFERENCE(S): Identification from Weinman et al. (1984); figure from Hitchcock and Cronquist (1978).

Grindelia spp.

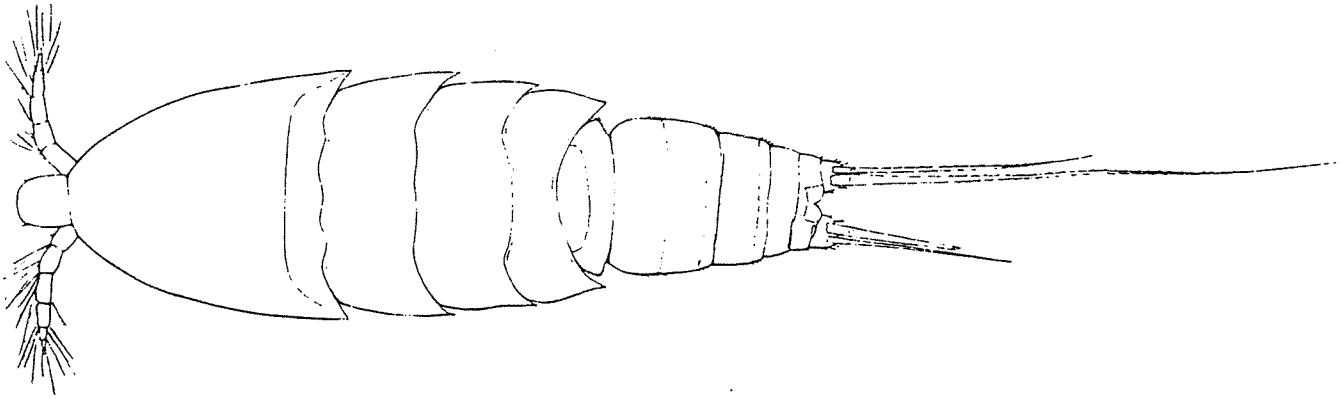
GROUP: rooted vascular plants

DESCRIPTION: Gumweed species; see *G. integrifolia* for characteristics and illustration.

HABITAT: High salt marshes and occasionally adjacent upland habitats.

REFERENCE(S): See Weinmann (1984) and Hitchcock and Cronquist (1978).

Harpacticus spinulosus



GROUP: epibenthic plankters

DESCRIPTION: Harpacticoid copepod.

HABITAT: Sandy bottoms.

REFERENCE(S): See Lang (1968).

Harpacticus spp.

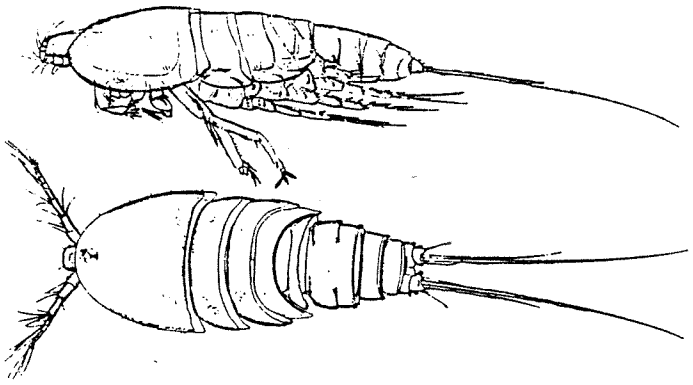
GROUP: epibenthic plankters

DESCRIPTION: Harpacticoid copepods; see *H. spinulosus* and *H. uniremis* for identifying characters and illustrations.

HABITAT: Epibenthic on various substrata.

REFERENCE(S): See Lang (1948), and Wells (1976).

Harpacticus uniremis



GROUP: epibenthic plankters

DESCRIPTION: Large harpacticoid copepod; often olive-green to bluish in color, with brown stripes or markings.

HABITAT: Intertidal to shallow subtidal, associated with macrophytes or detritus.

REFERENCE(S): See Wells (1976) for identification; figure from Ito (1976).

Heleidae (unid.)

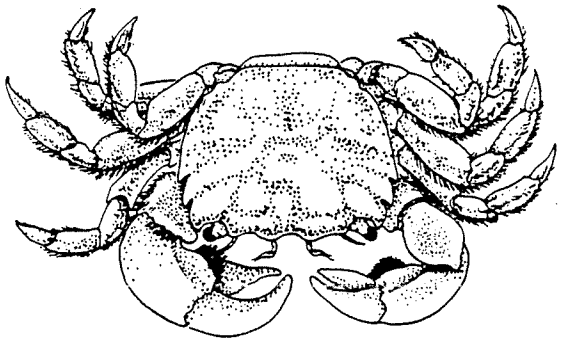
GROUP: neustonic and drift invertebrates

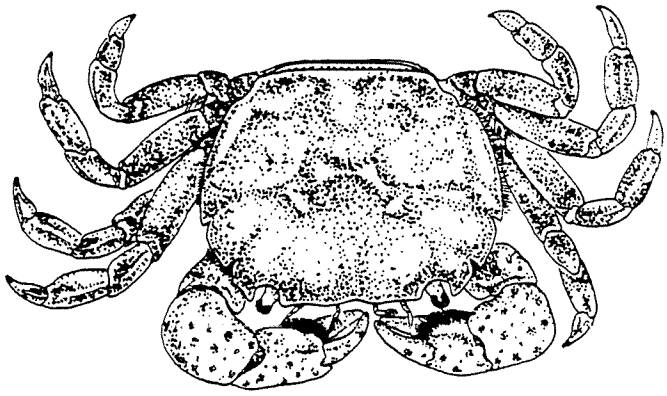
DESCRIPTION: Biting midge; family of Dipteran flies; see Ceratopogonidae.

HABITAT: In addition to neuston, often associated with detritus in depositional shorelines.

REFERENCE(S): Description and figure from Merritt and Cummins (1984).

Hemigrapsus spp.





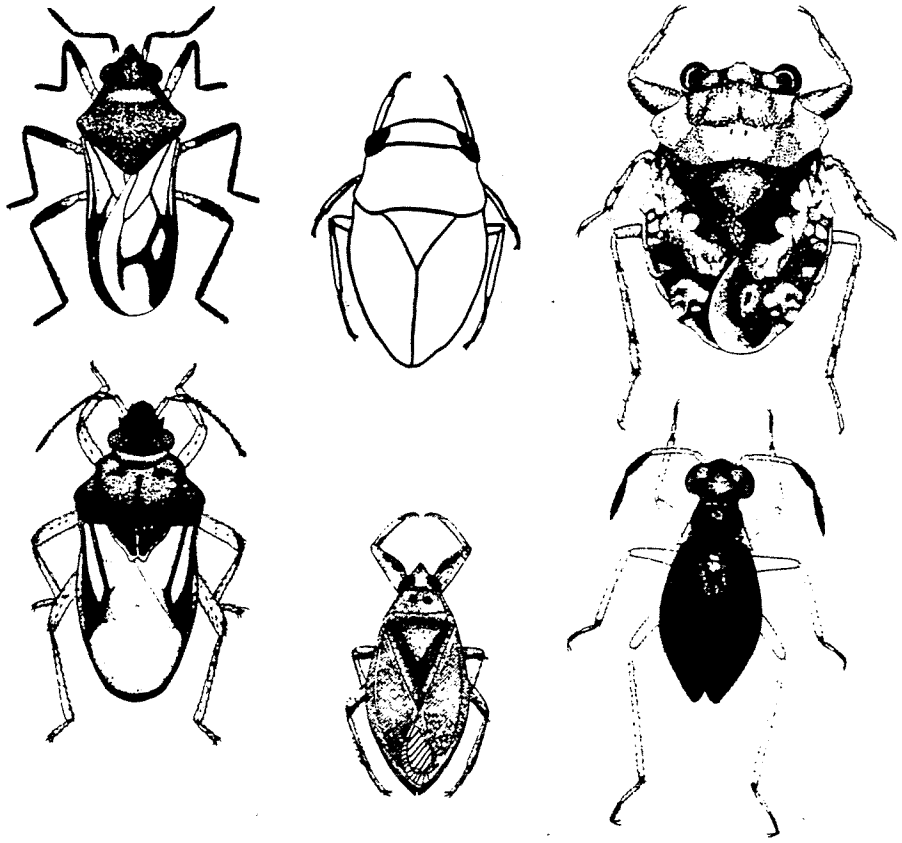
GROUP: evasive macroepifauna

DESCRIPTION: Shorecrabs with smooth dorsal surface and three teeth on anterolateral margin of carapace; two species prevalent in region: *H. nudis*, purple shorecrab has smooth legs and chelipeds with purple spots; *H. oregonensis*, green shorecrab, has hairy legss.

HABITAT: Rocky and gravel-cobble shores in euhaline waters.

REFERENCE(S): Kozloff (1983, 1987); figures from Yates (1988).

Hemiptera (unid.)



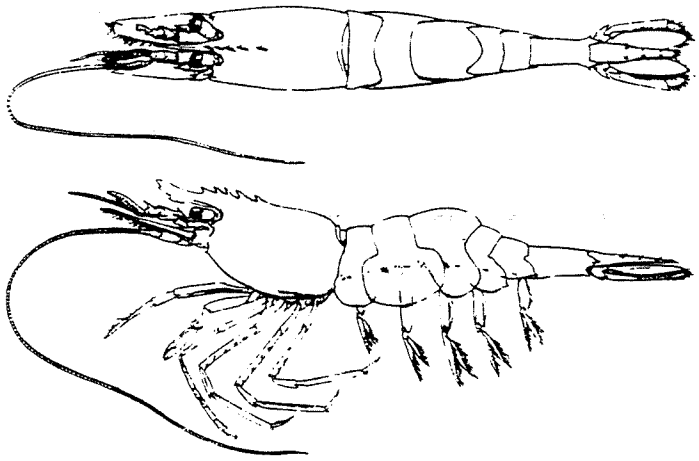
GROUP: surface epifauna

DESCRIPTION: True bugs; mouthparts in form of segmented beak.

HABITAT: In addition to surface drift, many Hemitperans are truly aquatic, both epifauna and water column surface.

REFERENCE(S): Description from Lehmkuhl (1979) and Merritt and Cummins (1984); figure from Lehmkuhl (1979).

Heptacarpus spp.



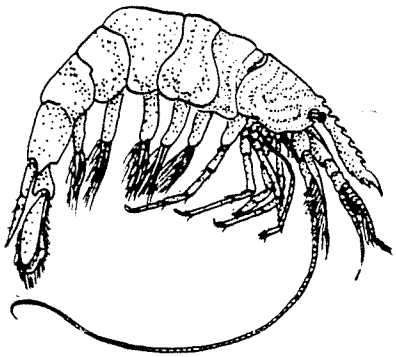
GROUP: evasive macroepifauna

DESCRIPTION: Broken-back shrimp; see taxonomic reference for distinguishing characteristics.

HABITAT: Variety of wetland habitats, predominantly in higher salinity regions of estuaries.

REFERENCE(S): See Kozloff (1987) for identification; figure from Butler (1980).

Hippolytidae (unid.)



GROUP: evasive macroepifauna

DESCRIPTION: Hippolytid shrimps; distinguished by rostrum and eyes uncovered by carapace; common genera are *Heptacarpus, Lebbeus, and Eualus*.

HABITAT: Subtidal hard bottom to intertidal gravel cobble; often associated with seaweeds and kelps.

REFERENCE(S): Description from Kozloff (1983, 1987); figure from Yates (1988).

Hobsonia florida

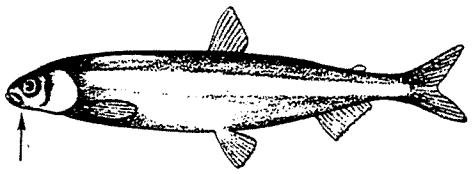
GROUP: sedentary infauna

DESCRIPTION: Terebellid polychaete worm with setae of bundle anterior to gills long; Note: figure not available.

HABITAT: Sandflats.

REFERENCE(S): Description from Kozloff (1987).

Hypomesus pretiosus



GROUP: motile fish

DESCRIPTION: Surfsmelt; silvery smelt with small mouth and upper jaw which terminates anterior of middle of eye; blue-green on dorsal surface, and silvery-white stripe down side.

HABITAT: Common baitfish species; frequently captured in surf zone of sandy and gravel-cobble beaches, especially during spawning season; diet composed principally of pelagic and epibenthic zooplankton.

REFERENCE(S): Figure from Eschmeyer et al. (1983).

Insecta (drift)

GROUP: neustonic and drift invertebrates

DESCRIPTION: Insects, e.g. flies, bees, wasps, beetles, etc.; see specific taxa.

HABITAT: All estuarine wetlands and prominent component of neuston in water column habitat.

REFERENCE(S): See Merritt and Cummins (1984) for taxonomic differentiation and illustrations.

Insecta (larvae)

GROUP: neustonic and drift invertebrates

DESCRIPTION: Larvae of insects; see Chironomidae, Diptera, etc. for specific taxa characteristics and illustrations.

HABITAT: All estuarine wetlands and prominent component of neuston in water column habitat.

REFERENCE(S): See Merritt and Cummins (1984) for taxonomic differentiation and illustrations.

Insecta (unid.)

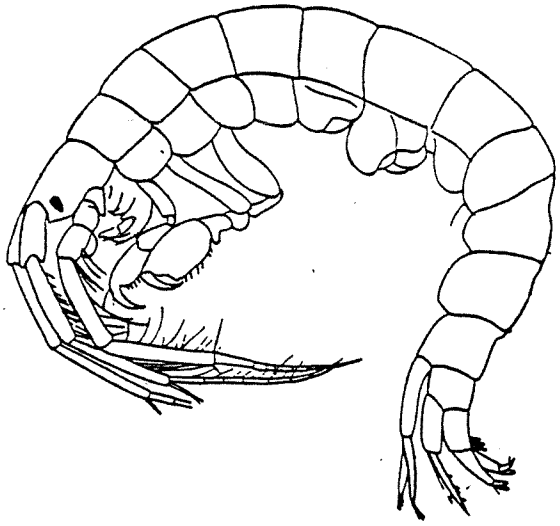
GROUP: neustonic and drift invertebrates

DESCRIPTION: See Insects (drift) and specific taxa.

HABITAT: All estuarine wetland habitats and prominent component of neuston in water column habitat.

REFERENCE(S): See Merritt and Cummins (1984) for taxonomic idfferentiation and illustrations.

Ischyrocerus spp.



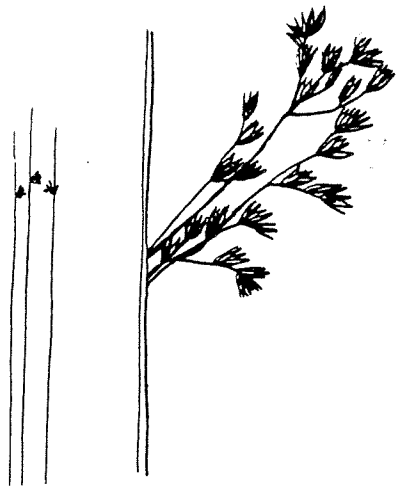
GROUP: epibenthic plankters

DESCRIPTION: Gammarid amphipod; see taxonomic reference for identifying characteristics.

HABITAT: Intertidal to subtidal; tube-dwelling on various substrata.

REFERENCE(S): See Kozloff (1987) for identification; figure from Gurjanova (1951).

Juncus balticus



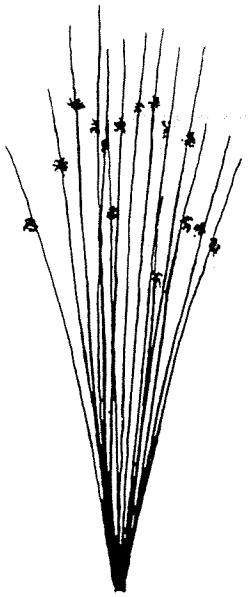
GROUP: rooted vascular plants

DESCRIPTION: This rush is tufted, with rounded stems 1-12 dm tall. Floral palicles are born laterally on the stems.

HABITAT: The plant is commonly found in organically enriched soils in backshore mesohaline marshes. Common associates include *Pontentilla pacifica* and *Deshampsia caespitosa*.

REFERENCE(S): Description from Weinmann et al. (1986), figrure from Hotchkiss (1972).

Juncus spp.



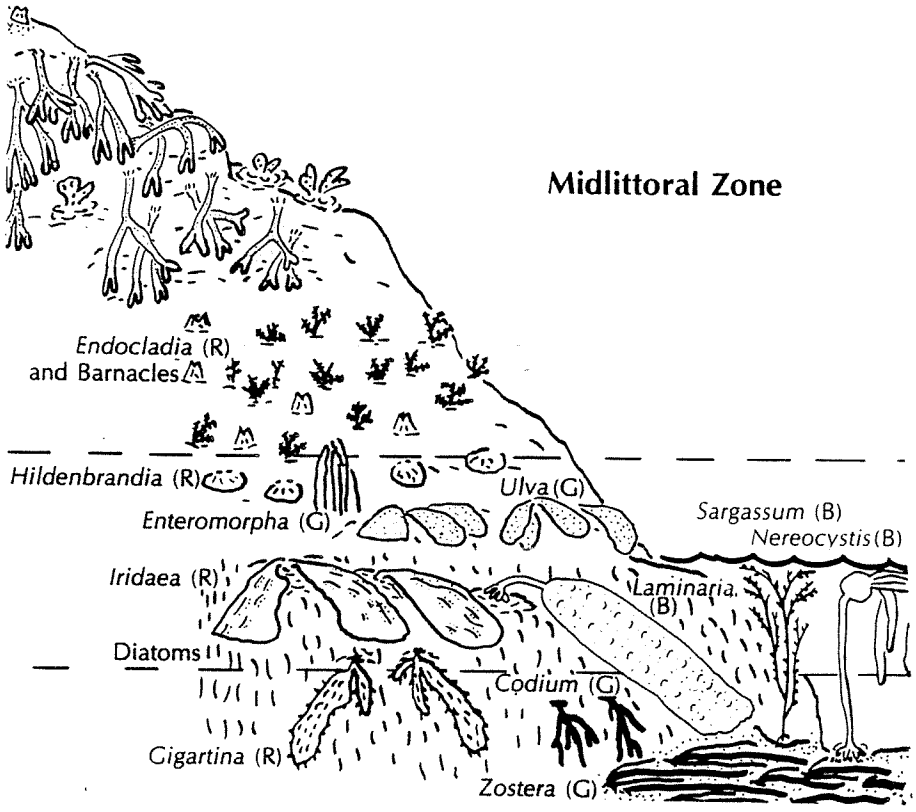
GROUP: rooted vascular plants

DESCRIPTION: Rushes; see *J. balticus*.

HABITAT: Emergent marshes and wet meadows.

REFERENCE(S): See Hitchcock and Cronquist (1978) and Hotchkiss (1972) for differentiation of species and illustrations.

Laminaria spp.



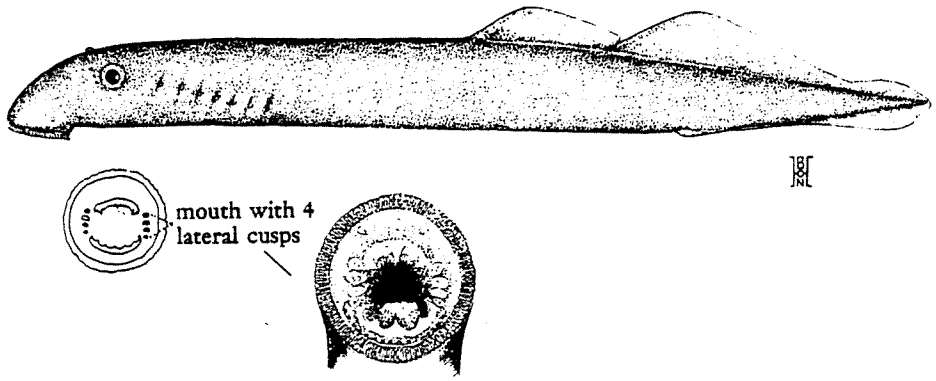
GROUP: benthic macroalgae

DESCRIPTION: Moderately large (considered a kelp) fleshy macroalgae with holdfast, stipe and blades.

HABITAT: Low intertidal and shallow subtidal in gravel-cobble beach and shallower portions of shallow subtidal hard substrate habitats.

REFERENCE(S): See identifying characters and illustrations in Smith (1969) and Waaland (1977); figure from Waaland (1977).

Lampetra tridentatus



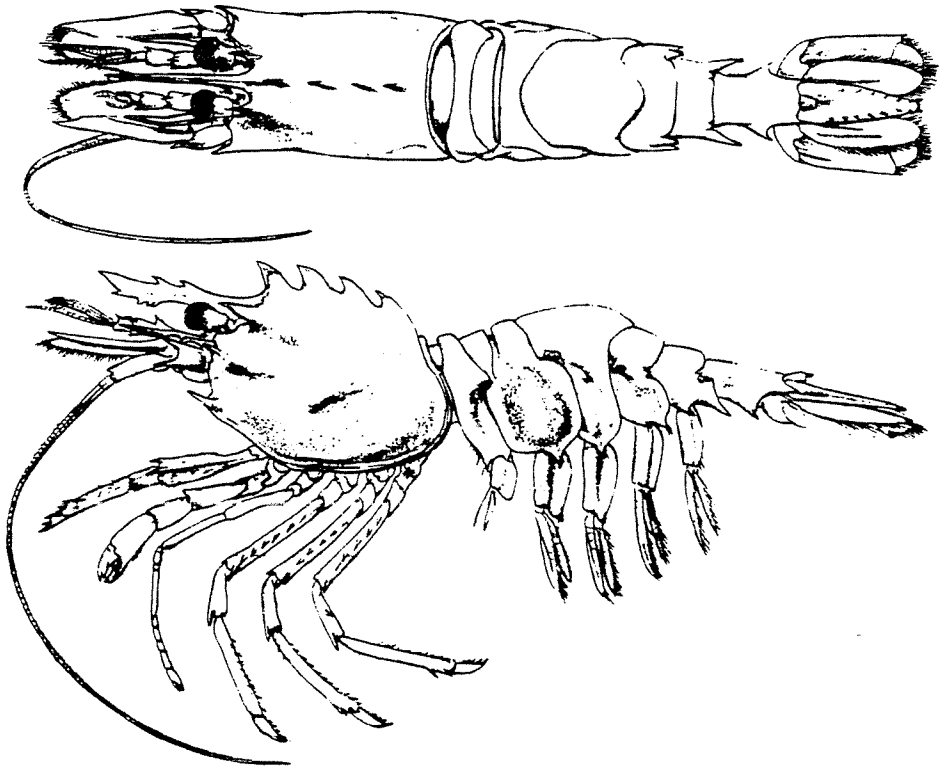
GROUP: motile fish

DESCRIPTION: Pacific lamprey; distinguished by sucking disc with supraoral bar with three cusps, infraoral bar with five cusps, and four pairs of lateral teeth.

HABITAT: Mainstem estuarine channels; typically demersal and often found attached to rocks along bottom.

REFERENCE(S): Description from Hart (1973); figures from Hart (1973) and Miller and Lea (1972).

Lebbeus spp.



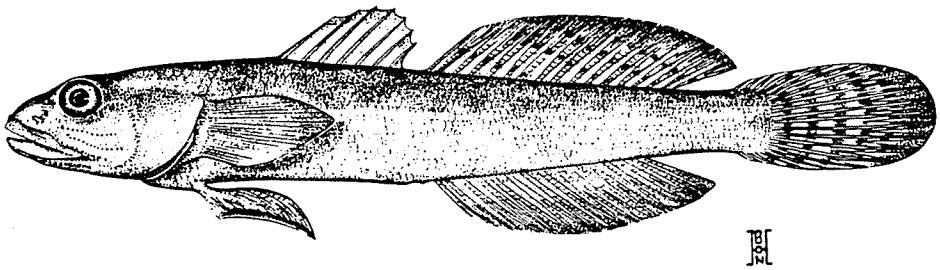
GROUP: evasive macroepifauna

DESCRIPTION: Lebbeid shrimps; common Hippolytid shrimps with only one supraorbital spine and and the third maxilliped without an exopodite; only *L. groenlandicus* is common.

HABITAT: Subtidal channel bottoms with gravel and hard substrate.

REFERENCE(S): Description and figure from Butler (1980).

Lepidogobius lepidus



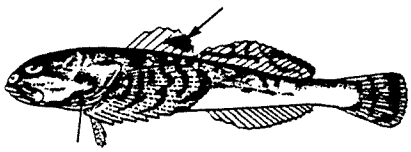
GROUP: sessile fish

DESCRIPTION: Bay goby; recognized by pelvic fins joined to form a hollow cone free of body, wide space between dorsal fins, fine scales, and black margin of first dorsal.

HABITAT: Intertidal mudflats.

REFERENCE(S): Description from Hart (1973) and Miller and Lea (1972); Figure from Hart (1973).

Leptocottus armatus



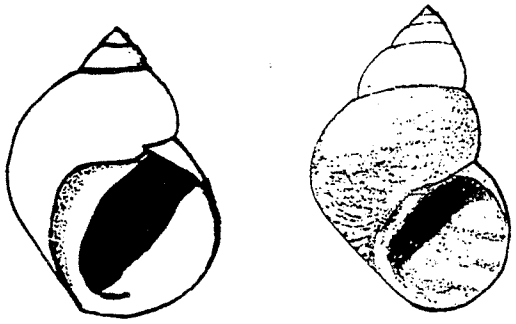
GROUP: sessile fish

DESCRIPTION: Pacific staghorn sculpin; large sculpin without scales; upper preopercular spine long and antlerlike; greenish-brown to tan on dorsal surface; cream to white ventrally.

HABITAT: Most common, ubiquitous estuarine sculpin; frequents all habitats but most prevalent on sandy substrates; eaten by a variety of seabirds and marine mammals.

REFERENCE(S): Figure from Eschmeyer et al. (1983).

Littorina spp.



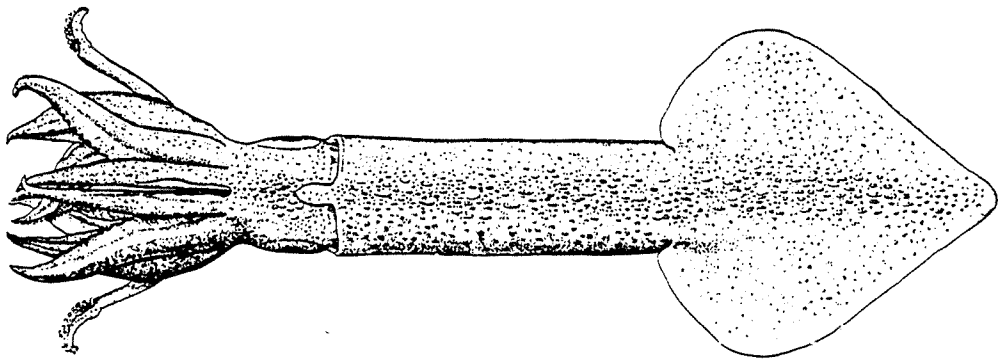
GROUP: surface epifauna

DESCRIPTION: Periwinkles; see taxonomic reference for distinguishing characteristics.

HABITAT: High intertidal under rocks and in crevices or pools.

REFERENCE(S): See Kozloff (1987) for identification; figure from Keen and Coan (1974).

Loligo opalescens



GROUP: motile pelagic macroinvertebrates

DESCRIPTION: Opalescent squid; slender squid with large eyes and short arms and tentacles relative to mantle.

HABITAT: Water column, schooling and often in surface (neritic) waters around pier and dock lights at night.

REFERENCE(S): Description from Kozloff (1983); figure from Kozloff (1987).

Lumpenus sagitta



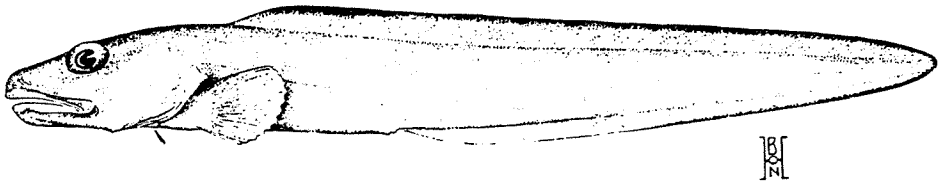
GROUP: sessile fish

DESCRIPTION: Elongate with head equal to approximately 1/10 of total length; greenish-brown streaks on side; barred caudal fin.

HABITAT: Common in bays, large channels, and shallows, especially in more saline reaches of estuaries.

REFERENCE(S): Figure from Eschmeyer et al. (1983).

Lycodopsis pacifica



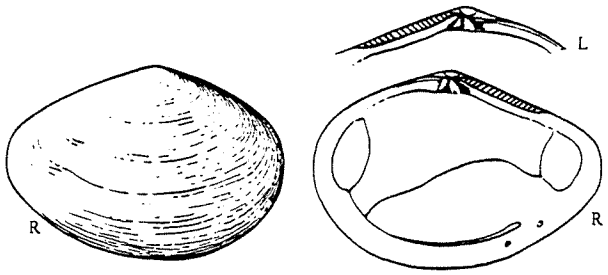
GROUP: sessile fish

DESCRIPTION: Blackbelly eelpout; recognized by black peritoneum which shows through skin on belly, no teeth on vomer and palatines and black spots on leading edge of dorsal.

HABITAT: Estuarine channels, usually soft-bottom to fine gravel.

REFERENCE(S): Description and figure from Hart (1972).

Macoma spp.



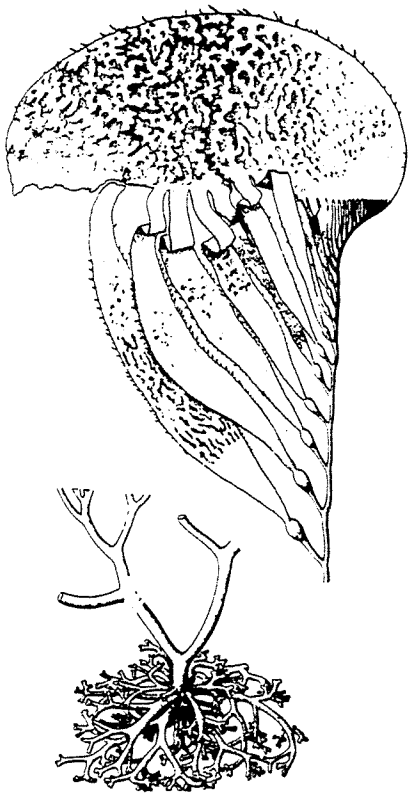
GROUP: sedentary infauna

DESCRIPTION: Bentnose clams; one common species, *M. nasuta*, is distinguishable by a characteristic right-hand bend in the posterior portion of the shell.

HABITAT: Mudflats to sand/cobble in embayments; able to live in anoxic sediments.

REFERENCE(S): See Kozloff (1987) for identification; figure from Keen and Coan (1974).

Macrocystis pyrifera



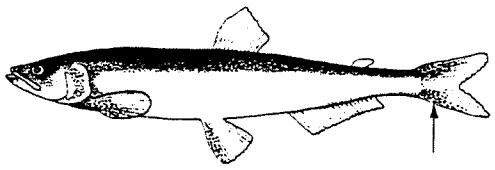
GROUP: benthic macroalgae

DESCRIPTION: Large gold-brown fleshy macroalgae (kelp) with extensive holdfast and frond system which results in multidimensional stand throughout water column and on surface; blades rise off series of small floats which are attached to stipe. M. *integrifolia* (see Waaland 1977 for description) may be confused with *M. pyrifera* in this region.

HABITAT: Forms extensive stands in shallow subtidal of gravel-cobble and shallow subtidal hard substrate habitats in euhaline reaches of estuaries.

REFERENCE(S): Figure from Smith (1969).

Mallotus villosus



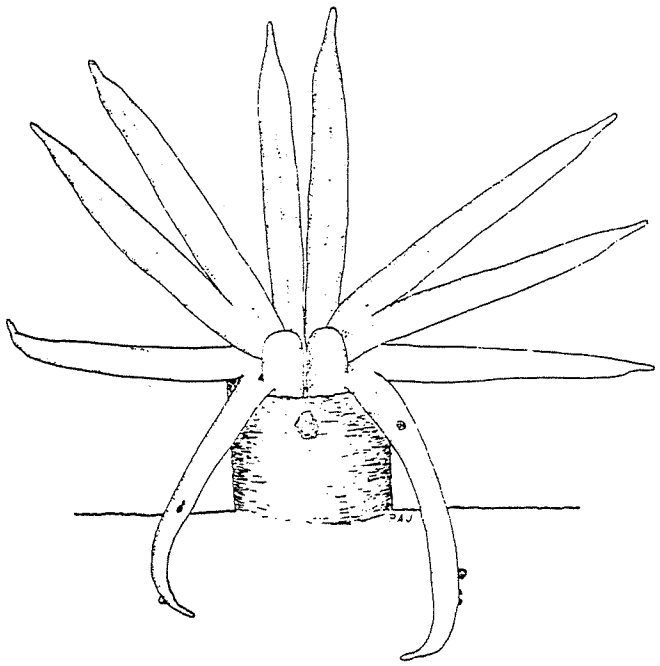
GROUP: motile fish

DESCRIPTION: Capelin; smelt with rectangular adipose fin with very long base; olive green dorsal surface; adults have hairy band along side.

HABITAT: Prominent schooling baitfish nearshore, especially April-October when spawning occurs on fine gravel-sand beaches; important forage fish; confined to higher salinity waters.

REFERENCE(S): Figure from Eschmeyer et al. (1983).

Manayunkia aestuarina



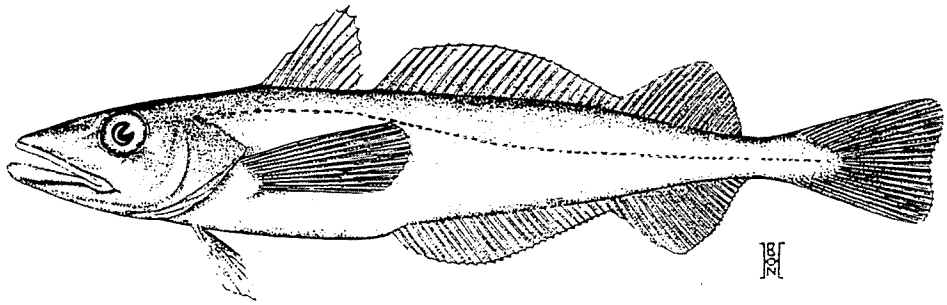
GROUP: sedentary infauna

DESCRIPTION: Sabellid polychaete worm characterized by anterior end with four radioles (featherlike structures), each with two pinnules.

HABITAT: Intertidal estuarine beaches.

REFERENCE(S): Description from Kozloff (1987); figure from Fauchald and Jumars (1979).

Merluccius productus



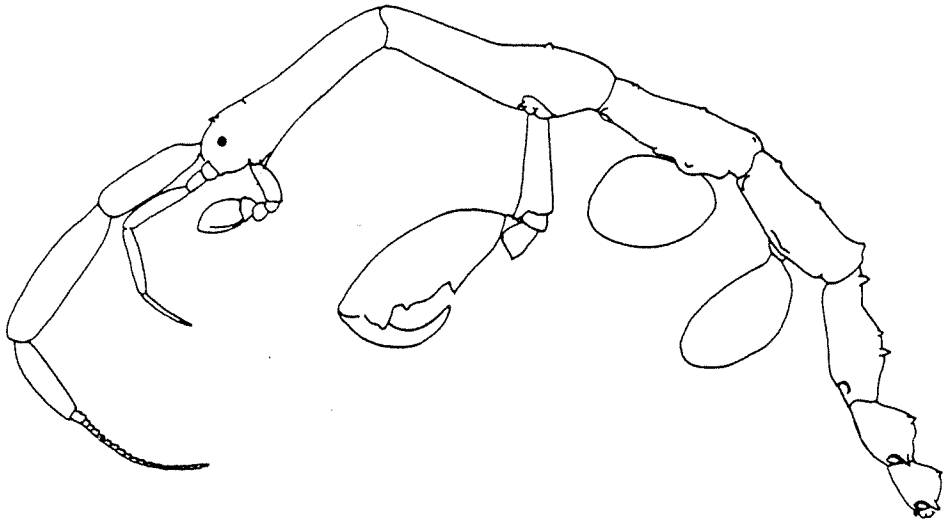
GROUP: motile fish

DESCRIPTION: Pacific hake; elongate cod without chin barbel; second dorsal and anal fish deeply notched without forming separate fins.

HABITAT: Ranges throughout water column in euhaline waters; important prey for marine mammals; feeds on nekton.

REFERENCE(S): Figure from Hart (1973)).

Metacaprella kennerlyi



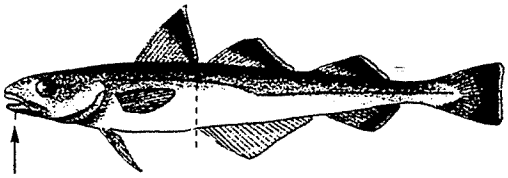
GROUP: epibenthic plankters

DESCRIPTION: Caprellid amphipod; see taxanomic reference for identification.

HABITAT: Epiphytic on eelgrass and macroalgae.

REFERENCE(S): See Laubitz (1970), and Kozloff (1987).

Microgadus proximus



GROUP: motile fish

DESCRIPTION: Pacific tomcod; small cod with a short chin barbel; insertion of anal fin slightly ahead of second dorsal.

HABITAT: Adults demersal, juveniles throughout water column, in higher salinity waters.

REFERENCE(S): Figure from Eschmeyer et al. (1983).

Microtus spp.

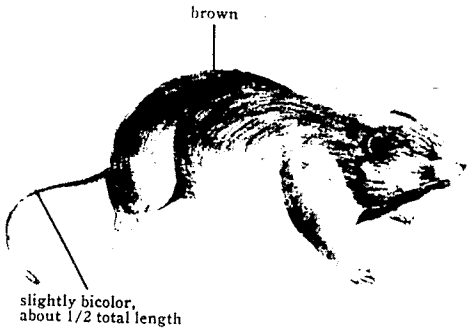
GROUP: herbivorous mammals

DESCRIPTION: Voles; small mouse-like mammals; see *M. townsendii* for distinguishing characteristics and illustration.

HABITAT: Vegetated marshes and upland habitats adjacent to water.

REFERENCE(S): See Ingles (1965) for description of *Microtus* species.

Microtus townsendii



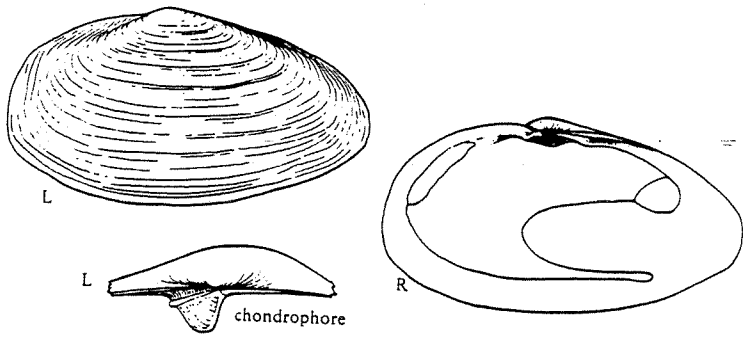
GROUP: herbivorous mammals

DESCRIPTION: Townsends vole; length 170-225 mm; tail slightly bicolored, 48-70 mm, about 40 to 50 percent of head and body length; hind foot 20-26 mm; ear 15-17 mm; upper parts dark brownish; under parts dark grayish; skull 30-31 mm; molars without roots; incisive foramen constricted (usually), about 5 mm long.

HABITAT: open grasslands in low country west of the Cascade Mountains in Oregon and Washington and in northwestern California.

REFERENCE(S): Description and figure from Ingles (1965).

Mya arenaria



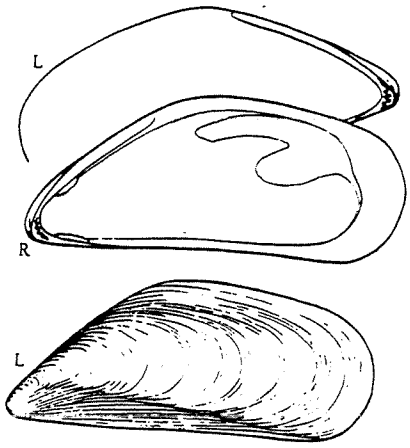
GROUP: sedentary infauna

DESCRIPTION: Eastern soft-shell clam; characterized by large spoon-shaped projection (chondrophore) on the left valve at the hinge, and by the light, brittle shell.

HABITAT: Mud/sand flats, especially with nearby freshwater outfall.

REFERENCE(S): See Kozloff (1987) for identification; figure from Keen and Coan (1974).

Mytilus edulis



GROUP: surface epifauna

DESCRIPTION: Bay or blue mussel; common in embayments; has smooth shell.

HABITAT: Intertidal on rock or cobbles; also occurs on docks or pilings.

REFERENCE(S): See Kozloff (1987) for identification; figure from Keen and Coan (1974).

Neanthes limnicola

GROUP: sedentary infauna

DESCRIPTION: Large nereid polychaete worms with conical paragnaths; Note: figure not available.

HABITAT: Common in mussel and barnacle mats and among seaweeds.

REFERENCE(S): Description from Smith et al. (1967).

Nematoda (unid.)

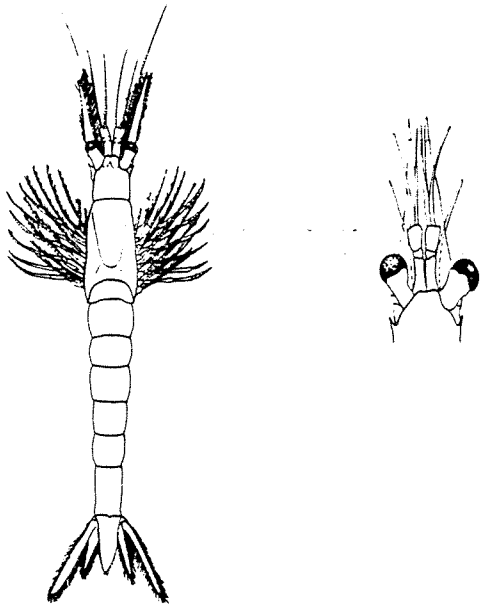
GROUP: sedentary infauna

DESCRIPTION: Elongate worms with unsegmented cuticle; Note: figure not available.

HABITAT: Free-living in almost all estuarine habitats.

REFERENCE(S): See Kozloff (1987) for further references to nematodes of the region.

Neomysis mercedis



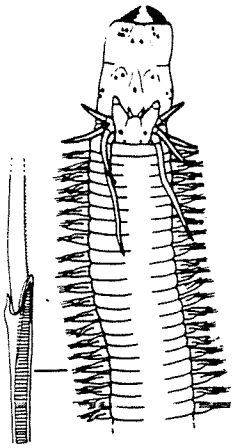
GROUP: evasive macroepifauna

DESCRIPTION: Mysid; see taxonomic reference for distinguishing characteristics.

HABITAT: Neritic; euryhaline, including marine, rivers, and a few lakes.

REFERENCE(S): See Kathmann et al. (1986) for identification and figure.

Nereidae (unid.)



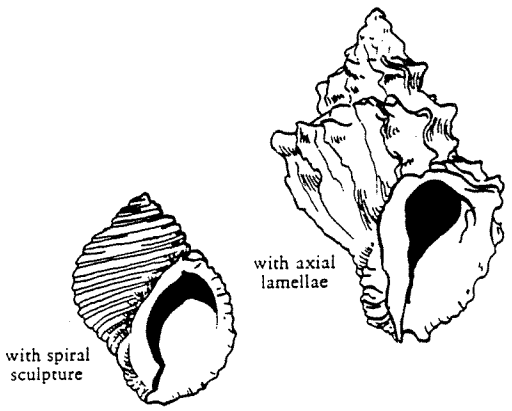
GROUP: evasive macroepifauna

DESCRIPTION: Large predacious polychaete worms with powerful jaws and eversible pharynx; often iridescent greenish color.

HABITAT: Variety of habitats.

REFERENCE(S): See Banse and Hobson (1974) for identification and figure.

Nucella spp.



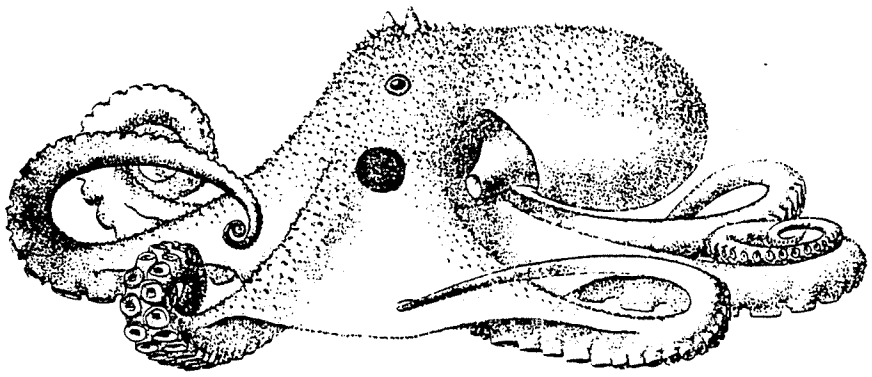
GROUP: surface epifauna

DESCRIPTION: Whelks; see taxonomic reference for distinguishing characteristics.

HABITAT: Intertidal to shallow subtidal on rocky substrata.

REFERENCE(S): See Kozloff (1987) for identification; figure from Keen and Coan (1974).

Octopus spp.



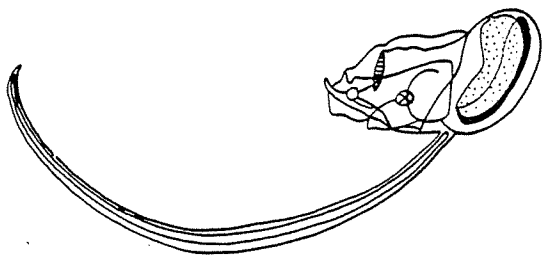
GROUP: motile pelagic macroinvertebrates

DESCRIPTION: Octopii; eight armed cephalopod; body ovoid and without fins and an internal shell.

HABITAT: Subtidal to low intertidal rocky habitats, particularly boulder-cobble.

REFERENCE(S): Description from Kozloff (1983, 1987); figure form Yates (1988).

Oikopleura spp.



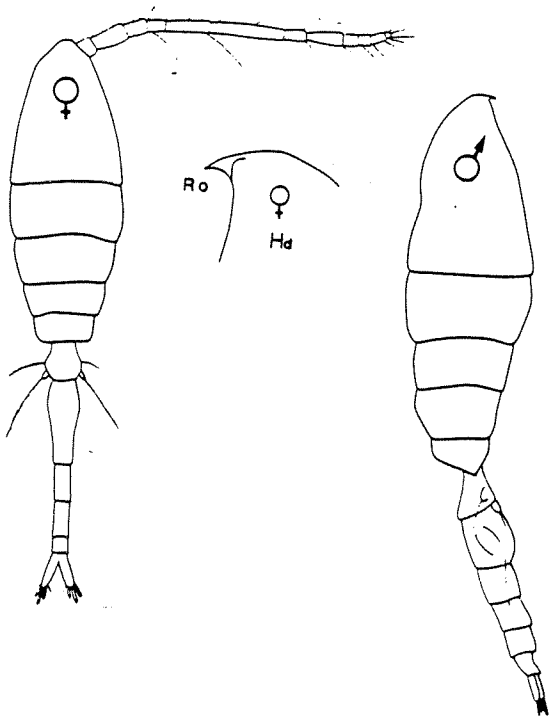
GROUP: pelagic zooplankton

DESCRIPTION: Larvacean; see taxonomic reference for identification.

HABITAT: Marine planktonic; builds large mucous 'house' from which it feeds on captured particles, only in euhaline region of estuaries.

REFERENCE(S): See Newell and Newell (1973) for identification and figure.

Oithona similis



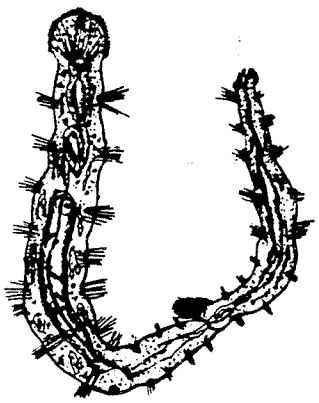
GROUP: pelagic zooplankton

DESCRIPTION: Cyclopoid copepod; see taxonomic reference for distinguishing characteristics.

HABITAT: Marine planktonic.

REFERENCE(S): See Gardner and Szabo (1982) for identification and figure.

Oligochaeta (unid.)



GROUP: surface epifauna

DESCRIPTION: Class of polychaete worms which have no parapodia and few setae.

HABITAT:

REFERENCE(S): Description from Smith et al. (1967) and Kozloff (1987); figure from Smith et al. (1967).

Oncorhynchus gorbuscha (fry)



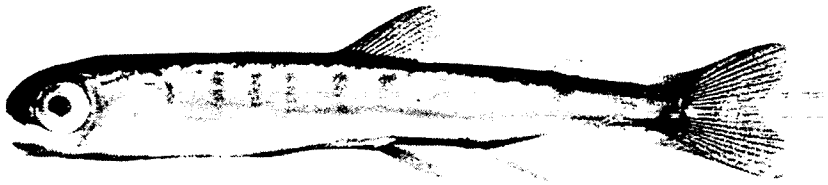
GROUP: motile fish

DESCRIPTION: Pink salmon; typically smallest salmon fry caught in estuaries; no parr marks; small scales; small eye diameter; fork of tail transparent.

HABITAT: Juveniles migrate through estuaries during winter- spring of (predominantly) even years; usually restricted to shallow water (1-2 m) habitats along migration corridor.

REFERENCE(S): Figure from Hart (1973).

Oncorhynchus keta (fry)



GROUP: motile fish

DESCRIPTION: Chum salmon; similar or slightly larger than pink fry; parr marks mostly above lateral line; comparatively larger eye diameter than pink; fork of tail black.

HABITAT: One of the most estuarine-dependent juvenile salmon; found in all shallow water habitats but feeds most extensively in eelgrass and marsh habitats.

REFERENCE(S): Figure from Hart (1973).

Oncorhynchus spp.

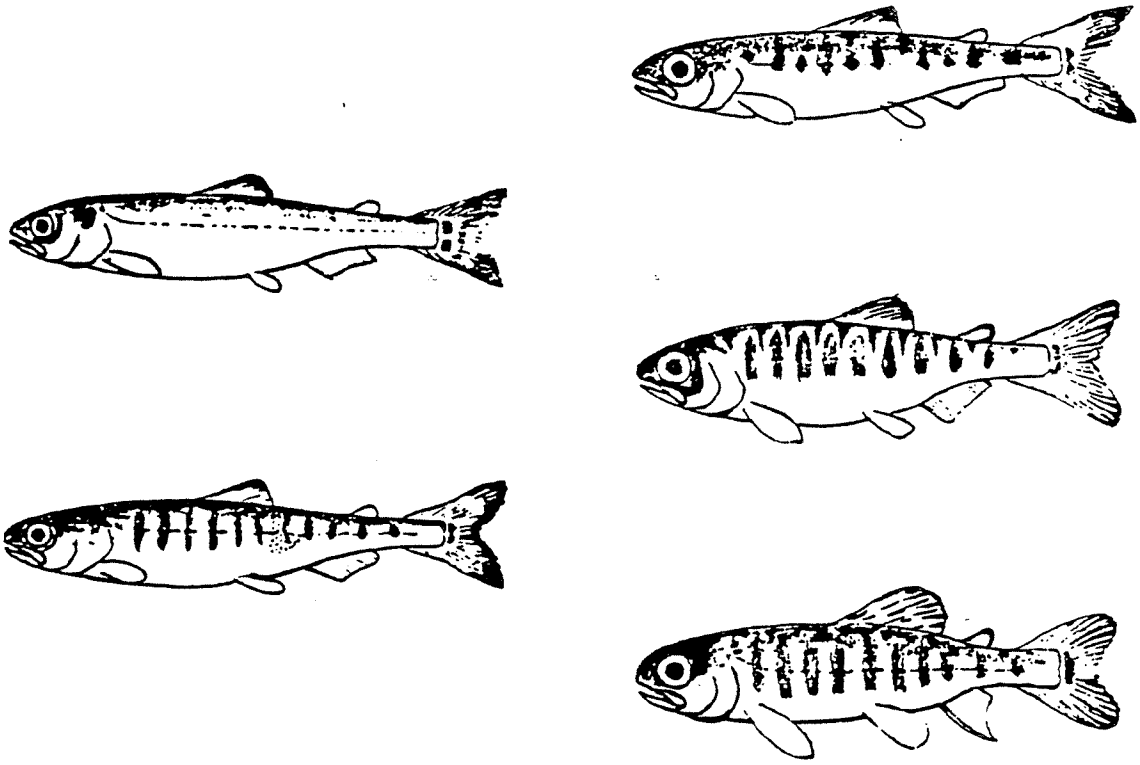
GROUP: motile fish

DESCRIPTION: Juvenile salmon; distinguished from the other salmonids by 13-19 rays in anal fin (vs. 8-12 for trouts, etc.). See *O. gorbuscha* and *O. keta* for identifying characters and illustrations.

HABITAT: Surface waters, both intertidal and neritic depending in general on size.

REFERENCE(S): Description from Hart (1973).

Oncorhynchus spp. (fry)



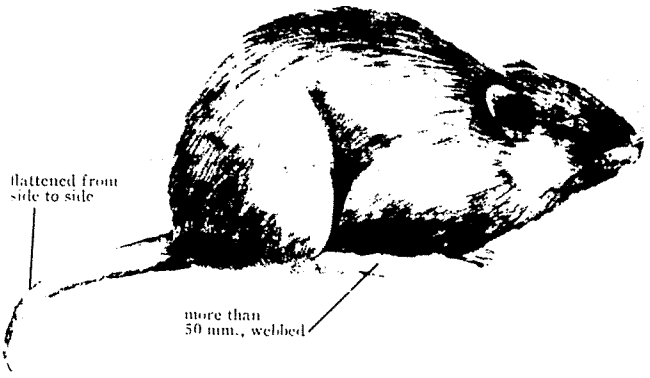
GROUP: motile fish

DESCRIPTION: Salmon; silvery, robust fry with cycloid scales and adipose fin; see Hart (1973) and Phillips (1977) for differentiating characters.

HABITAT: Anadromous; juvenile migrate from freshwater spawning grounds in early spring through fall, depending upon both species and stock characteristics; utilization of shallow water habitats is size dependent.

REFERENCE(S): Figure from Phillips. (1977).

Ondatra zibethicus



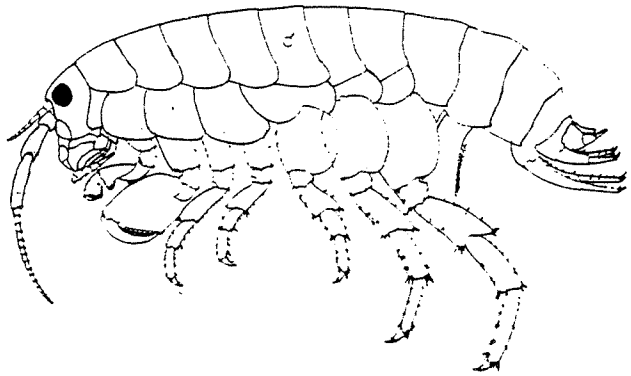
GROUP: herbivorous mammals

DESCRIPTION: Muskrat; length 435-620 mm, about 20 inches; tail scaly, sides flattened, 170-294 mm; hind foot 62-88 mm, webbed; ear, crown, 13-20 mm; skull 46-54 mm, basilar length; dull rusty brown to dark brown all over, except that feet are darker and mouth region is lighter.

HABITAT: Native along the Colorado River and along streams and lakes of eastern California; throughout most of the low country in Oregon and Washington, introduced widely in many other places, especially the San Joaquin Valley, California. Generally found in cattail marshes or in the banks of slow-moving streams.

REFERENCE(S): Description and figure from Ingles (1965).

Orchestia traskiana



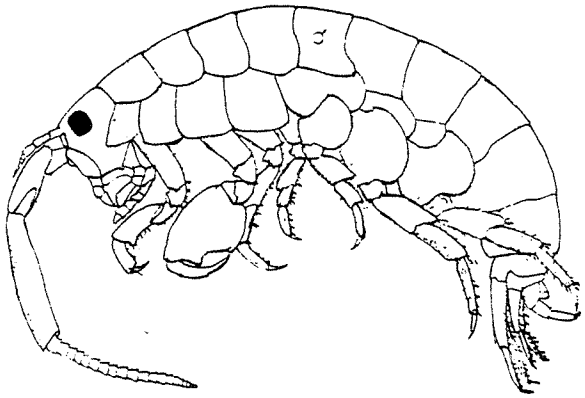
GROUP: evasive macroepifauna

DESCRIPTION: Beach flea; see taxonomic reference for identification.

HABITAT: Drift debris of rocky and stony beaches, but also on sand and in estuaries and salt marshes; occurs on both exposed and protected shores.

REFERENCE(S): See Kozloff (1987) for identification; figure from Bousfield (1982).

Orchestoidea pugettensis



GROUP: epibenthic plankters

DESCRIPTION: Sand hopper; see taxonomic reference for identification.

HABITAT: Coarse to fine sand beaches of both surf-exposed and protected shores, including estuaries.

REFERENCE(S): See Kozloff (1987) for identification; figure from Bousfield (1979).

Orchomene minuta

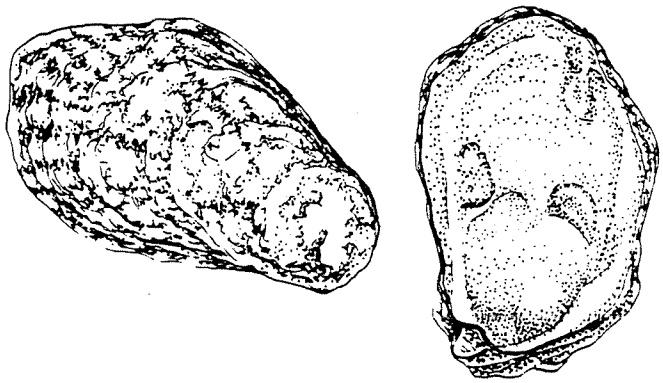
GROUP: epibenthic plankters

DESCRIPTION: Lysianassid amphipod; Note: figure not available.

HABITAT: Intertidal and subtidal soft sediment?

REFERENCE(S): See Kozloff (1987) for description of related species.

Ostrea lurida



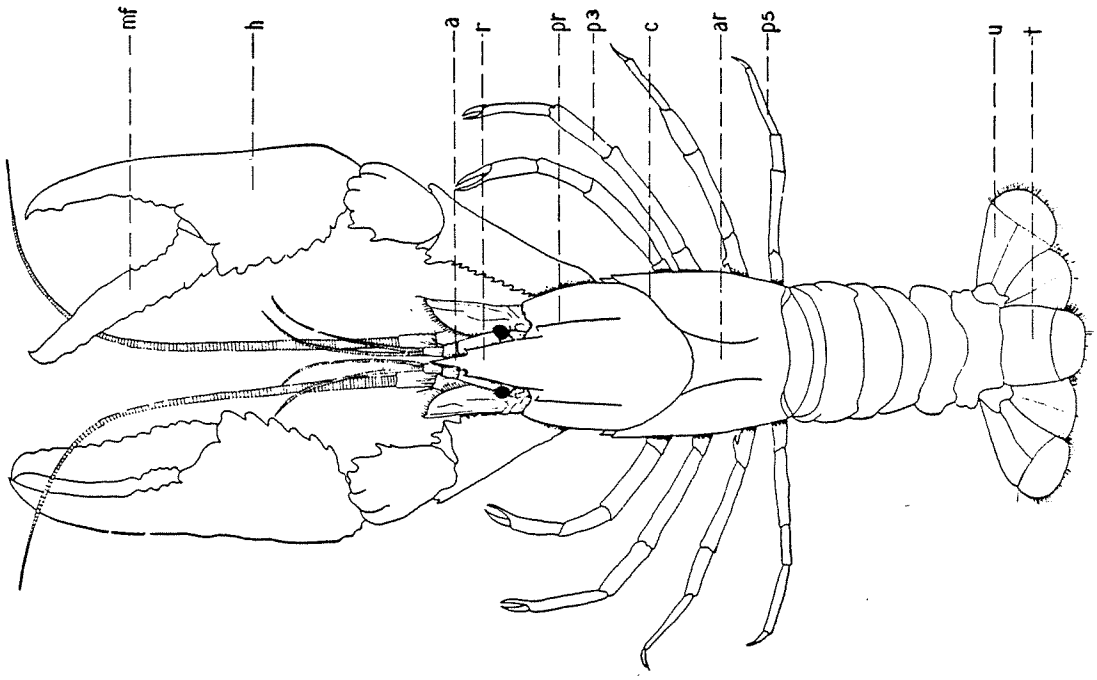
GROUP: surface epifauna

DESCRIPTION: Olympia or native oyster; distinguished from Japanese oyster by lack of discoloration of adductor muscle scar.

HABITAT: Attached to rocks, especially those around mudflats.

REFERENCE(S): Description by Kozloff (1983); figure from Yates (1988).

Pacificastacus leniusculus



GROUP: evasive macroepifauna

DESCRIPTION: Crayfish.

HABITAT: Channels and shallow subtidal portions of emergent marshes, mudflats and gravel-cobble habitats in oligohaline reaches of estuaries.

REFERENCE(S): See general freshwater biology text; figure of generic crayfish from Pennak (1953)..

Pancolus californiensis

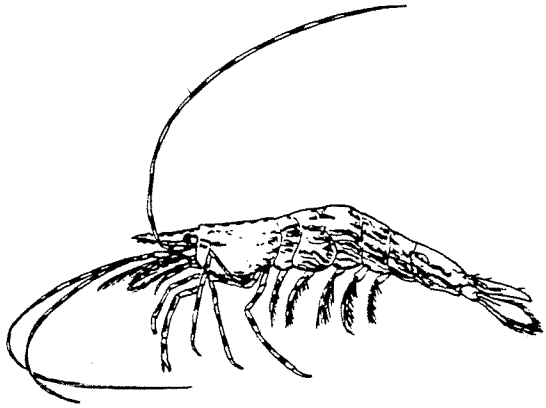
GROUP: epibenthic plankters

DESCRIPTION: Tanaid distinguished by three free pleonites on pleon; Note: figure not available.

HABITAT: Intertidal mud- and sandflats and shallow subtidal soft sediment habitats.

REFERENCE(S): See Kozloff (1987) for description.

Pandalus danae



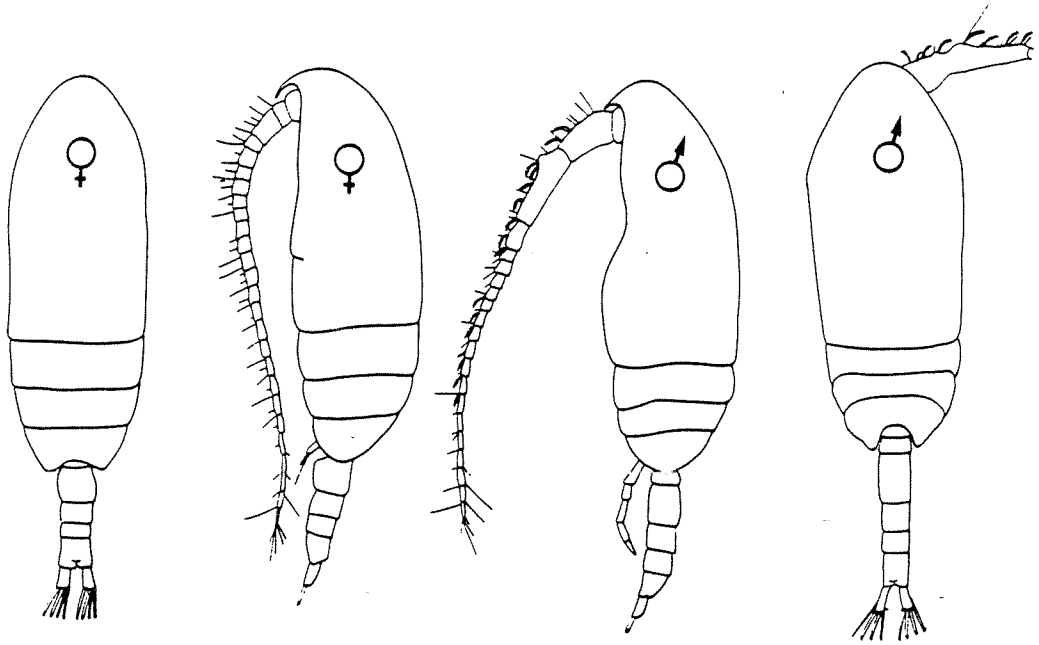
GROUP: evasive macroepifauna

DESCRIPTION: Coonstripe shrimp; pandalid shrimp distinguished by six pairs o small lateral spines on telson.

HABITAT: Gravel or sand channel bottoms in 22-64 m depths.

REFERENCE(S): Description from Kozloff (1987) and Butler (1987); figure from Yates (1988).

Paracalanus spp.



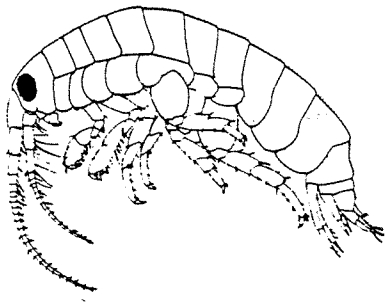
GROUP: pelagic zooplankton

DESCRIPTION: Small calanoid copepods, probably some undescribed species; see taxonomic reference for distinguishing characteristics.

HABITAT: Marine planktonic, especially surface waters.

REFERENCE(S): See Gardner and Szabo (1982) for identification and figure.

Paramoera columbiana



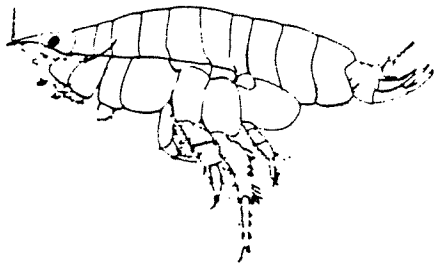
GROUP: epibenthic plankters

DESCRIPTION: Gammarid amphipod.

HABITAT: Low intertidal in areas of decreased salinity; in gravel and other sediments.

REFERENCE(S): See Kozloff (1987).

Paraphoxus spp.



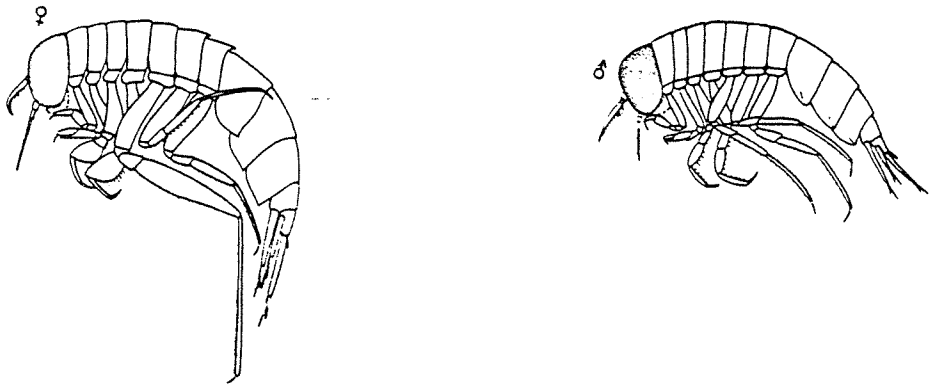
GROUP: epibenthic plankters

DESCRIPTION: Gammarid amphipod.

HABITAT: Intertidal to subtidal in fine sediments.

REFERENCE(S): See Kozloff (1987).

Parathemisto pacifica



GROUP: pelagic zooplankton

DESCRIPTION: The most common hyperiid amphipod in Puget Sound; distinguished by dilated carpus of pereiopods three and four.

HABITAT: Marine planktonic and nektonic.

REFERENCE(S): See Bowman (1960) for identification; figure from Bowman and Gruner (1973).

Parophyrs vetulus

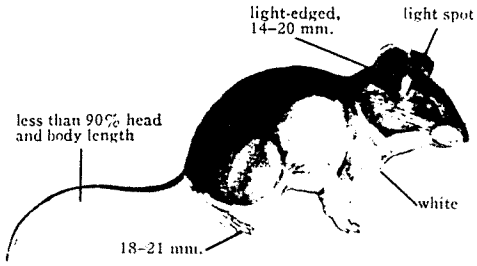
GROUP: sessile fish

DESCRIPTION: Archaeic name for English sole; see *Pleuronectes vetulus.*

HABITAT:

REFERENCE(S):

Peromyscus maniculatus



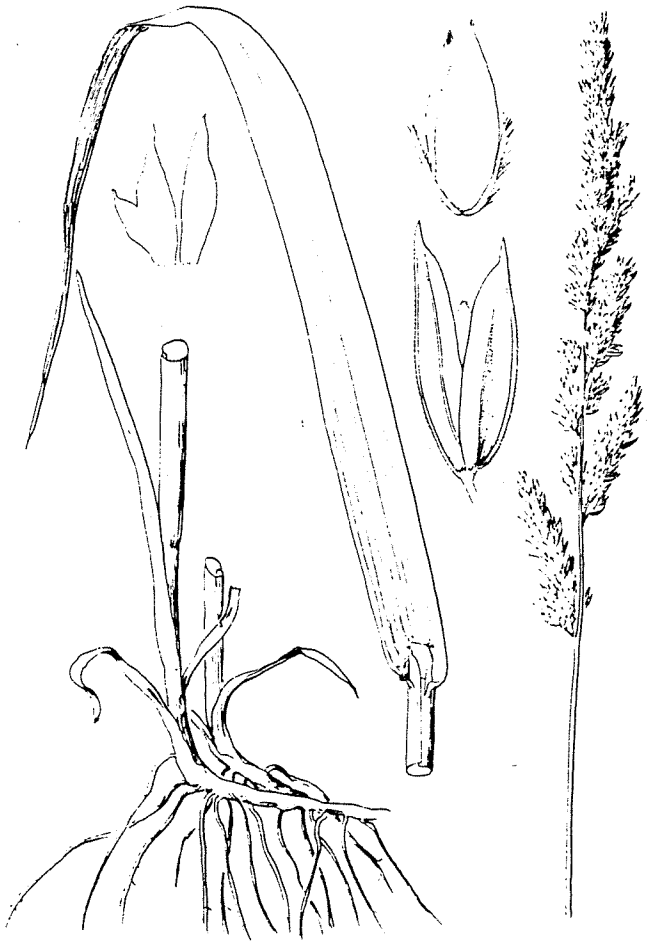
GROUP: herbivorous mammals

DESCRIPTION: Deer mouse; length 148-200 mm, about seven inches; tail 60-90 mm; hind foot 18-22 mm; ear 14-20 mm; skull 24-26.5 mm; yellowish brown to grayish above, pure white below; feet white; tail usually less than 90 percent of head and body, bicolored (may be as long or longer than the head and body in the subspecies *P. m. austerus* and *P. m. rubidus* along the coast), with the width of the dorsal stripe about half the circumference of the tail, frequently a lighter spot in front of the ear and a delicate lighter edge around the ear; accessory cusps (anterostyles) on the M^1; premaxilary bones not extending posterior to the ends of the nasals..

HABITAT: Nearly all communities and life zones.

REFERENCE(S): Description and figure from Ingles (1965).

Phalaris arundinacea



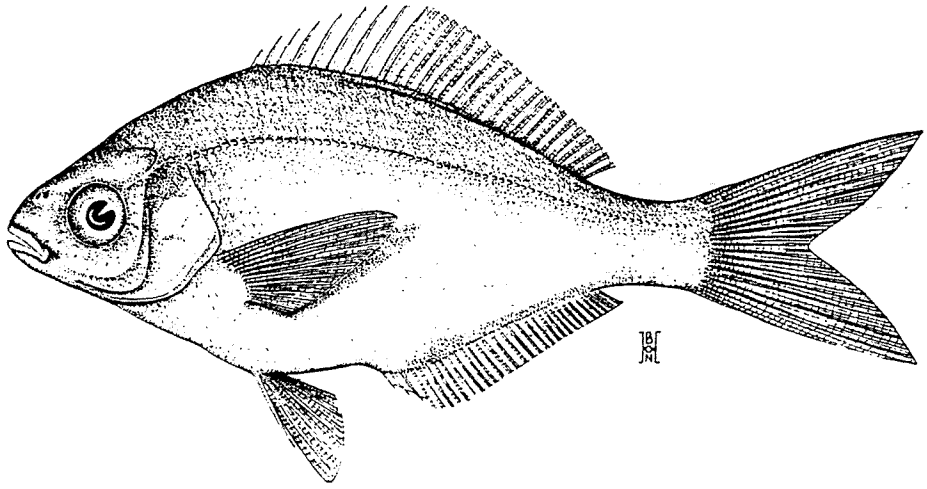
GROUP: rooted vascular plants

DESCRIPTION: Reed canarygrass is a tall, perennial grass, normally exceeding 1 m, and under ideal conditions, exceeding 2 m in height. The sturdy, often hollow, stems can be 1 cm in diameter and have a reddish tinge at the top during the growing season. Individual leaves measure up to 2 cm wide and 3 dm long. Flowers and seeds are borne on culms which stand high above the leaves. The panicles measure to 2 dm in length.

HABITAT: Reed canarygrass is one of the most broadly ranging and, therefore, commonly encountered freshwater wetland plants. The species typically occurs where soils remain saturated or nearly saturated during most of the growing season, but where standing water does not persist for extended times. Once established, the species can tolerate extended inundation. Reed canarygrass can dominate where irregular or fluctuating water regimes inhibit the success of other wetland species (e.g. cattails). It commonly grows in roadside ditches, rights-of-way, and on river dikes and levees where the soils would appear to be well-drained and only rarely saturated, as well in shallow marshes and meadows. Under the dryer conditions, the plant is shorter, has smaller flowering spikes and flowers earlier in the season.

REFERENCE(S): Identification from Weinman et al. 1984; figure from Hitchcock and Cronquist 1978.

Phanerodon furcatus



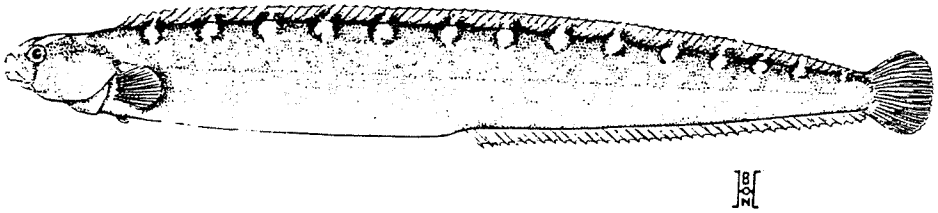
GROUP: motile fish

DESCRIPTION: White surfperch; distinguished by frenum attaching the lower lip to the lower jaw, its deeply forked tail and the rather low dorsal fiin having spinous section deeper and running into the soft-rayed part almost in a smooth curve.

HABITAT: Common in sheltered bays, typically in eelgrass and gravel-cobble beach habitats.

REFERENCE(S): Description and figure from Hart (1973).

Pholis laeta



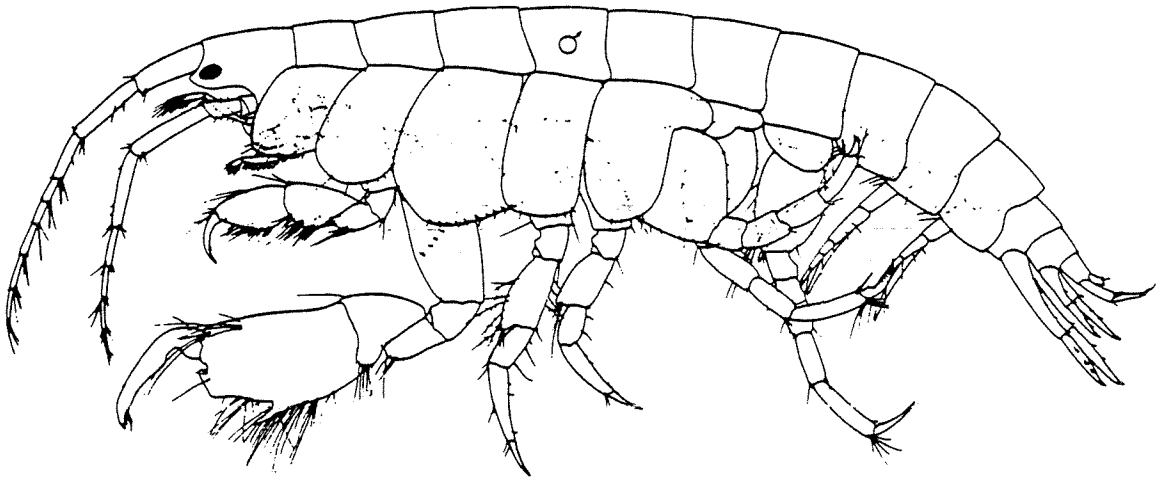
GROUP: sessile fish

DESCRIPTION: Crescent gunnels; distinguised by series of crescent shaped markings along base of dorsal fin.

HABITAT: Generally in gravel-cobble intertidal habitats.

REFERENCE(S): Description and figure from Hart (1973).

Photis lacia



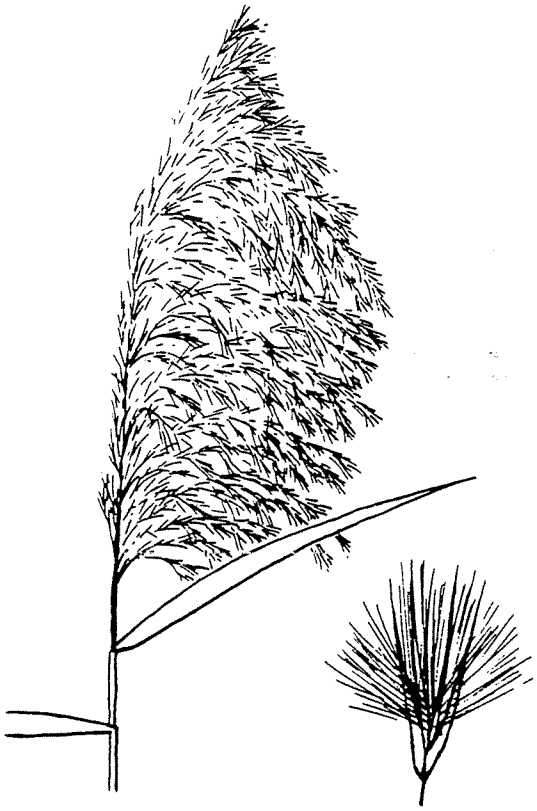
GROUP: epibenthic plankters

DESCRIPTION: Gammarid amphipod.

HABITAT: Subtidal; soft sediments.

REFERENCE(S): See Conlan (1983), and Kozloff (1987).

Phragmites spp.



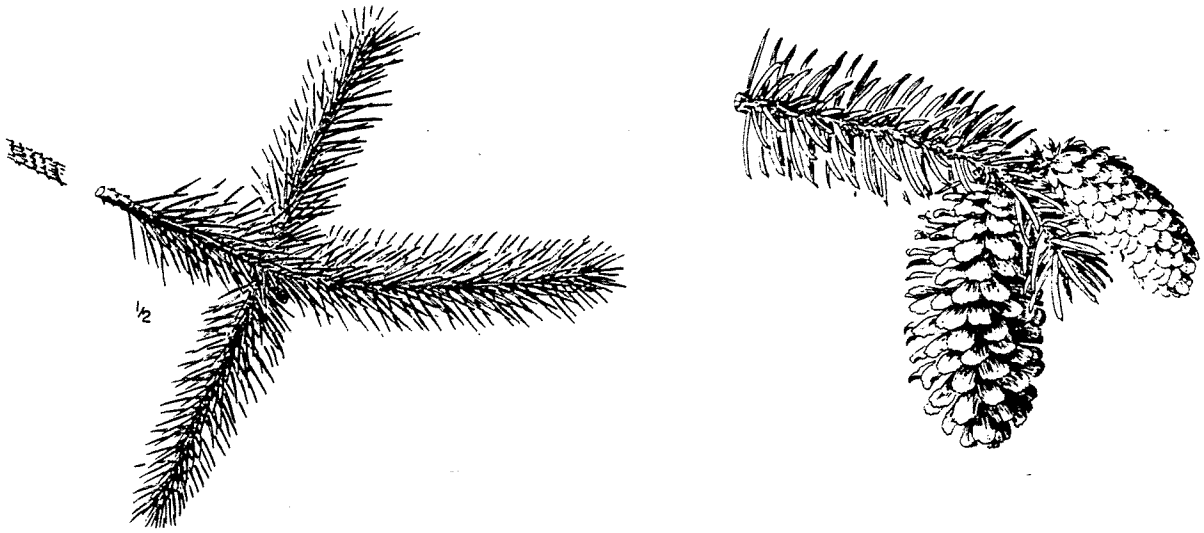
GROUP: rooted vascular plants

DESCRIPTION: Reedgrasses; stems from usually higher than a man to three times as high. In the common species in this region, *P. communis*, the leaves are grayish-green, close to each other and usually sticking out from stems at a big angle, to 0.6 m long and 1 cm wide; flower clusters almost 1 m long, often purple when young, usually whitish and fluffy when old; each spikelet with 3 to 7 flowers, and with many long hairs on the axis between flowers.

HABITAT: Brackish marshes.

REFERENCE(S): Description and figure from Hotchkiss (1972).

Picea sitchensis



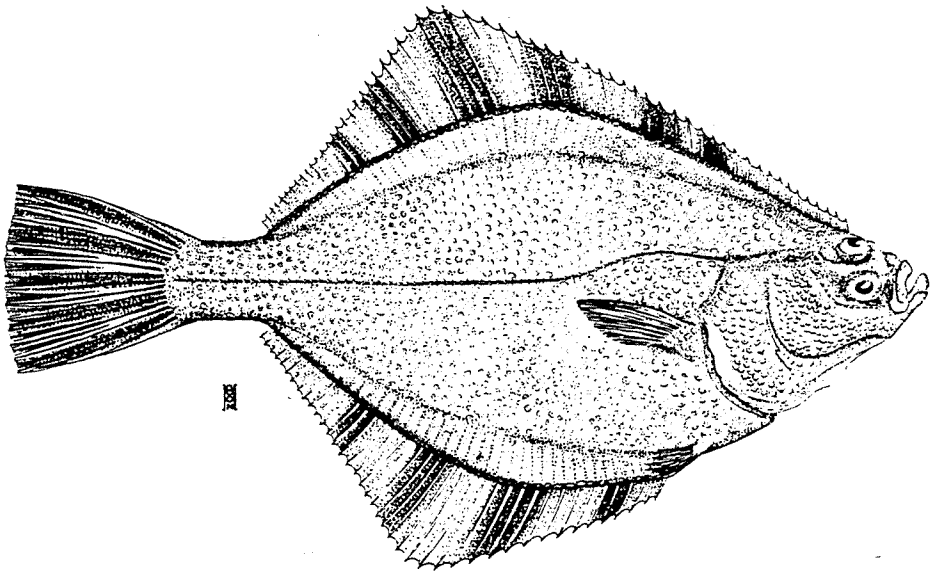
GROUP: rooted vascular plants

DESCRIPTION: Sitka spruce dominates our spruce swamps. It is the only spruce, in fact, the only needled tree commonly found in Pacific Northwest wetlands. Cones and needles are distinctive. Female cones have cornflake-like scales; male cones appear to be extensions of upper branches giving the impression the branch tips are dying. Needles are stiff and uncomfortably sharp.

HABITAT: In non-wetlands, Sitka spruce is a very large tree, especially on the Olympic Peninsula where it grows to 70 m in height with a diameter to 5 m at the base. Under very wet conditions, the trees do not achieve this great stature but are short and often scrubby in appearance with gangly Lower branches and a broad based trunk. Sitka spruce can tolerate standing water throughout much of the year. Common understory plants are red alder, sedges, and skunk cabbage. The higher and dryer hummocks at the base of the tree often are populated by normally nonwetland species such as sword fern, lily-of-the valley and salal. It is a useful and valuable lumber tree.

REFERENCE(S): Identification from Weinmann et al. (1984); figure from Hitchcock and Cronquist (1978).

Platichthys stellatus



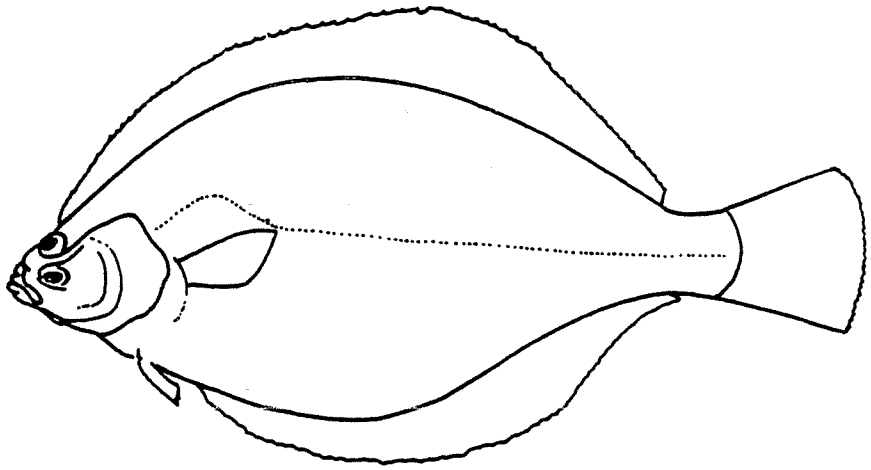
GROUP: sessile fish

DESCRIPTION: Starry flounder; one of the largest flatfish found in estuaries; can be either right- or left-eyed; oblique dark bars on caudal and anal fins; rough, tubercular scales.

HABITAT: Euryhaline; found in most wetland habitats, especially mudflat and tidal channels in emergent marshes; commonly migrates onto sand and mudflats to feed on benthic invertebrates during flood tides.

REFERENCE(S): Figure from Hart (1973).

Pleuronectidae (unid.)



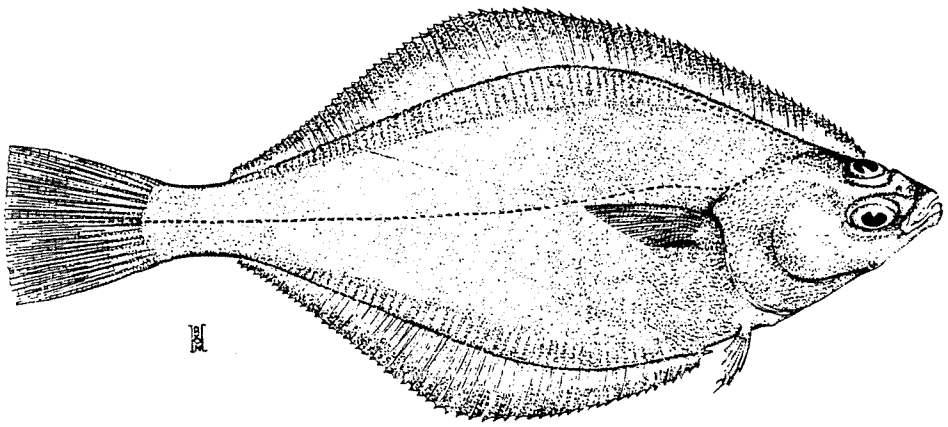
GROUP: sessile fish

DESCRIPTION: Righteye flounders; eyes and color on right-hand side and symmetrically placed pelvic fins.

HABITAT: Variety of soft bottom to gravel, subtidal and intertidal habitats.

REFERENCE(S): See Hart (1973) for key to species of region.

Pleuronectes vetulus



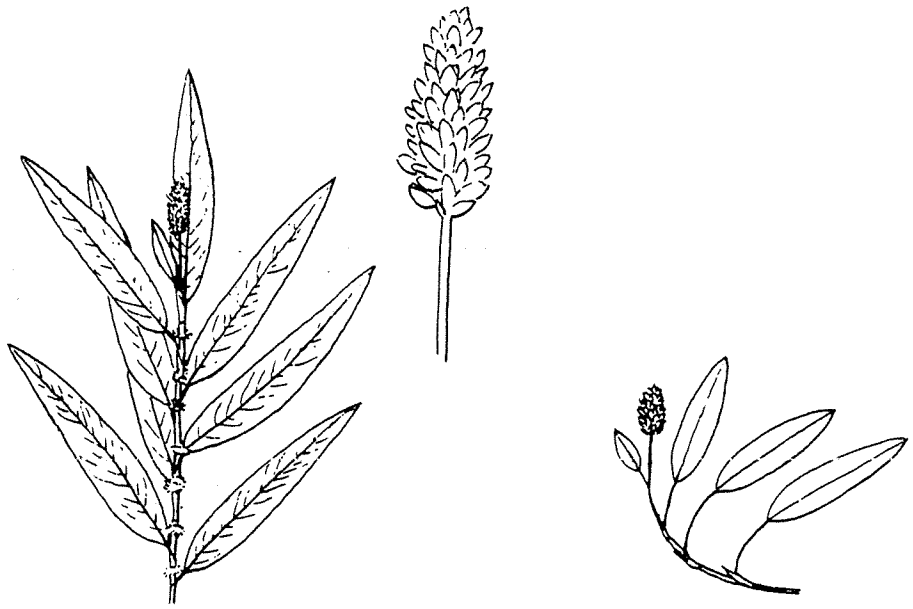
GROUP: sessile fish

DESCRIPTION: English sole; right-eyed flounder with pointed snout; eyed side with smooth scales; upper eye visible from blind side.

HABITAT: Most abundant flatfish in sand- and mudflat habitats; feeds on benthic invertebrates.

REFERENCE(S): Figure from Hart (1973).

Polygonum spp.



GROUP: rooted vascular plants

DESCRIPTION: Most knotweeds are characterized by swollen nodes where the leaf joins the stem. There is also a distinctive sheath which surrounds the node and leaf junction and may extend up the stem as much as 1 cm. The stems are generally round, smooth, shiny, and often reddish. Water smart weeds have long (5 to 15 cm), narrow Leaves with very distinctive veins. The pink or pink and white flowers form dense elongated clusters at the tip of the stem as well as from the leaf axils. In deep fresh marshes, these clusters stand erect above the water surface, while most of the leaves remain submerged.

HABITAT: Over 30 species of smartweed occur in the Pacific Northwest. Most of those west of the Cascades are found in moist to wet freshwater areas. Two species of water smartweed (*P. persicaria* and *P. punctatum*), are most common along lakeshores and in shallow and deep fresh marshes.

REFERENCE(S): Identification from Weinmann et al. (1984); figure of *P. amphibium* from Hotchkiss (1977).

Polygonum hydropiperoides



GROUP: rooted vascular plants

DESCRIPTION: Herbaceous perennial, nearly glabrous to strongly pubescent, the stem up to 1 m long, usually somewhat decumbent and tending to root freely; leaves numerous, only slightly reduced upward, short-petiolate or the upper ones subsessile, the blade narrowly to broadly lanceolate or oblong-lanceoltae, 5-12 (14) cm long, acute to acuminate, the base acute, glabrous to strongly strigose; stipules 1-2 cm long, strigose and bristly-ciliate; inflorescence of 2-several slender, often interrupted, spike-like racemes (panicles); perianth greenish to white or pinkish, 2.5-3 mm long, glabrous externally on the exposed area, 5-lobed slightly more than half the length, the 5 segments oblong, subequal, the inner ones sometimes slightly glandular, stamens 8, included; styles 3, connate about half their length, about 0.5 mm long.

HABITAT: In moist to swampy areas, usually growing in mud, from the lowland into the lower mountain valleys.

REFERENCE(S): Description and figure from Hitchcock and Cronquist 1978.

Pontogeneia rostrata

GROUP: epibenthic plankters

DESCRIPTION: Gammarid amphipod; Note: figure not available.

HABITAT: Low intertidal and subtidal on algae, eelgrass, and various sediments.

REFERENCE(S): See Kozloff (1987).

Populus trichocarpa



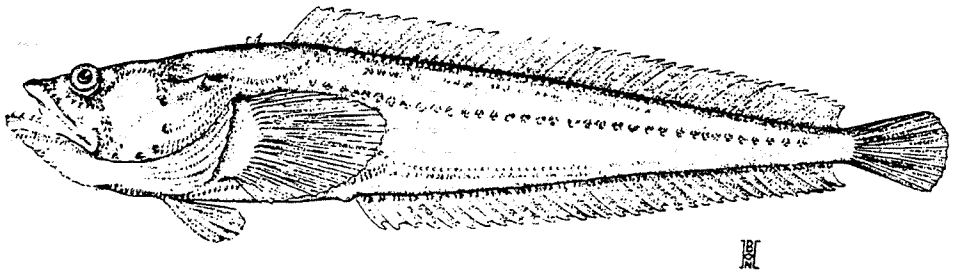
GROUP: rooted vascular plants

DESCRIPTION: Populus trichocarpa is the western vicariad of the more eastern and northern P. balsamifera L., which differs in its narrower, glabrous, 2-carpellate ovaries and fruits and fewer (commonly about 20) stamens. There is evidently some hybridization and introgression between them where their ranges overlap, and they might with some justification be treated as geographical races of a single species. the differences between them are on the same order of magnitude as those between other generally recognized species of Populus, however, and they are here retained as distinct. The precise geographic boundary between the two is somewhat obscure, especially inasmuch as many herbarium specimens are sterile.

HABITAT: Mostly along streams and around lakeshores, but in moister regions sometimes in better-drained soil away from water.

REFERENCE(S): Identification and figure from Hitchcock and Cronquist 1978.

Porichthys notatus



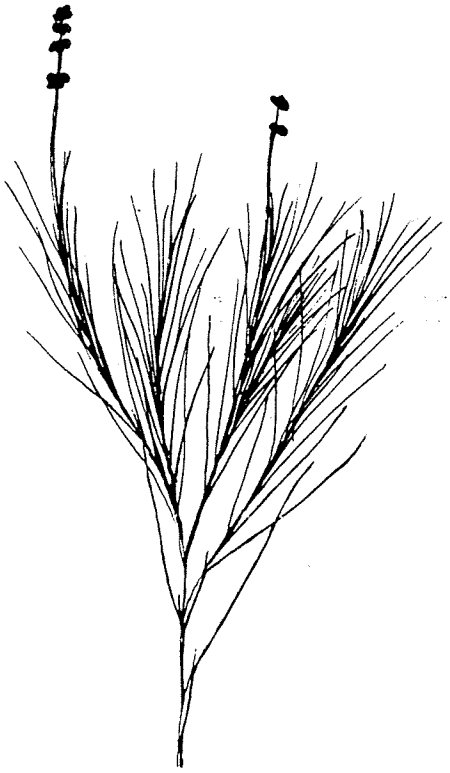
GROUP: sessile fish

DESCRIPTION: Plainfin midshipman; Identified by rows of luminous organs and ciri, protrusible eyes and two large canine teeth on vomer.

HABITAT: Adults in soft-bottom subtidal except when spawning, which occurs under rocks in intertidal gravel-cobble habitats.

REFERENCE(S): Description and figure from Hart (1973).

Potomogeton spp.



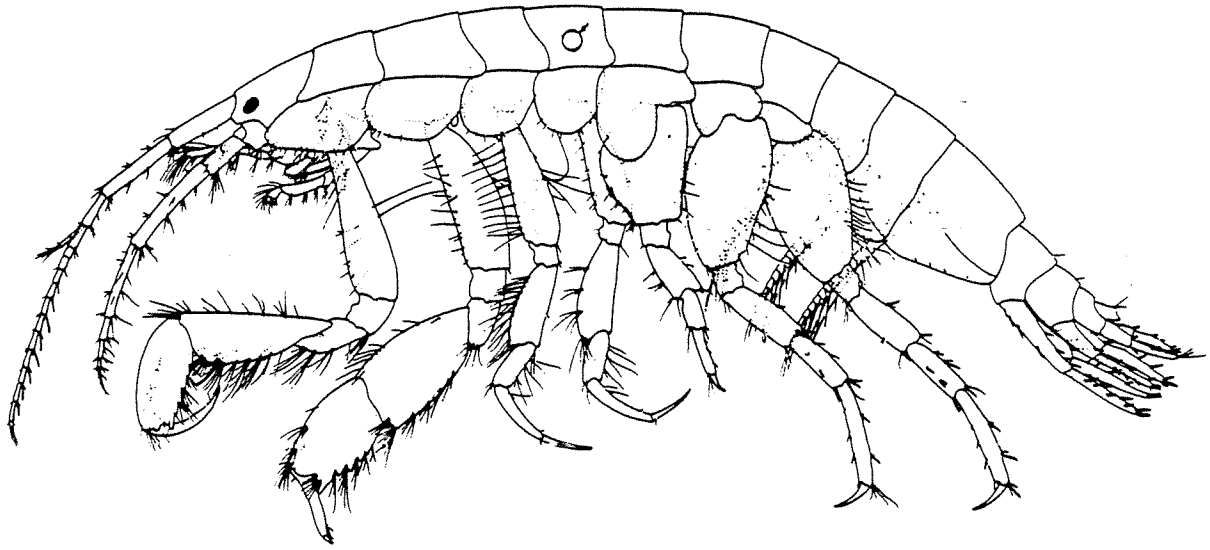
GROUP: rooted vascular plants

DESCRIPTION: Pondweeds; diverse genera distinguished by threadlike to ribbonlike leaves, some oblong to oval, scattered singly on flexible underwater stems, but often paired to bunched toward the stem tips.

HABITAT: Brackish marshes.

REFERENCE(S): See Hitchcock and Cronquist (1978) and Hotchkiss (1972) for descriptions of *Potomogeton* species; figure of *P. filimormis* from Hotchkiss (1972).

Protomedeia penates



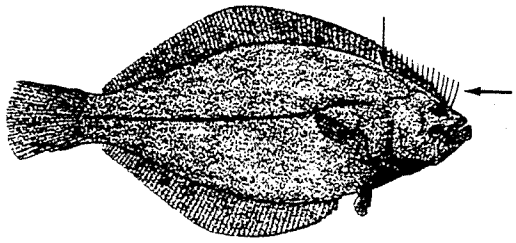
GROUP: sedentary infauna

DESCRIPTION: Gammarid amphipod.

HABITAT: On mud or sand of protected and semiprotected coasts; low intertidal to 400 m.

REFERENCE(S): Description available in Kozloff (1987); figure from Conlan (1983).

Psettichthys melanostictus



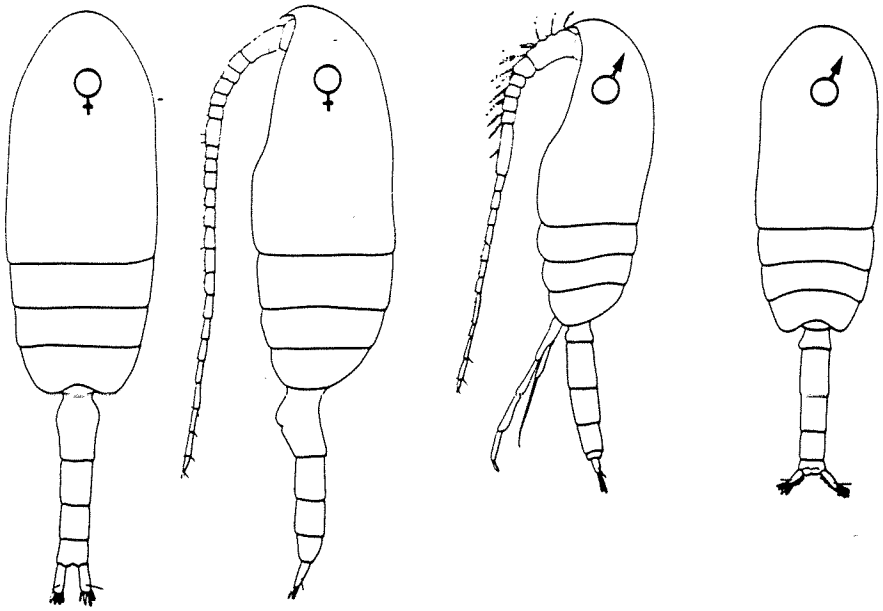
GROUP: sessile fish

DESCRIPTION: Sand sole; right-eyed flounder; fin rays long and free of membrane at anterior edge of dorsal fin; large mouth; uniform grey or brown in color.

HABITAT: Common, predominantly on sandflats; feeds specifically on benthic crustaceans.

REFERENCE(S): Figure from Eschmeyer (1983).

Pseudocalanus minutus



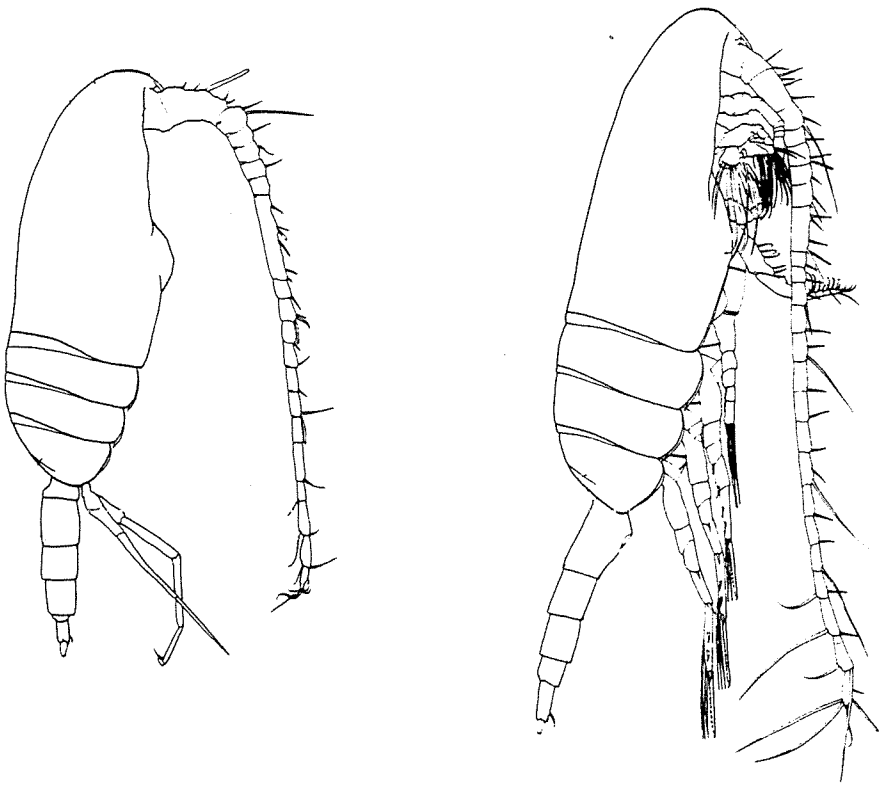
GROUP: pelagic zooplankton

DESCRIPTION: Calanoid copepod.

HABITAT: Planktonic marine.

REFERENCE(S): See Gardner and Szabo (1982).

Pseudocalanus spp.



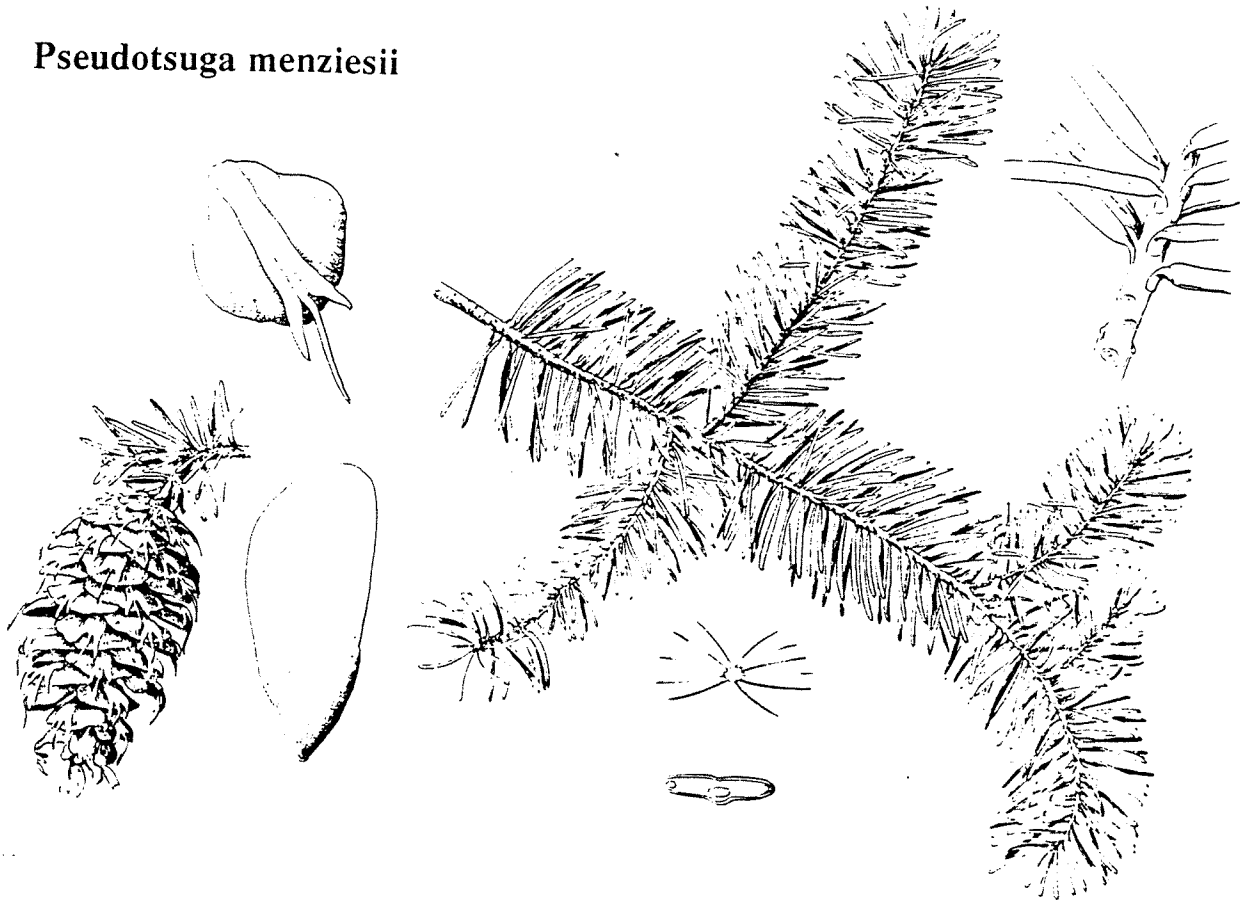
GROUP: pelagic zooplankton

DESCRIPTION: Calanoid copepod; see taxonomic reference for distinguishing characteristics; figure is of *P. minutus*.

HABITAT: Marine planktonic.

REFERENCE(S): See Gardner and Szabo (1982) and Frost (1989) for identification; figure from Frost (1989).

Pseudotsuga menziesii



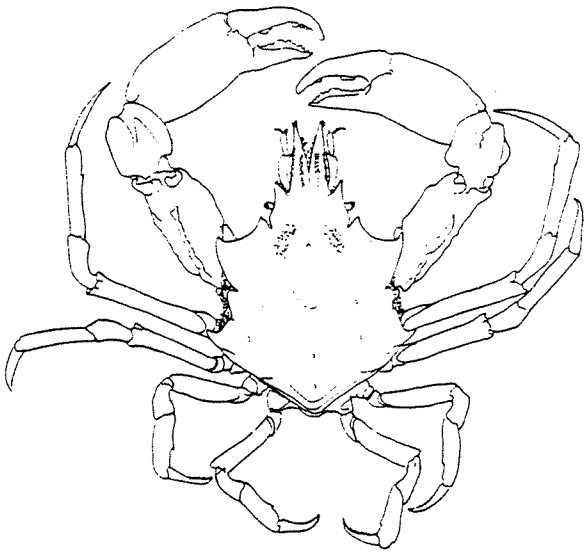
GROUP: rooted vascular plants

DESCRIPTION: 'Douglas fir': Giant forest trees up to 70 (90) m tall, ultimately with very thick, rough, dark brown bark, the branches spreading to drooping, the crown of young trees pyramidal and with a stiffly erect leader, older trees with a flattenedcrown; branching rather irregular, the branchlets not always opposite, mostly pubescent for several years; buds non-resinous, sharp-pointed, usually cinnamon-red to -brownish; needles retained 7-10 years, (1.5) 2-3 (3.5) cm long, obtuse to acute, yellow-green to dark green or bluish-green, mostly uniformly spreading or turned upward, rarely spreading in one plane, slightly grooved and without whitish stomata on the upper surface, the lower surface with two longitudinal bands of white stomata separated by a prominent midvein; seeds 5-6 mm long, the broad wind up to twice as long.

HABITAT: Moist to very dry areas from sea level to midmontane. A shade intolerant species, which does not reproduce well in in deeply shaded forests, but ultimately usually establishing itself abundantly in burned or logged areas. Not only is this the most important forest tree in N. Am., it is one of the largest. There is considerable variation in the species and aside from a few horticultural forms that are known, there are two well defined geographic races.

REFERENCE(S): Description and figure from Hitchcock and Cronquist 1978.

Pugettia gracilis



GROUP: evasive macroepifauna

DESCRIPTION: Spider crab; see taxonomic reference for identification.

HABITAT: Eelgrass, kelp, and encrusting algae; intertidal and subtidal.

REFERENCE(S): See Kozloff (1987) for identification; figure from Hart (1982).

Rumex spp.



GROUP: rooted vascular plants

DESCRIPTION: In the Pacific Northwest, curly dock (*R. crispus*) will be the species most frequently encountered in wetlands, although other dock species do occur. Curly dock is distinguished by its overall deep reddish-brown coloration throughout most of the year, appearing dried out or dead. The species grows erect from 3 to 8 dm in height and stands above most plants in fresh meadows where it one of the most distinctive species. Prior to and during flowering, the plant is yellowish green, often with a reddish tinge. Flowers are greenish-white and individually inconspicuous though forming dense, branched spikes. The minute seeds are sharply three-angled and sometimes appear to be winged. Leaves, stems, and flower turn reddish-brown soon after initial flowering. The leaves are 1 to 3 dm in length and wrinkled along the edges.

HABITAT: Dock is an adaptable plant found in wet meadows, shallow fresh marshes, and in nonwetland habitats throughout low elevations. It is occasionally found in high salt or brackish marshes. Associated species are numerous and diverse, including reed canarygrass, various grasses, and sedges.

REFERENCE(S): Identification from Weinmann et al. (1984); figure from Hitchcock and Cronquist (1978).

Ruppia maritima



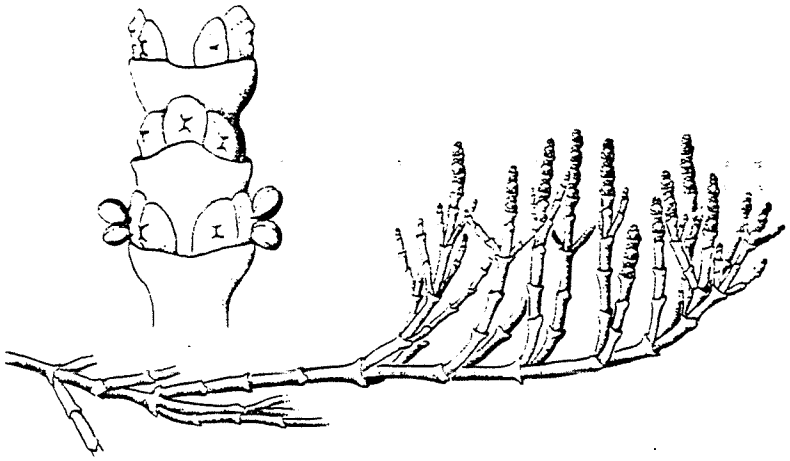
GROUP: rooted vascular plants

DESCRIPTION: Stems up to 8 dm long; leaves semi-capillary, scarcely 0.5 mm. broad, up to 12 cm long, bordered at base by adnate, more or less sheathing stipules mostly 5-15 mm long, the stipule tips sometimes free for 1-2 mm; flowering spikes axillary to and sheathed by the uppermost leaves of the stem, the peduncle elongating as the fruits mature and ultimately 3-30 cm long and straight to strongly coiled; fruits ovoid or more of less pyriform, symmetrical to strongly asymmetrical, 1.5-3 mm long.

HABITAT: Along the Pacific coast from Alaska to Baja California, inland in ditches, ponds, and lakes, throughout Canada and the U.S., to the Atlantic coast; South America and the Old World.

REFERENCE(S): Identification and figure from Hitchcock and Cronquist 1978.

Salicornia spp.



GROUP: rooted vascular plants

DESCRIPTION: PlantsPickleweeds, which have cylindrical, fleshy stems but no true leaves; *S. virginica* (illustrated) is prevalent species in this region.

HABITAT: Both low and high salt marshes, especially on sandy substrates.

REFERENCE(S): See Weinmann et al. (1984) for photograph; identifying characteristics and figure from Hotchkiss (1972).

Salix spp.

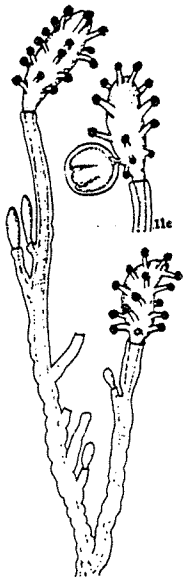
GROUP: rooted vascular plants

DESCRIPTION: Willow; more than 30 species with a variety of characteristics are recognized in the Pacific Northwest. Leaves are generally elongated, but vary from extremely narrow to almost round; most have a pointed tip. Length varies from 2 to 10 cm. For some species, the furry catkins which emerge in late winter to spring, often before the leaves, are a distinctive feature. Willows are generally tall shrubs or short trees (4 to 8 m) but can reach 20 m in height. In swamp situations, willows may be mistaken for red alder, but can be distinguished by their smaller leaves with smooth edges and indistinct veins.

HABITAT: Willows are common in swamps and along streams and river banks, but may also be found in moist upland settings. They tolerate temporary inundation, but not prolonged flooding during the growing season. Along rivers, they often grow on sand and gravel bars which are inundated during high water. In this setting they trap sediments, ultimately raising the bar's elevation sufficiently to allow cotton woods and other less water-tolerant species to establish. In this way the willow often establishes new riparian communities. In more bog-like situations they are often associated with Douglas spiraea. Cattails, Pacific ninebark, and red osier dogwood are common associates in swamps.

REFERENCE(S): Identification from Weinmann et al. (1984); figure from Hitchcock and Cronquist (1978).

Sarsia spp.



GROUP: surface epifauna

DESCRIPTION: Hydroids; distinguished by polyps releasing medusae with exumbrellar nematocysts and/or hydranths with tentacles arranged in two whorls, tentacles in both whorls capitate, and polyp releasing medusae with four simple tentacles; illustration of *S. eximia*.

HABITAT: On lower intertidal and shallow subtidal hard substrates and on eelgrass blades.

REFERENCE(S): Diagnostics and figure from Kozloff (1987).

Saunderia spp.

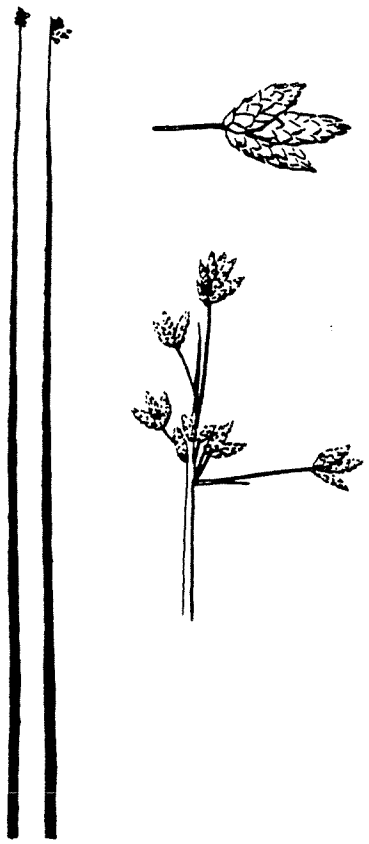
GROUP: surface epifauna

DESCRIPTION: Beach flies; prominent chironomid; Note: figure not available.

HABITAT: Gravel cobble beaches; larvae are tube builders nestling in algae and detritus.

REFERENCE(S): Description from Merritt and Cummins (1984).

Scirpus acutus



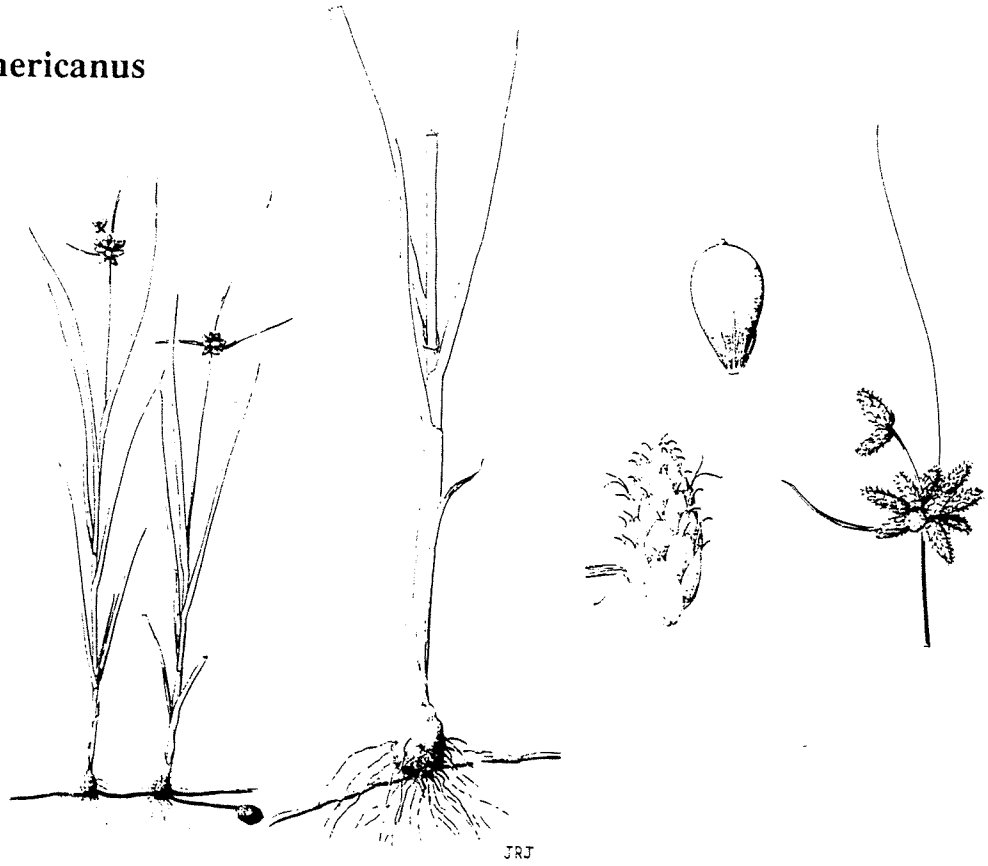
GROUP: rooted vascular plants

DESCRIPTION: One of the tallest herbaceous marsh plants in the Pacific Northwest, hardstem bulrush typically stands at least 2 m high and may grow to 2.5 m. The grey-green, round stems can be as much as 3 cm in diameter at the base. A spike bearing about 10 spikelets on short peduncles at the top of the main stem is a distinctive feature. A narrow bract, 3 to 4 cm in length, extends beyond the spikes appearing to be an extension of the stem. The plant has short linear leaves concentrated near the base. Soft-stem bulrush is not readily distinguishable from hardstem bulrush in the field, but is generally less common in this region.

HABITAT: This species grows primarily in freshwater marshes, but occasionally occurs in high brackish marshes as well. It is associated most often with cattail in shallow marshes and with waterlilies in deep marshes, though it often forms visually dominant monotypic stands. The species is restricted to wetland habitats and can grow where the water reaches a meter in depth.

REFERENCE(S): Identification from Weinmann et al. (1984); figure from Hotchkiss (1972).

Scirpus americanus



GROUP: rooted vascular plants

DESCRIPTION: American threesquare forms stands of scattered culms from O.3 to 1.5 m in height. Each culm is triangular in cross section, with flat sides. The several flat, elongated leaves (2 to 4 mm in width and O.2 to 1.0 m long) are borne near the base. A compact cluster composed of one to eight yellowish-brown to reddish-purple spikelets protrudes at the base of a prominent, sharply tipped green bract, 2 to 15 cm in length, which appears as a continuation of the culm. American threesquare is a perennial and fruits from June through September.The plant grows from dark brown rhizomes as does a similar species, Olney's threesquare; the latter appears slightly stouter, and its culm appears three-winged in cross section.

HABITAT: American threesquare is typical of low salt and brackish marshes occurring at or near mean high water, but extends into high marshes such as the fringing salt marshes of Grays Harbor, Willapa Bay and Padilla Bay. The species does not appear to tolerate high salinity compared to Olney's threesquare. Associated species include smooth cordgrass, seaside arrowgrass, and Lyngby's sedge.

REFERENCE(S): Identification from Weinmann et al. (1984); figure from Hitchcock and Cronquist (1978).

Scirpus maritimus



GROUP: rooted vascular plants

DESCRIPTION: A sharply triangular stem, 5 to 10 mm in diameter and 0.5 to 1.5 m in height, typifies this bulrush. The leaves (to 0.5 m long) are evenly distributed along the stem. Spikelets are reddish-brown, large (1 to 3 cm long), and numerous. Most are attached closely to the stem, though there are normally two or three short (to 5 cm) stalks emanating from the basal cluster with to 10 spikelets at their ends. Several bracts up to 10 cm long) extend from the base of the spikelet.

HABITAT: This large bulrush commonly occurs in high brackish or salt marshes that are inundated about once a day. It may also occur infrequently in low salt marshes. It often forms a minor component of high marsh communities containing Pacific silverweed, sedges, or other species. In the Skagit River delta, however, it is one of three bulrushes, (with hardstem bulrush and American threesquare), which dominate most tidal marsh communities. There it is recognized as a major food source for migrating and wintering waterfowl, especially snow geese.

REFERENCE(S): Identification from Weinmann et al. (1984); figure from Hitchcock and Cronquist (1978).

Scirpus spp.

GROUP: rooted vascular plants

DESCRIPTION: Rushes/bulrushes; see *S. acutus, S. americanus, S. maritimus,* and *S. validus* for specific diagnostic characteristics and illustrations.

HABITAT: Brackish marshes.

REFERENCE(S): See Hitchcock and Cronquist (1978) for descriptions of *Scirpus* spp.

Scirpus validus



GROUP: rooted vascular plants

DESCRIPTION: Similar to *S. acutus*, but averaging smaller and more slender, the stems soft, easily crushed between the fingers; inflorescence tending to be looser and more open, with longer, laxer, sometimes drooping rays, some of the spikelets often borne singly instead of all in sessile clusters; spikelets averaging smaller, seldom over 1 cm long, more shining and reddish-brown; scales mostly (2) 2.5-3 (3.5) mm long, with a brown of tawny ground-color, so that the fine, red-brown striolae are not usually prominent at 10X; margins of the scales entire to somewhat lacerate or shortly fringed-ciliolate, but less conspicuously so than in *S. acutus*; achenes not wholly concealed by the scales at maturity, mostly 2.0-2.3-mm long. Common name tule, softstem bulrush.

HABITAT: Marshes and muddy shores of lakes and streams at lower elevations, colonial but seldom forming large exclusive colonies in the fashion of *S. acutus*; tolerant of alkali; widespread in temperate North America, and south into tropical America, and found in appropriate habitats throughout our range, somewhat less commonly than *S. acutus*.

REFERENCE(S): Identification and figure from Hotchkiss (1972).

Scirpus validus (seeds)

GROUP: rooted vascular plants

DESCRIPTION: See *Scirpus validus*

HABITAT:

REFERENCE(S):

Scolioidea (unid.)

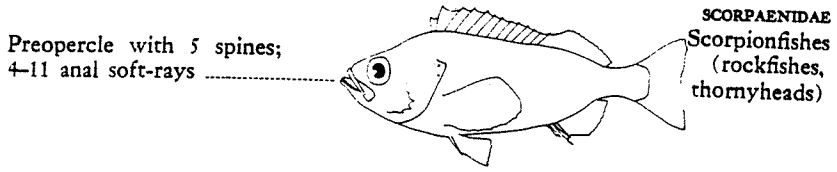
GROUP: neustonic and drift invertebrates

DESCRIPTION: Parasidic wasps; Note: figure not available.

HABITAT: Neuston in all but subtidal habitats.

REFERENCE(S): See Merritt and Cummins (1984).

Scorpaenidae (unid.)



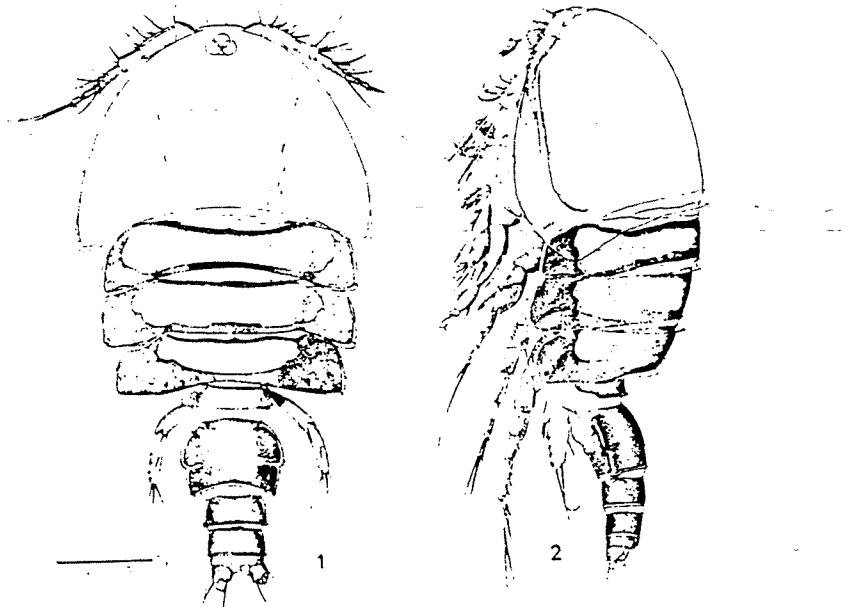
GROUP: motile fish

DESCRIPTION: Rockfishes; gill opening extends at least as far as base of lowest pectoral fin ray; opening behind gill arch is much reduces or absent; and two opercular spines and five preopecular spines.

HABITAT: Larvae and small juveniles in water column; most adults demersal around subtidal hard substrate.

REFERENCE(S): Description from Hart (1973); figure from Miller and Lea (1971).

Scutellidium arthuri



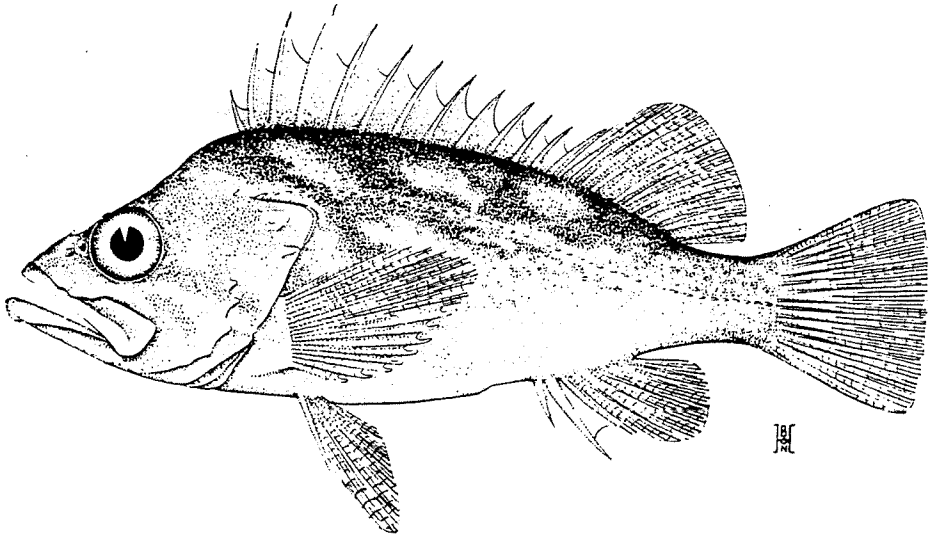
GROUP: epibenthic plankters

DESCRIPTION: Dark blue-black harpacticoid copepod.

HABITAT: Almost exclusively found attached to eelgrass and macroalgae.

REFERENCE(S): See Wells (1976); figure from Itô.

Sebastes caurinus



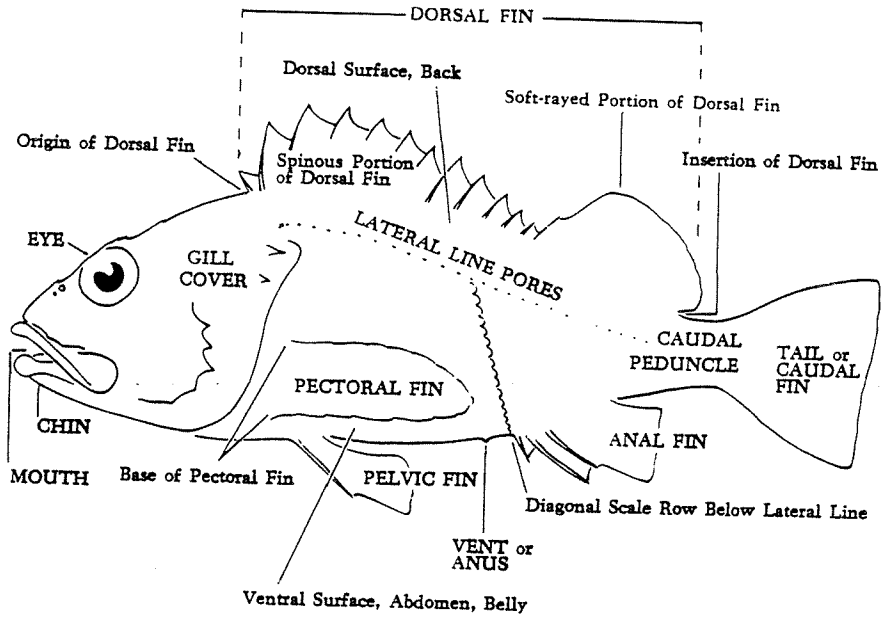
GROUP: motile fish

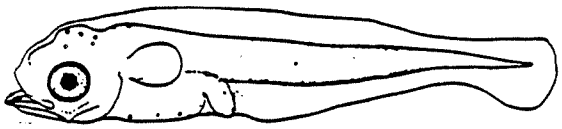
DESCRIPTION: Copper rockfish; dark fins, deep cuadal peduncle and latter 2/3 of lateral line area is clear of coloration.

HABITAT: Larvae and small juveniles in water column; adults demersal in subtidal hard substrate habitats.

REFERENCE(S): Description from Hart (1973) and Miller and Lea (1972); figure from Hart (1973).

Sebastes spp.





GROUP: motile fish

DESCRIPTION: Rockfishes; distinguished from other genera by dorsal spine/ray counts of 11 to 14/11 to 18 and no continous sharp redge along side of head.

HABITAT: Larvae and small juveniles in water column; adults demersal in subtidal and hard substrate habitats.

REFERENCE(S): See Hart (1973) for description and figures of most species found in this regio; figure from Miller and Lea (1971) and Garrison and Miller (1982).

Sium suave



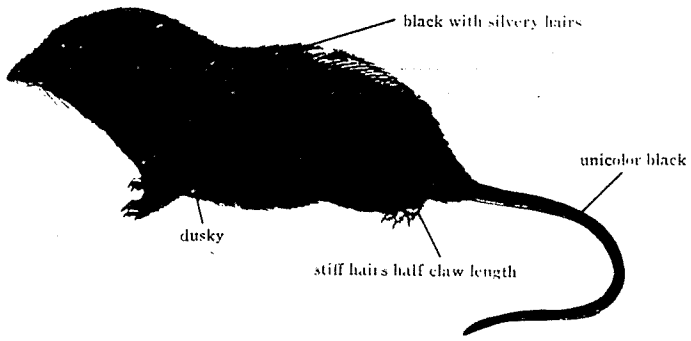
GROUP: rooted vascular plants

DESCRIPTION: Perennial from a very short erect crown, the fibrous roots sometimes originating at one or two lower nodes of the stem as well as from the crown; stem solitary, stout, ribbed-striate, mostly 5-12 dm tall, generally branched above; leaves basal and cauline or all cauline, the lower long-petiolate, the upper with progressively shorter, winged petioles, all pinnately once compound with 7-13 sessile, merely serrulate to deeply pinnatisect and again cleft leaflets, these 2-9 cm long, 1.5-10 (20) mm wide, typically lance-linear; primarily lateral veins of the leaflets mostly branched and inconspicuous, not bearing any obvious relation to the marginal teeth or sinuses; involucre of 6-10 lanceolate or linear bracts 3-15 mm long, entire or incised, unequal, reflexed, involucel of 4-8 inconspicuous narrow bractlets 1-3 mm long; rays of the umbels m

HABITAT: Swampy places and in shallow water, in the valleys and foothills; s. British Columbia to central Califiifornia.

REFERENCE(S): Identification and figure from Hitchcock and Cronquist (1978).

Sorex bendirii



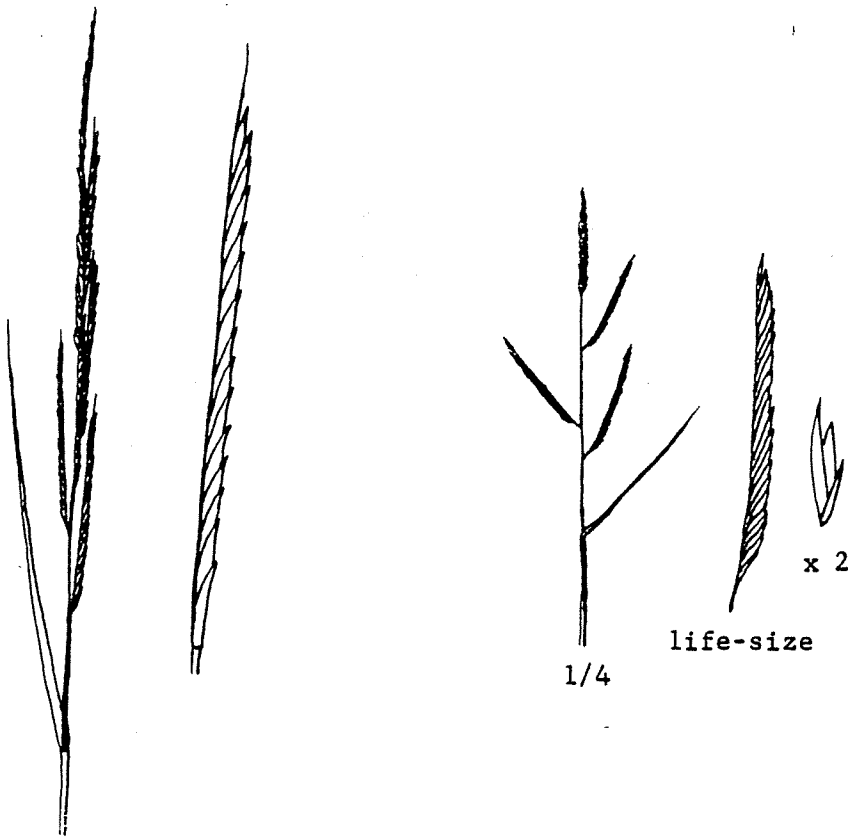
GROUP: herbivorous mammals

DESCRIPTION: Pacific water shrew or marsh shrew; length 145-74 mm; tail unicolored, 61-80 mm; hind foot 18-22 mm; condylobasal length 20.8-23.8 mm; hind feet with a weak fringe of inconspicuous hairs about half as long as the claws; black or sooty brown dorsally, frequently "frosted: with silver-tipped hairs; underparts very little lighter than upper parts..

HABITAT: Swamps, marshes, damp ravines, and under logs in damp woods in the Transition and Canadian life zones of northwestern California and the western third of Oregon and Washington.

REFERENCE(S): Description and figure from Ingles (1965).

Spartina spp.



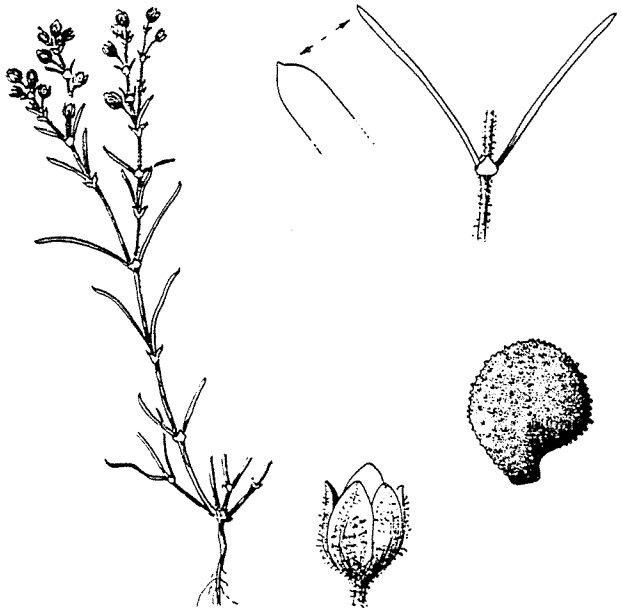
GROUP: rooted vascular plants

DESCRIPTION: Cordgrasses; two species, *S. alterniflora* and *S. patens* occur in this region. The former, saltmarsh cordgrass, has stems from ankle-high where the ground is barely flooded by high tides to higher than a man along marsh creeks; leaves to 0.6 m long and 2 wide, long tapering; flowers with long, upright branches. The latter species, saltmeadow cordgrass, has ankle-high to waist-high stems and leaves to 0.5 m long and 0.5 cm wide and long tapering; flower clusters to 18 cm long, usually with three to six branches.

HABITAT: Brackish marshes; *S. alterniflora* is an exotic which has invaded coastal estuaries and Puget Sound, and is expanding dramatically in unvegetated mudflat habitats.

REFERENCE(S): See Hitchcock and Cronquist (1973) for distinguishing characteristics; figures from Hotchkiss (1972)..

Spergularia marina



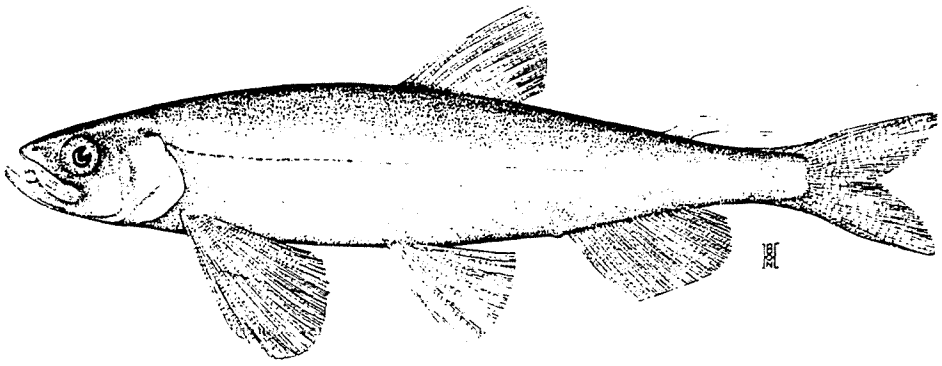
GROUP: rooted vascular plants

DESCRIPTION: This sprawling annual plant feels fleshy to the touch. The drab white to pale pink flowers are about 1 cm in diameter. The sepals are longer than the petals, partially obscuring them. Opposite, narrow linear leaves are 2 to 4 cm long.

HABITAT: This plant is most typical of low salt and brackish marshes where it is sometimes a pioneer species; it may also range into the high salt marsh. Capable of withstanding regular tidal inundation, it is also particularly adapted to high salinities. As the common name implies, it generally grows on sandy substrate. The plant is often inconspicuous among its dominant associates, which include pickleweed and fleshy jaumea.

REFERENCE(S): Identification from Weinman et al. 1984; figure from Hitchcock and Cronquist 1978.

Spirinchus thaleichthys



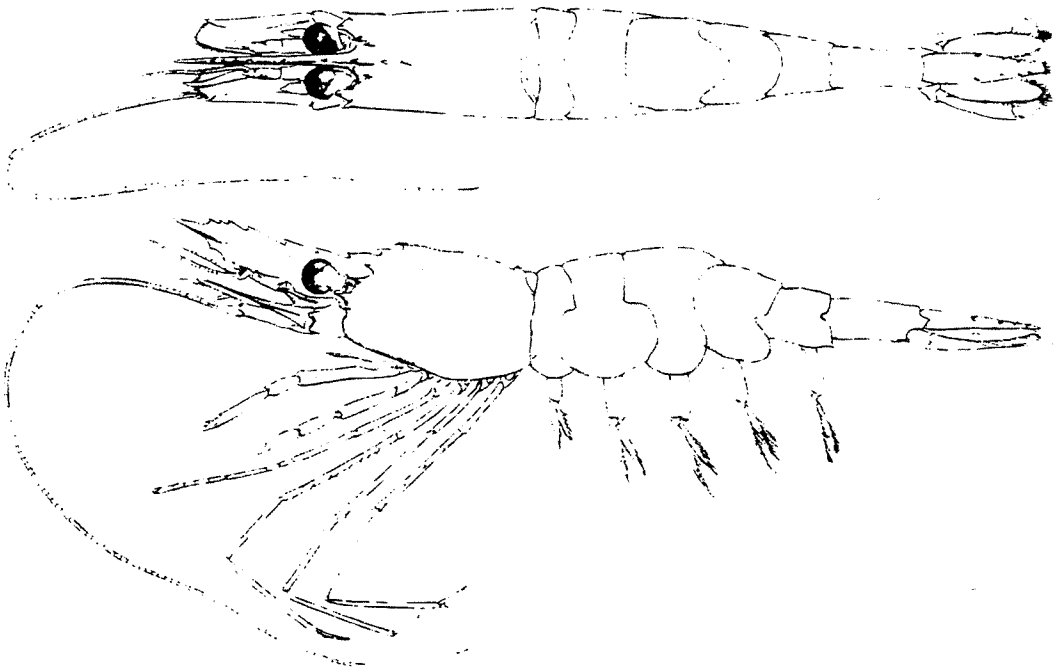
GROUP: motile fish

DESCRIPTION: Longfin smelt; distinguished from other smelts by canine teeth on tongue; very large pectoral fins, and upper jaw extending to rear of eye.

HABITAT: Not extremely well known; most common along bottom of mainstem channels of estuaries.

REFERENCE(S): Description and figure from Hart (1973).

Spirontocaris spp.



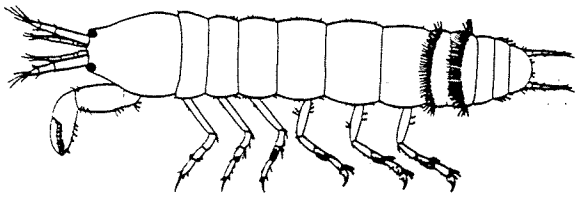
GROUP: evasive macroepifauna

DESCRIPTION: Hippolytid shrimp.

HABITAT: Subtidal on various substrata.

REFERENCE(S): See Butler (1980), and Kozloff (1987).

Tanais spp.



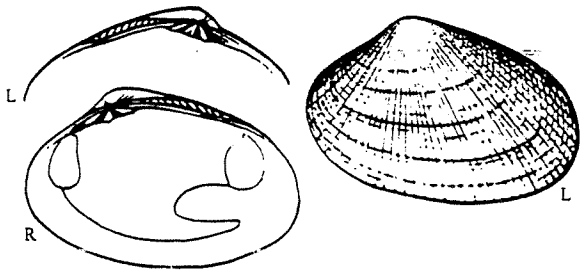
GROUP: sedentary infauna

DESCRIPTION: Tanaid; distinguished from others in the region by four free pleonites (others have three or five).

HABITAT: Tube building in soft sediments; intertidal to subtidal.

REFERENCE(S): See Holdich and Jones (1983) for identification and figure.

Tapes (Ruditapes) philipinarum



GROUP: sedentary infauna

DESCRIPTION: Manila or japanese littleneck clam; originally called *T. japonica* and *Veneropsis japonica*. Oblong with widely spaced radial ridges; no teeth on inside of valves near ventral margins; valve interior yellowish with purple stain.

HABITAT: Gravel-cobble beaches in euhaline waters.

REFERENCE(S): Description from Kozloff (1983, 1987); figure from Yates (1988).

Teleostei (larvae)

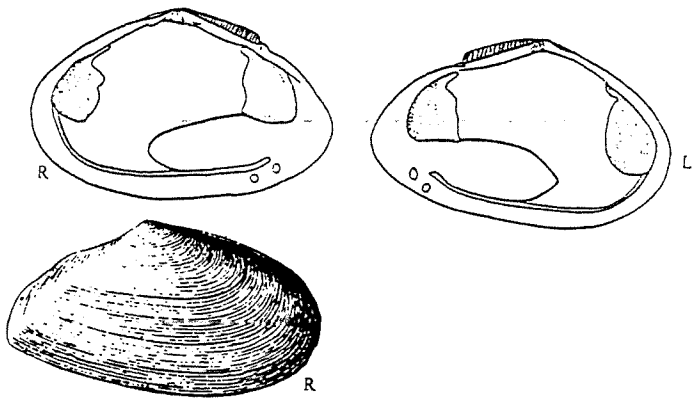
GROUP: pelagic zooplankton

DESCRIPTION: Diverse bony fishes; usually short, compressed body with thin dermal scales and a symmetrical tail; often possessing air bladder.

HABITAT: Water column; often concentrated along tidal fronts.

REFERENCE(S): See Garrison and Miller (1982) for further description and figures.

Tellina spp.



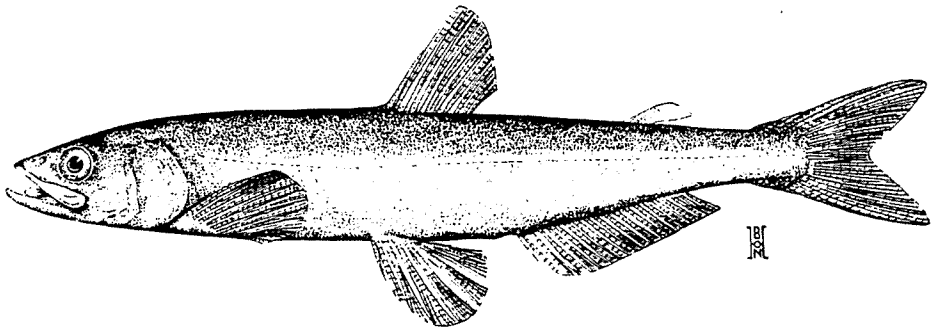
GROUP: sedentary infauna

DESCRIPTION: Clam; see taxonomic references for distinguishing characters.

HABITAT: Silt or sand from intertidal to 440 meters.

REFERENCE(S): See Kozloff (1987) for identification and figure; additional figure from Keen and Coan (1974).

Thaleichthys pacificus



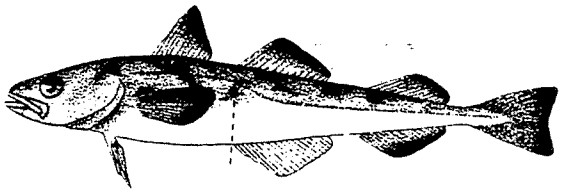
GROUP: motile fish

DESCRIPTION: Eulachon; silvery smelt with marked striations on gill cover; upper jaw extending to rear of eye; fine black specking on back.

HABITAT: Anadromous; migrates directly through estuarine surface waters to spawn in winter-spring; larvae and postlarvae drift rapidly through, and don't appear to rear in, estuaries; feeds on zooplankton.

REFERENCE(S): See Hart (1972) for identification and figure.

Theragra chalcogramma



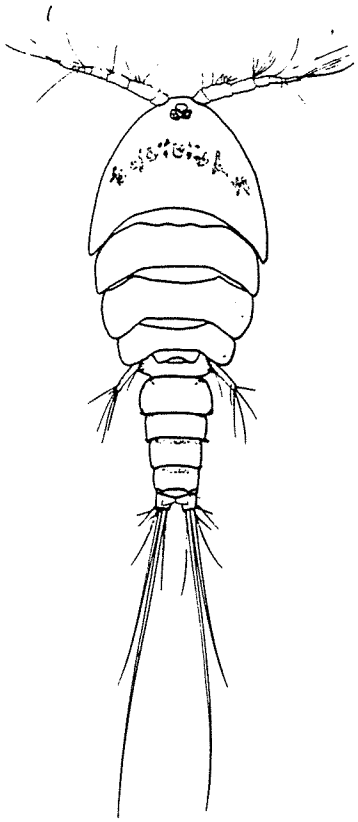
GROUP: motile fish

DESCRIPTION: Walleye pollock; distinguished from other Gadid fishes by location of anal vent below space between first and second dorsal fins.

HABITAT: In estuaries, in water column or demersoal in mainstem channels.

REFERENCE(S): Description and figure from Eschmeyer et al. (1983).

Tisbe spp.



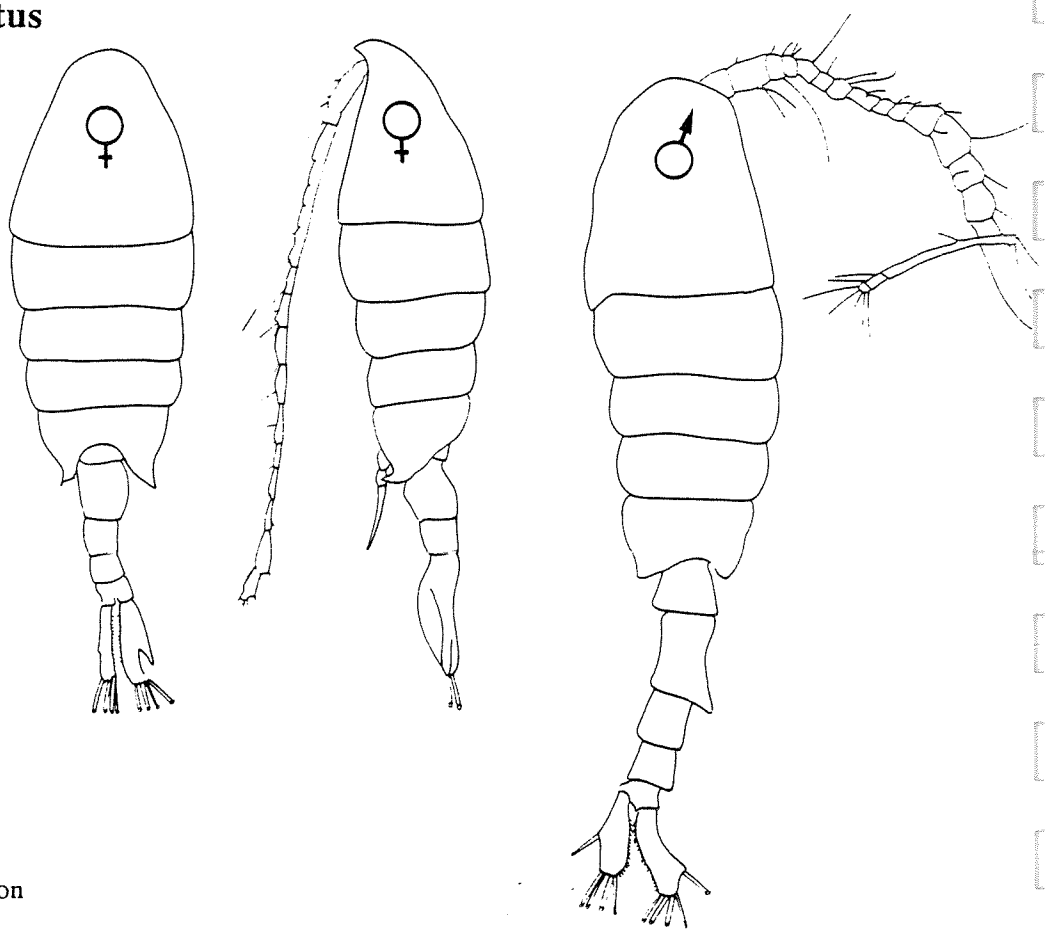
GROUP: epibenthic plankters

DESCRIPTION: Large harpacticoid copepods which are somewhat dorsoventrally flattened; adults have distinctive red stripes on the body.

HABITAT: Epibenthic; associated with detritus or macrophytes.

REFERENCE(S): See Wells (1976) for identification; figure from Volkmann and Rocco (1972).

Tortanus discandatus



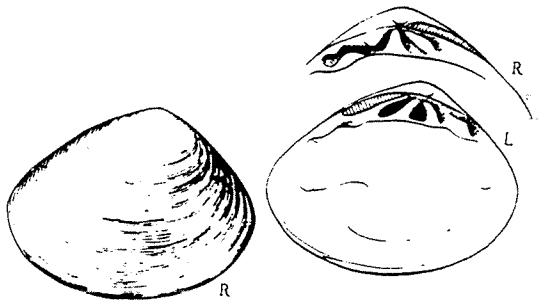
GROUP: pelagic zooplankton

DESCRIPTION: Calanoid copepod; see taxonomic reference for description.

HABITAT: Marine planktonic.

REFERENCE(S): See Gardner and Szabo (1982).

Transennella tantilla



GROUP: sedentary infauna

DESCRIPTION: Very small clam; recognized by siphons fused for half their length; tentacles on siphons long and flexible; posterior end of shell usually brown or purplish.

HABITAT: Buried partially in clean sand, especially around eelgrass roots and rhizomes, in protected embayments and beaches.

REFERENCE(S): Description from Kozloff (1983); figure from Keen and Coan (1974).

Triglochin maritimum



GROUP: rooted vascular plants

DESCRIPTION: The fleshy, succulent leaves are 1 to 8 dm in length and tufted from the root mat or from short rhizomes. Each leaf has a sheath which encircles the inner, older, and usually shorter Leaves. This sheath may extend as much as one-third of the leaf length. The sheath distinguishes seaside arrow grass from seaside plantain, which appears similar when not in flower. A Long flower stalk extends from the center of the plant above the Leaves. The tiny, green or purplish flowers are numerous, individually stalked,and densely clustered along the upper one-third of the stalk. The plant is nonpersistent in winter, the above-ground portion being removed by winter tides.

HABITAT: Arrowgrass is common in low salt or brackish marshes where it is usually inundated twice a day. Occasionally arrowgrass may be found in high marshes where inundation occurs once daily; however, only rarely is it a dominant feature in these communities. In salt marshes, it may be associated with pickleweed, fleshy jaumea, and salt grass. In brackish marshes, common associates are sedges, Pacific silverweed, and American threesquare. Although not common, seaside arrowgrass has also been noted in alkaline seeps east of the Cascades.

REFERENCE(S): Identification from Weinmann et al. (1984); figure from Hitchcock and Cronquist (1978).

Triglochin palustris



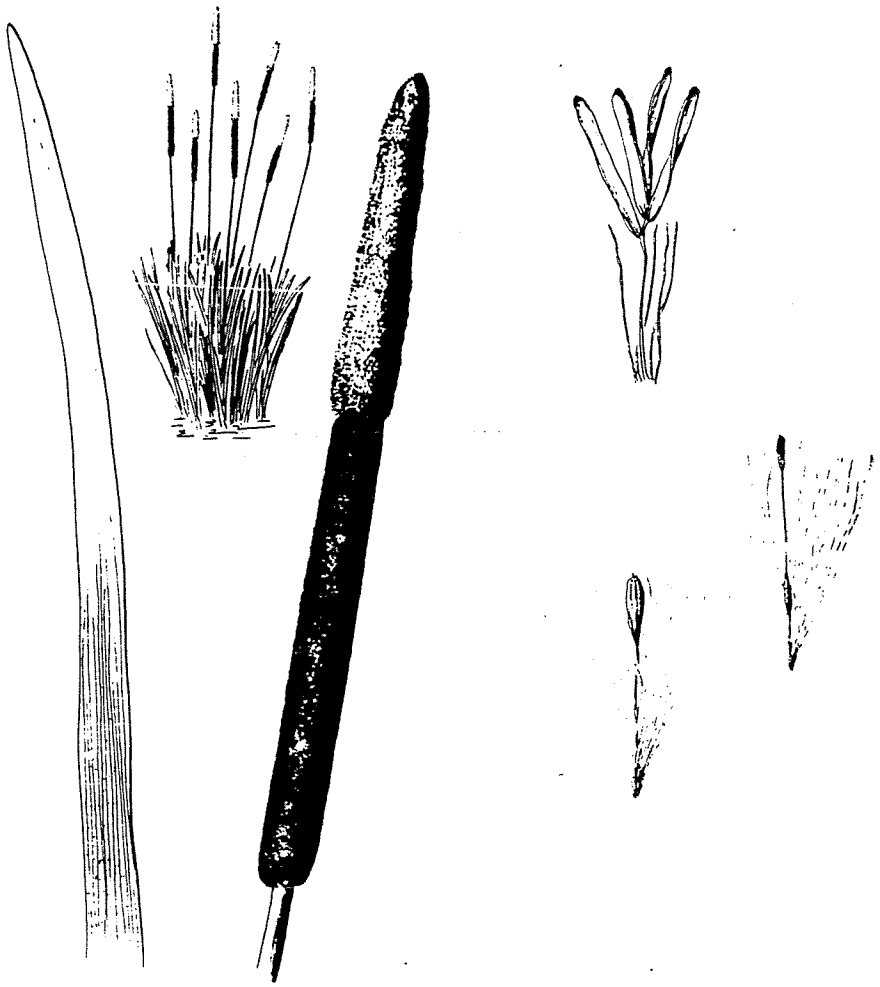
GROUP: rooted vascular plants

DESCRIPTION: Plants 1.5-6 dm tall, with short, ascending rhizomes; leaves 1/2-3/4 as long as the plant, the blades only 1-2 mm broad, sharp-pointed, the ligules 0.5-1.5 mm long, parted to the base, racemes about half the length of the plant; pendicles slender, erect in fruit and then mostly 4-6 mm long; perianth segments about 1.5 (2) mm long, slightly exceeding the stamens; fruit linear-clavate, mostly 6-7 mm long, the 3 carpels separating upward and remaining suspended from the tip, acicular at the base.

HABITAT: Coastal bogs to inland meadows, mudflats, and gravelly stream margins, often where brackish or alkaline

REFERENCE(S): Identification and figure from Hitchcock and Cronquist (1978).

Typha latifolia



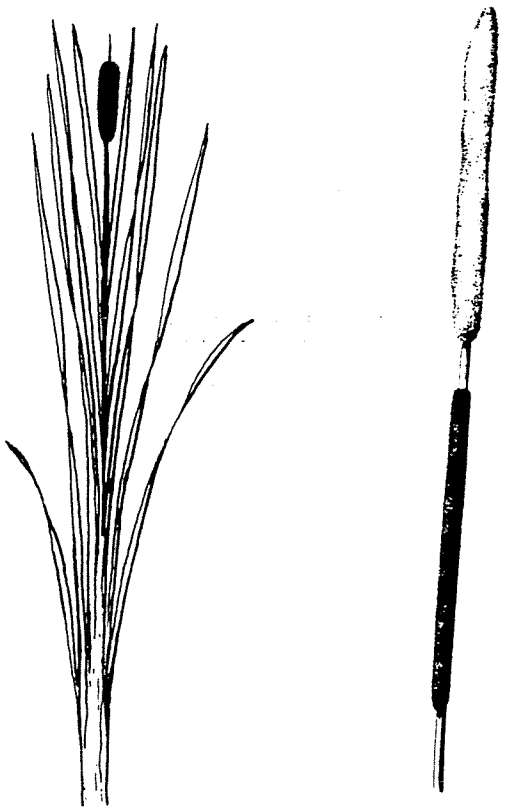
GROUP: rooted vascular plants

DESCRIPTION: Broadleaf cattail. Most common cattail in this region. Plant has separate female and male flowers. The female flowers are borne on the familiar large, brown cylinder atop each stem. The male flowers are borne above the female flowers, becoming a withered spike shortly after flowering. There is no separation between the male and female flowers in common cattail (T. latifolia). Leaves are strap-like, sheathing and nearly as tall as the flower stems. Cattails stand between 1 and 2 m in height.

HABITAT: Restricted to shallow marshes, usually growing in standing water. It often forms vast monotypic stands, but scattered individuals commonly grow in roadside ditches and wet disturbed areas. Generally a lowland species, it occurs up to about 1,000 m elevation. Numerous shallow marsh species are associated with this plant; it is also a common codominant with Douglas spirea in shrub-swamps

REFERENCE(S): Identification from Weinmann et al. (1984); figure from Hitchcock and Cronquist (1978).

Typha spp.



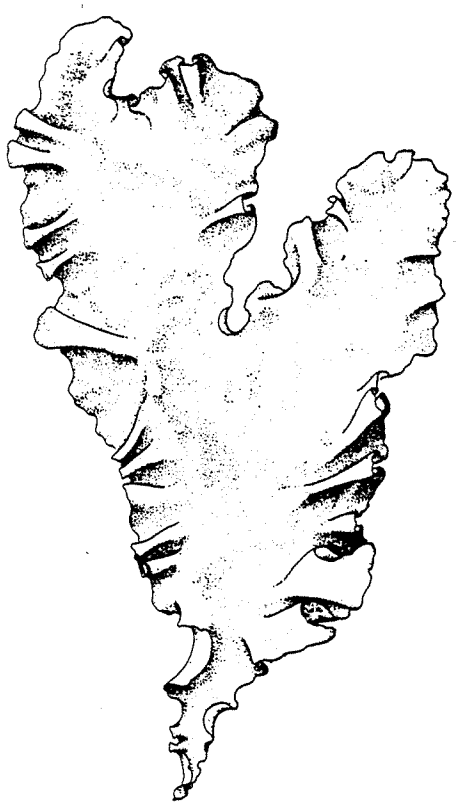
GROUP: rooted vascular plants

DESCRIPTION: Cattails; see *T. latifolia,* most common species in estuarine wetland in region, for description and figure. Narrow leaf cattail, T. angustifolia, is also present and is distinguished by leaves usually shorter than a man and no wider than a pencil. Mature dark-brown female spikes are not as thick as green piece of stem separating male and female spikes; above the ground, the stem is gray and slightly rough.

HABITAT: Brackish marshes.

REFERENCE(S): See Hotchkiss (1972) and Weinmann et al. (1984) for diagnostic characteristics for species of region; figure from Hotchkiss (1972).

Ulva spp.



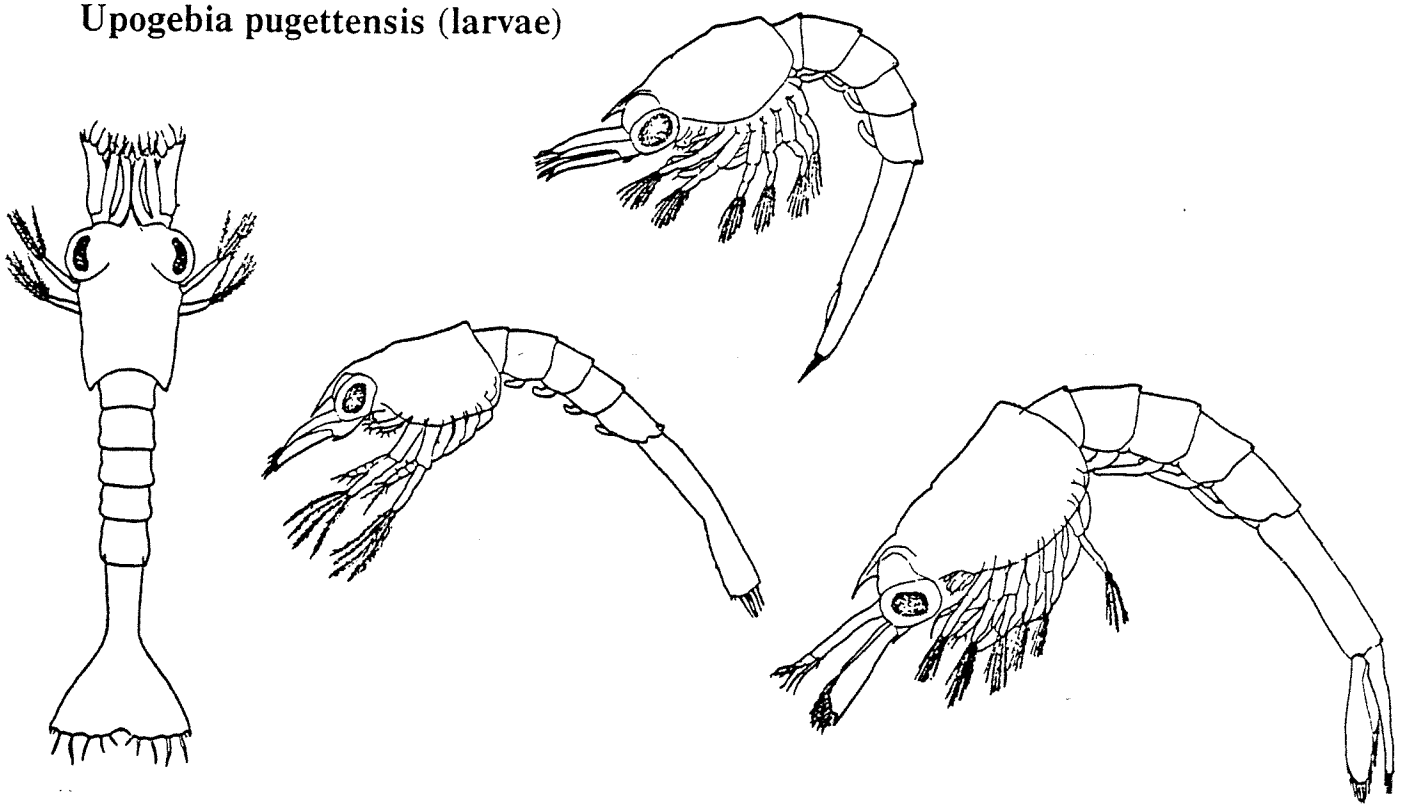
GROUP: benthic macroalgae

DESCRIPTION: This taxon represents a group of species that are basically flat, thin green blades attached with or without a short stipitate region to rocky substrata. The blades can be variously divided or perforated. Blades up to 2 m in diameter can be found in quiet waters.

HABITAT: Intertidal mixed coarse sediments can contain extensive amounts of green Ulva, especially in summer. This taxon, in combination with other taxa of the genera Monostroma and Enteromorpha, are grouped under the common term 'ulvoids' for simplicity.

REFERENCE(S): Description from WDNR (1989), and Scagel (1972), figure from Smith (1969).

Upogebia pugettensis (larvae)



GROUP: pelagic zooplankton

DESCRIPTION: Shrimp-like crustacean larvae.

HABITAT: Water column, often aggregated along tidal fronts.

REFERENCE(S): See Hart (1937) for taxonomic characteristics and figures.

Veneropsis japonica

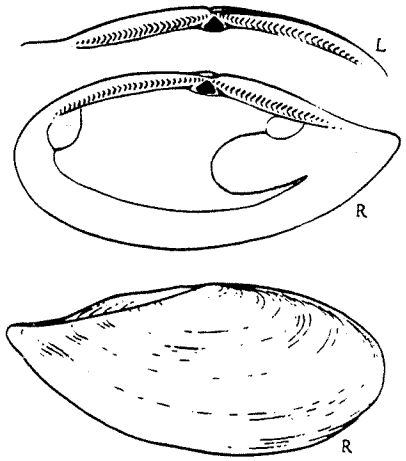
GROUP: sedentary infauna

DESCRIPTION: Manila or Japanese littleneck clams; nomenclature replaced by *Tapes philipinarum*.

HABITAT: Mid-intertidal sand/gravel/cobble.

REFERENCE(S): See Kozloff (1987) for identification; figure from Keen and Coan (1974).

Yoldia spp.



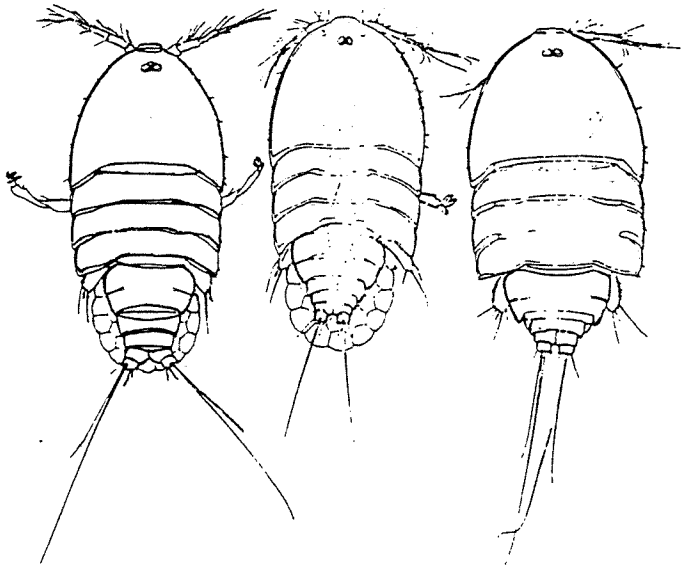
GROUP: sedentary infauna

DESCRIPTION: Clam; see taxonomic references for distinguishing characters.

HABITAT: Intertidal to 2,000 meters.

REFERENCE(S): See Kozloff (1987) for identification; figure from Keen and Coan (1974).

Zaus spp.



GROUP: epibenthic plankters

DESCRIPTION: Medium-sized harpacticoid which is very dorsoventrally flattened; often bluish-green in color.

HABITAT: Associated with marine macrophytes.

REFERENCE(S): See Wells (1976) for identification; figure fom Ito (1974).

Zostera japonica

GROUP: rooted vascular plants

DESCRIPTION: In *Z. japonica*, the flat, grass-like leaves are up to 2 mm wide and do not exceed 15 cm in length. The upright stems originate from an underground rhizome. The seeds are enclosed in elongated membranous, translucent packets; Note: figure not available.

HABITAT: *Z. japonica* occurs high on the intertidal between 1.0 m and 2.4 m above MLLW. This species grows well in sandy or muddy substrate and may be found along both low and moderate energy shorelines throughout Puget Sound.

REFERENCE(S): Description from Weinmann et al. (1984).

Zostera marina



GROUP: rooted vascular plants

DESCRIPTION: In *Z. marina*, the flat, grass-like leaves are up to 1.4 cm wide and can be over 3 m in length. The upright stems originate from an underground rhizome. The seeds are enclosed in elongated membranous, translucent packets.

HABITAT: *Z. marina* occurs up to about 1.8 m above MLLW and as deep as 6.6 m below MLLW. This species grows well in sandy or muddy substrate and may be found along both low and moderate energy shorelines throughout Puget Sound.

REFERENCE(S): Description from Weinman et al. (1984), figure from Hitchcock and Cronquist (1978).

Zostera spp.

GROUP: rooted vascular plants

DESCRIPTION: See *Z. marina* and *Z. japonica*.

HABITAT: Eelgrass.

REFERENCE(S): See Phillips (1984).

APPENDIX F: ATTRIBUTE DESCRIPTION BIBLIOGRAPHY

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APPENDIX G: PHYSICAL RELATIONSHIPS OF HIGH IMPORTANCE

In addition to the biological relationships that were the focus of much of the Protocol, the process of developing the Protocol also identified many relationships between fish and wildlife assemblage species and physical characteristics of their associated habitats that were of high importance in determining the functional importance of the habitat. Unfortunately, few, if any, specific attributes of these relationships were identified by the respondents to the questionnaires or through the literature search. This section lists the relationships that were indicated as being of high importance but which remain largely unaddressed by the current version of the Protocol. Future research should be designed to provide more quantitative information on the relationships between fish and wildlife species and the physical characteristics of their environment in order for future assessment methodologies to address this important gap.

Emergent Marsh

American coot
- Refuge/Physiology: Physical Complexity, Bathymetric Features
- Refuge/Physiology: Physical Complexity, Horizontal Edges
- Reproduction: Elevation, Riparian

American goldfinch
- Feeding: General, Sound
- Reproduction: Elevation, Riparian

American wigeon
- Feeding: General, Sound
- Feeding: General, Water/Sediment Quality
- Refuge/Physiology: General, Sound
- Refuge/Physiology: General, Water/Sediment Quality
- Reproduction: Elevation, Intertidal
- Reproduction: Elevation, Riparian
- Reproduction: General, Sound

Bufflehead
- Feeding: General, Water/Sediment Quality
- Refuge/Physiology: General, Water/Sediment Quality
- Refuge/Physiology: Physical Complexity, Bathymetric Features
- Refuge/Physiology: Physical Complexity, Vertical Relief

Black brant
- Feeding: General, Graveling
- Feeding: General, Light
- Feeding: General, Sound
- Feeding: General, Water/Sediment Quality
- Refuge/Physiology: General, Sound
- Refuge/Physiology: General, Water/Sediment Quality
- Refuge/Physiology: Physical Complexity, Bathymetric Features

Canada goose
- Feeding: General, Water/Sediment Quality
- Refuge/Physiology: General, Water/Sediment Quality
- Refuge/Physiology: Physical Complexity, Bathymetric Features
- Refuge/Physiology: Physical Complexity, Vertical Relief
- Reproduction: Elevation, Riparian
- Reproduction: General, Sound

Chinook salmon
- Feeding: General, Salinity
- Feeding: General, Temperature
- Feeding: General, Light
- Feeding: General, Sound
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Sound
- Refuge/Physiology: General, Water/Sediment Quality
- Refuge/Physiology: General, Turbidity
- Refuge/Physiology: Physical Complexity, Bathymetric Features
- Refuge/Physiology: Physical Complexity, Horizontal Edges
- Reproduction: Elevation, Riparian

Chum salmon

Feeding: General, Salinity
Feeding: General, Detritus
Feeding: General, Temperature
Feeding: General, Light
Feeding: General, Sound
Feeding: General, Water/Sediment Quality
Feeding: General, Turbidity
Refuge/Physiology: General, Sound
Refuge/Physiology: General, Water/Sediment Quality
Refuge/Physiology: General, Turbidity
Refuge/Physiology: Physical Complexity, Bathymetric Features
Refuge/Physiology: Physical Complexity, Horizontal Edges
Reproduction: Elevation, Riparian

Common goldeneye

Feeding: General, Water/Sediment Quality
Refuge/Physiology: General, Water/Sediment Quality
Refuge/Physiology: Physical Complexity, Bathymetric Features

Common snipe

Feeding: General, Sound
Feeding: General, Water/Sediment Quality
Refuge/Physiology: General, Sound
Refuge/Physiology: Physical Complexity, Horizontal Edges
Refuge/Physiology: Physical Complexity, Vertical Relief
Reproduction: Elevation, Riparian
Reproduction: General, Sound

Cutthroat trout

Feeding: General, Salinity
Feeding: General, Temperature
Feeding: General, Light
Feeding: General, Sound
Feeding: General, Water/Sediment Quality
Feeding: General, Turbidity
Refuge/Physiology: General, Water/Sediment Quality
Refuge/Physiology: General, Turbidity
Refuge/Physiology: Physical Complexity, Bathymetric Features
Refuge/Physiology: Physical Complexity, Vertical Relief
Reproduction: Elevation, Riparian

Dark-eyed junco

Feeding: General, Sound
Reproduction: Elevation, Riparian

Great blue heron

Feeding: General, Sound
Feeding: General, Water/Sediment Quality
Refuge/Physiology: General, Sound
Refuge/Physiology: General, Turbidity
Refuge/Physiology: Physical Complexity, Bathymetric Features
Refuge/Physiology: Physical Complexity, Horizontal Edges
Refuge/Physiology: Physical Complexity, Vertical Relief
Reproduction: Elevation, Riparian
Reproduction: General, Sound

Gadwall

Feeding: General, Sound
Feeding: General, Water/Sediment Quality
Refuge/Physiology: General, Sound
Refuge/Physiology: General, Water/Sediment Quality
Refuge/Physiology: Physical Complexity, Vertical Relief
Reproduction: Elevation, Riparian
Reproduction: General, Sound

Greater yellowlegs

Feeding: General, Sound
Refuge/Physiology: General, Water/Sediment Quality
Refuge/Physiology: Physical Complexity, Bathymetric Features

Green-winged teal

Feeding: General, Sound
Feeding: General, Water/Sediment Quality
Refuge/Physiology: General, Water/Sediment Quality
Refuge/Physiology: Physical Complexity, Horizontal Edges
Refuge/Physiology: Physical Complexity, Vertical Relief
Reproduction: Elevation, Riparian
Reproduction: General, Sound

Least sandpiper

Feeding: General, Sound
Refuge/Physiology: General, Water/Sediment Quality

Mallard

Feeding: General, Water/Sediment Quality
Refuge/Physiology: General, Sound
Refuge/Physiology: General, Water/Sediment Quality
Refuge/Physiology: Physical Complexity, Horizontal Edges
Refuge/Physiology: Physical Complexity, Vertical Relief
Reproduction: Elevation, Riparian
Reproduction: General, Sound

Merlin

Feeding: General, Sound
Reproduction: Elevation, Riparian
Reproduction: General, Sound

Muskrat

Feeding: General, Sound
Reproduction: Elevation, Riparian

Northern oriole

Reproduction: Elevation, Riparian

Osprey

Feeding: General, Sound
Feeding: General, Water/Sediment Quality
Feeding: General, Turbidity
Refuge/Physiology: Physical Complexity, Vertical Relief
Reproduction: Elevation, Riparian

Pacific harbor seal

Feeding: General, Sound
Refuge/Physiology: General, Sound
Refuge/Physiology: Physical Complexity, Bathymetric Features
Reproduction: General, Sound

Prickly sculpin

Reproduction: General, Water/Sediment Quality

Raccoon
Reproduction: Elevation, Riparian
Red-tail hawk
Feeding: General, Sound
Refuge/Physiology: General, Sound
Reproduction: Elevation, Riparian
Reproduction: General, Sound
Redwing blackbird
Refuge/Physiology: Physical Complexity, Vertical Relief
Short-billed dowitcher
Feeding: General, Sound
Refuge/Physiology: General, Water/Sediment Quality
Song sparrow
Feeding: General, Sound
Refuge/Physiology: Physical Complexity, Vertical Relief
Reproduction: Elevation, Riparian
Spotted sandpiper
Feeding: General, Sound
Refuge/Physiology: General, Water/Sediment Quality
Reproduction: General, Water/Sediment Quality
Savannah sparrow
Feeding: General, Sound
Reproduction: Elevation, Riparian
Threespine stickleback
Feeding: General, Salinity
Feeding: General, Temperature
Feeding: General, Water/Sediment Quality
Refuge/Physiology: General, Water/Sediment Quality
Refuge/Physiology: General, Turbidity
Refuge/Physiology: Physical Complexity, Horizontal Edges
Refuge/Physiology: Physical Complexity, Vertical Relief
Reproduction: Elevation, Subtidal
Townsend vole
Feeding: General, Sound
Refuge/Physiology: Physical Complexity, Vertical Relief
Western sandpiper
Feeding: General, Sound
Refuge/Physiology: General, Water/Sediment Quality
Reproduction: General, Water/Sediment Quality

Mudflat

Bufflehead

Feeding: General, Water/Sediment Quality
Refuge/Physiology: General, Sound
Refuge/Physiology: General, Water/Sediment Quality
Refuge/Physiology: Physical Complexity, Bathymetric Features
Refuge/Physiology: Physical Complexity, Vertical Relief

Canada goose

Feeding: General, Sound
Feeding: General, Water/Sediment Quality
Refuge/Physiology: General, Sound
Refuge/Physiology: General, Water/Sediment Quality
Refuge/Physiology: Physical Complexity, Vertical Relief
Reproduction: Elevation, Riparian

Common goldeneye

Feeding: General, Water/Sediment Quality
Refuge/Physiology: General, Sound
Refuge/Physiology: General, Water/Sediment Quality
Refuge/Physiology: Physical Complexity, Bathymetric Features
Refuge/Physiology: Physical Complexity, Vertical Relief

Common snipe

Feeding: General, Sound
Feeding: General, Water/Sediment Quality
Refuge/Physiology: General, Sound
Refuge/Physiology: Physical Complexity, Vertical Relief

Dunlin

Feeding: General, Sound
Feeding: General, Water/Sediment Quality
Refuge/Physiology: General, Sound
Refuge/Physiology: Physical Complexity, Vertical Relief

Dungeness crab

Feeding: General, Carrion
Feeding: General, Detritus

English sole

Refuge/Physiology: Physical Complexity, Horizontal Edges
Refuge/Physiology: Physical Complexity, Vertical Relief
Reproduction: Elevation, Subtidal
Reproduction: General, Salinity
Reproduction: General, Temperature

Great blue heron

Feeding: General, Sound
Feeding: General, Turbidity
Refuge/Physiology: General, Sound
Refuge/Physiology: Physical Complexity, Bathymetric Features
Refuge/Physiology: Physical Complexity, Horizontal Edges
Refuge/Physiology: Physical Complexity, Vertical Relief
Reproduction: Elevation, Riparian
Reproduction: General, Sound

Greater yellowlegs
- Feeding: General, Sound
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Sound
- Refuge/Physiology: Physical Complexity, Bathymetric Features
- Refuge/Physiology: Physical Complexity, Vertical Relief

Least sandpiper
- Feeding: General, Sound
- Feeding: General, Water/Sediment Quality
- Refuge/Physiology: General, Sound
- Refuge/Physiology: Physical Complexity, Vertical Relief

Pacific harbor seal
- Feeding: General, Sound
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Sound
- Refuge/Physiology: General, Water/Sediment Quality
- Refuge/Physiology: Physical Complexity, Horizontal Edges
- Refuge/Physiology: Physical Complexity, Vertical Relief

Pacific staghorn sculpin
- Refuge/Physiology: General, Salinity
- Refuge/Physiology: Physical Complexity, Vertical Relief
- Reproduction: Elevation, Subtidal

Raccoon
- Feeding: General, Sound
- Feeding: General, Turbidity

Short-billed dowitcher
- Feeding: General, Sound
- Feeding: General, Water/Sediment Quality
- Refuge/Physiology: General, Sound
- Refuge/Physiology: Physical Complexity, Vertical Relief
- Reproduction: General, Sound

Spotted sandpiper
- Feeding: General, Sound
- Feeding: General, Water/Sediment Quality
- Refuge/Physiology: General, Sound
- Refuge/Physiology: Physical Complexity, Vertical Relief

Starry flounder
- Refuge/Physiology: Physical Complexity, Horizontal Edges
- Refuge/Physiology: Physical Complexity, Vertical Relief
- Reproduction: Elevation, Subtidal
- Reproduction: General, Salinity
- Reproduction: General, Temperature

Western sandpiper
- Feeding: General, Sound
- Feeding: General, Water/Sediment Quality
- Refuge/Physiology: General, Sound
- Refuge/Physiology: Physical Complexity, Vertical Relief

Sandflat

Common goldeneye
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Water/Sediment Quality

Common snipe
- Feeding: General, Sound
- Feeding: General, Water/Sediment Quality
- Refuge/Physiology: General, Sound
- Refuge/Physiology: General, Water/Sediment Quality
- Refuge/Physiology: Physical Complexity, Vertical Relief

Dunlin
- Feeding: General, Sound
- Feeding: General, Water/Sediment Quality
- Refuge/Physiology: General, Sound
- Refuge/Physiology: General, Water/Sediment Quality
- Refuge/Physiology: Physical Complexity, Vertical Relief
- Reproduction: General, Water/Sediment Quality

Great blue heron
- Feeding: General, Sound
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Sound
- Refuge/Physiology: Physical Complexity, Horizontal Edges
- Refuge/Physiology: Physical Complexity, Vertical Relief
- Reproduction: Elevation, Riparian
- Reproduction: General, Sound

Greater yellowlegs
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Sound
- Refuge/Physiology: General, Water/Sediment Quality
- Refuge/Physiology: Physical Complexity, Vertical Relief
- Reproduction: General, Water/Sediment Quality

Horned grebe
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Water/Sediment Quality

Least sandpiper
- Feeding: General, Sound
- Feeding: General, Water/Sediment Quality
- Refuge/Physiology: General, Sound
- Refuge/Physiology: General, Water/Sediment Quality
- Refuge/Physiology: Physical Complexity, Vertical Relief
- Reproduction: General, Water/Sediment Quality

Pacific sanddab
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Water/Sediment Quality

Sand sole

Feeding: General, Salinity
Feeding: General, Water/Sediment Quality
Feeding: General, Turbidity
Refuge/Physiology: General, Water/Sediment Quality

Spotted sandpiper

Feeding: General, Sound
Feeding: General, Water/Sediment Quality
Refuge/Physiology: General, Sound
Refuge/Physiology: General, Water/Sediment Quality
Refuge/Physiology: Physical Complexity, Vertical Relief
Reproduction: General, Water/Sediment Quality

Speckled sanddab

Feeding: General, Water/Sediment Quality
Feeding: General, Turbidity
Refuge/Physiology: General, Water/Sediment Quality

Gravel/Cobble Beach

Bufflehead
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Water/Sediment Quality

Buffalo sculpin
- Refuge/Physiology: Physical Complexity, Bathymetric Features

Coho salmon
- Feeding: General, Salinity
- Feeding: General, Temperature
- Feeding: General, Turbidity
- Refuge/Physiology: General, Salinity
- Refuge/Physiology: General, Temperature
- Refuge/Physiology: General, Sound
- Refuge/Physiology: General, Turbidity
- Refuge/Physiology: Physical Complexity, Bathymetric Features
- Refuge/Physiology: Physical Complexity, Horizontal Edges

Copper rockfish
- Refuge/Physiology: General, Salinity
- Refuge/Physiology: Physical Complexity, Bathymetric Features
- Reproduction: Elevation, Subtidal
- Reproduction: Substrate, Sediment

Cutthroat trout
- Feeding: General, Temperature
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Salinity
- Refuge/Physiology: General, Temperature
- Refuge/Physiology: General, Sound
- Refuge/Physiology: General, Water/Sediment Quality
- Refuge/Physiology: General, Turbidity
- Refuge/Physiology: Physical Complexity, Bathymetric Features
- Refuge/Physiology: Physical Complexity, Vertical Relief

Double-crested cormorant
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: Physical Complexity, Vertical Relief

Dolly varden
- Feeding: General, Temperature
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Temperature
- Refuge/Physiology: General, Water/Sediment Quality
- Refuge/Physiology: Physical Complexity, Bathymetric Features
- Refuge/Physiology: Physical Complexity, Vertical Relief

Great sculpin
- Refuge/Physiology: Physical Complexity, Bathymetric Features

Horned grebe
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Water/Sediment Quality

Least sandpiper
- Feeding: General, Sound
- Feeding: General, Water/Sediment Quality
- Refuge/Physiology: Physical Complexity, Vertical Relief

Mew gull
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Water/Sediment Quality
- Refuge/Physiology: Physical Complexity, Vertical Relief

Pacific herring
- Reproduction: Elevation, Intertidal
- Reproduction: Elevation, Subtidal

Pile perch
- Reproduction: Elevation, Subtidal

Padded sculpin
- Refuge/Physiology: Physical Complexity, Bathymetric Features

Pacific tomcod
- Reproduction: Elevation, Subtidal

Raccoon
- Feeding: General, Turbidity

Red rock crab
- Feeding: General, Water/Sediment Quality

Rock sole
- Feeding: General, Water/Sediment Quality
- Refuge/Physiology: Physical Complexity, Bathymetric Features
- Refuge/Physiology: Physical Complexity, Vertical Relief

Surf smelt
- Feeding: General, Salinity
- Feeding: General, Temperature
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Salinity
- Refuge/Physiology: General, Temperature
- Refuge/Physiology: General, Water/Sediment Quality
- Refuge/Physiology: General, Turbidity
- Refuge/Physiology: Physical Complexity, Bathymetric Features
- Reproduction: Elevation, Intertidal
- Reproduction: Substrate, Sediment

Spotted sandpiper
- Feeding: General, Sound
- Feeding: General, Water/Sediment Quality
- Refuge/Physiology: Physical Complexity, Vertical Relief

Starry flounder
- Feeding: General, Water/Sediment Quality
- Refuge/Physiology: Physical Complexity, Bathymetric Features
- Refuge/Physiology: Physical Complexity, Vertical Relief

Western grebe
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Water/Sediment Quality

Whitespotted greenling
- Reproduction: Elevation, Subtidal

Eelgrass

Bufflehead
- Feeding: General, Sound
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Water/Sediment Quality
- Refuge/Physiology: Physical Complexity, Bathymetric Features

Black brant
- Feeding: General, Graveling
- Feeding: General, Sound
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Water/Sediment Quality
- Refuge/Physiology: Physical Complexity, Bathymetric Features
- Refuge/Physiology: Physical Complexity, Vertical Relief

Canada goose
- Feeding: General, Sound
- Feeding: General, Water/Sediment Quality
- Refuge/Physiology: General, Water/Sediment Quality
- Refuge/Physiology: Physical Complexity, Vertical Relief

Chum salmon
- Feeding: General, Salinity
- Feeding: General, Detritus
- Feeding: General, Temperature
- Feeding: General, Light
- Feeding: General, Sound
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Salinity
- Refuge/Physiology: General, Temperature
- Refuge/Physiology: General, Sound
- Refuge/Physiology: General, Water/Sediment Quality
- Refuge/Physiology: General, Turbidity
- Refuge/Physiology: Physical Complexity, Horizontal Edges
- Refuge/Physiology: Physical Complexity, Vertical Relief

Dungeness crab
- Feeding: General, Salinity
- Feeding: General, Carrion
- Feeding: General, Detritus
- Feeding: General, Graveling
- Reproduction: General, Salinity
- Reproduction: General, Water/Sediment Quality

Great blue heron
- Feeding: General, Sound
- Feeding: General, Turbidity
- Refuge/Physiology: General, Sound
- Refuge/Physiology: General, Water/Sediment Quality
- Refuge/Physiology: Physical Complexity, Bathymetric Features
- Refuge/Physiology: Physical Complexity, Vertical Relief
- Reproduction: Elevation, Riparian

Greater yellowlegs
- Feeding: General, Sound
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Sound
- Refuge/Physiology: Physical Complexity, Vertical Relief

Glaucous-winged gull
- Feeding: General, Carrion
- Feeding: General, Water/Sediment Quality
- Refuge/Physiology: General, Water/Sediment Quality
- Refuge/Physiology: Physical Complexity, Vertical Relief

Kelp perch
- Refuge/Physiology: General, Salinity

Least sandpiper
- Feeding: General, Sound
- Refuge/Physiology: General, Sound
- Refuge/Physiology: Physical Complexity, Vertical Relief

Osprey
- Feeding: General, Sound
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: Physical Complexity, Vertical Relief
- Reproduction: Elevation, Riparian

Pacific harbor seal
- Refuge/Physiology: General, Sound
- Refuge/Physiology: Physical Complexity, Bathymetric Features
- Refuge/Physiology: Physical Complexity, Horizontal Edges
- Refuge/Physiology: Physical Complexity, Vertical Relief

Shiner perch
- Refuge/Physiology: General, Salinity
- Refuge/Physiology: Physical Complexity, Vertical Relief

Spotted sandpiper
- Feeding: General, Sound
- Refuge/Physiology: General, Sound
- Refuge/Physiology: Physical Complexity, Vertical Relief

Striped seaperch
- Refuge/Physiology: General, Salinity

Western sandpiper
- Refuge/Physiology: General, Sound

Nearshore Subtidal Soft Bottom

C-O sole
- Feeding: General, Salinity
- Feeding: General, Water/Sediment Quality
- Refuge/Physiology: General, Water/Sediment Quality

Dungeness crab
- Reproduction: Elevation, Subtidal

Dover sole
- Feeding: General, Salinity
- Feeding: General, Water/Sediment Quality
- Refuge/Physiology: General, Water/Sediment Quality

Hybrid sole
- Feeding: General, Salinity
- Feeding: General, Water/Sediment Quality
- Refuge/Physiology: General, Water/Sediment Quality

Mountain whitefish
- Feeding: General, Salinity

Northern squawfish
- Feeding: General, Salinity
- Reproduction: General, Salinity

Pacific cod
- Feeding: General, Salinity
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Salinity
- Refuge/Physiology: General, Water/Sediment Quality
- Refuge/Physiology: General, Turbidity
- Reproduction: Elevation, Subtidal
- Reproduction: General, Salinity

Pacific tomcod
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Water/Sediment Quality
- Refuge/Physiology: General, Turbidity
- Reproduction: General, Salinity

Rough sculpin
- Feeding: General, Water/Sediment Quality
- Refuge/Physiology: General, Water/Sediment Quality

Ratfish
- Feeding: General, Salinity
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Water/Sediment Quality
- Reproduction: General, Salinity

Sturgeon poacher
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Water/Sediment Quality

Walleye pollock

Feeding: General, Salinity
Feeding: General, Water/Sediment Quality
Feeding: General, Turbidity
Refuge/Physiology: General, Water/Sediment Quality
Refuge/Physiology: General, Turbidity
Reproduction: General, Salinity

Water Column

Bufflehead
- Feeding: General, Water/Sediment Quality
- Refuge/Physiology: General, Water/Sediment Quality

Coho salmon
- Feeding: General, Temperature
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Salinity
- Refuge/Physiology: General, Temperature
- Refuge/Physiology: General, Water/Sediment Quality
- Refuge/Physiology: General, Turbidity

Chinook salmon
- Feeding: General, Temperature
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Salinity
- Refuge/Physiology: General, Temperature
- Refuge/Physiology: General, Water/Sediment Quality
- Refuge/Physiology: General, Turbidity

Chum salmon
- Feeding: General, Temperature
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Salinity
- Refuge/Physiology: General, Temperature
- Refuge/Physiology: General, Water/Sediment Quality
- Refuge/Physiology: General, Turbidity

Common goldeneye
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Water/Sediment Quality

Common merganser
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Water/Sediment Quality

Double-crested cormorant
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Water/Sediment Quality
- Refuge/Physiology: Physical Complexity, Bathymetric Features
- Refuge/Physiology: Physical Complexity, Vertical Relief

Gadwall
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Water/Sediment Quality
- Reproduction: Elevation, Riparian

Mew gull
- Feeding: General, Detritus
- Feeding: General, Water/Sediment Quality
- Refuge/Physiology: General, Water/Sediment Quality

Osprey
- Feeding: General, Water/Sediment Quality
- Refuge/Physiology: General, Water/Sediment Quality
- Refuge/Physiology: Physical Complexity, Vertical Relief
- Reproduction: Elevation, Riparian

Pacific herring
- Refuge/Physiology: General, Salinity
- Reproduction: Elevation, Intertidal
- Reproduction: Elevation, Subtidal
- Reproduction: General, Salinity
- Reproduction: General, Water/Sediment Quality

Pacific harbor seal
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Sound
- Refuge/Physiology: General, Water/Sediment Quality
- Refuge/Physiology: Physical Complexity, Vertical Relief

Pink salmon
- Feeding: General, Temperature
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Salinity
- Refuge/Physiology: General, Temperature
- Refuge/Physiology: General, Water/Sediment Quality
- Refuge/Physiology: General, Turbidity

Pacific sand lance
- Refuge/Physiology: General, Salinity

Red-breasted merganser
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Water/Sediment Quality

River lamprey
- Refuge/Physiology: Physical Complexity, Water Movement

Surf smelt
- Reproduction: Elevation, Intertidal
- Reproduction: General, Salinity

Steelhead (rainbow) trout
- Feeding: General, Temperature
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Temperature
- Refuge/Physiology: General, Water/Sediment Quality
- Refuge/Physiology: General, Turbidity

Northern sea lion
- Feeding: General, Water/Sediment Quality
- Refuge/Physiology: General, Water/Sediment Quality
- Refuge/Physiology: Physical Complexity, Vertical Relief

Western brook lamprey
- Refuge/Physiology: Physical Complexity, Water Movement

Western grebe
- Feeding: General, Water/Sediment Quality
- Feeding: General, Turbidity
- Refuge/Physiology: General, Water/Sediment Quality

APPENDIX H: LIST OF CONTRIBUTORS

This section lists the many persons whose contributions where invaluable to the development of the Protocol. A variety of contributors participated at one or more of the stages, either as a participant in the Urban Estuary Mitigation Work Group (UEMWG), and thus a respondent to Matrix I and II, as one of the research experts surveyed in the Attribute Data Questionnaire, or as a participant in the Port Townsend workshop. For their cooperation and assistance, the authors express their gratitude.

John Armstrong, 2
Environmental Protection Agency
Seattle, WA

Thomas W.H. Backman 2
U.S. Fish & Wildlife Service (POF)
Washington, DC

George Blomberg 1
Port of Seattle
Seattle, WA

Marc Boule 3
Shapiro & Associates, Inc.
Seattle, WA

Gary Bradfield 2
Botany Department
Vancouver, BC

Ken Brunner 3
Corps of Engineers, Seattle District
Seattle, WA

Mary Burg 1
Washington Department of Ecology
Olympia, WA

Dan Cheney 2,3
BioAquatics International
Bellevue, WA

John Cooper 1,3
U.S. Fish and Wildlife Service
Olympia, WA

Andrea Copping 3
Puget Sound Water Quality Authority
Seattle, WA

Jeff Cordell 3
Fisheries Research Institute
Seattle, WA

Paul Dinnel 2
School of Fisheries
Seattle, WA

Robert L. Emmett 2
National Marine Fisheries Service
Hammond, OR

Kern Ewing 2
Range Science Department
Logan, UT

Kurt Fresh 2
Washington Department of Fisheries
Olympia, WA

Michael Graybill 3
South Slough Nat'l. Estuarine Sanctuary
Charleston, OR

Paul Hickey 1
Muckleshoot Indian Tribe
Auburn, WA

Liz Hoenig 3
Muckleshoot/Suquamish Tribes
Seattle, WA

Rich Horner 3
Department of Civil Engineering
Seattle, WA

Greg Hueckel 2,3
Washington Department of Fisheries
Olympia, WA

DeAnn Kirkpatrick 3
Institute of Marine Studies
Seattle, WA

Kathy Kunz 1,3
Environmental Protection Agency
Seattle, WA

Pat Lambert 3
Institute for Marine Studies
Seattle, WA

Mark LaSalle 3
U.S. Army Corp of Engineers
Vicksburg, MS

1 = UEMWG participant
2 = Attribute Questionnaire respondent
3 = Workshop participant

Colin Levings [2]
Department of Fisheries and Oceans
West Vancouver, BC

Dave McEntee [1]
Port of Tacoma
Tacoma, WA

Andy McMillan [1]
Washington Department of Ecology
Olympia, WA

Russ McMillan [3]
Washington Department of Ecology
Olympia, WA

Mary Lou Mills [3]
Washington Department of Fisheries
Olympia, WA

Joe Miyamoto [1,3]
Puyallup Tribe of Indians
Tacoma, WA

Thomas F. Mumford, Jr. [3]
Department of Natural Resources
Olympia, WA

Karen Northup [1]
Corps of Engineers, Seattle District
Seattle, WA

Ronald C. Phillips [2]
Department of Natural and Mathematical Sciences
Seattle, WA

Dr. Klaus O. Richter [2]
Kirkland, WA

Diane E. Robbins [3]
Invert-Aid
Tacoma, WA

Ralph T. Rogers [3]
Environmental Protection Agency
Portland, OR

Michael Rylko [1,3]
Environmental Protection Agency
Seattle, WA

Leslie Sacha [1]
Port of Tacoma
Tacoma, WA

Jim Shafer [3]
Washington Department of Transportation
Olympia, WA

Dave Shreffler [2,3]
Fisheries Research Institute
Seattle, WA

Charles Simenstad [1,2,3]
Fisheries Research Institute
Seattle, WA

Ann Soule [3]
University of Arizona
Tucson, AZ

Michelle Stevens [3]
Washington Department of Ecology
Olympia, WA

Naki Stevens [3]
Puget Sound Water Quality Authority
Seattle, WA

Heather A. Stout [3]
B-Twelve Associates
Kent, WA

Curtis D. Tanner [1,3]
Institute for Marine Studies
Seattle, WA

Ronald M. Thom [2,3]
Fisheries Research Institute
Seattle, WA

Rex Van Wormer [3]
IES Associates
Olympia, WA

1 = UEMWG participant
2 = Attribute Questionnaire respondent
3 = Workshop participant

Gary Voerman [3]
Environmental Protection Agency
Seattle, WA

Terrence R. Wahl [2]
Bellingham, WA

Fred Weinmann [3]
Corps of Engineers, Seattle District
Seattle, WA

Ann E. Wessel [1,3]
Washington Department of Ecology
Olympia, WA

Gary L. Williams [2,3]
G.L. WIlliams and Associates, Ltd.
Coquitlam, BC

Susan L. Williams, [2]
Friday Harbor Laboratories
Friday Harbor, WA

Frances Wilshusen [3]
Squaxin Island Indian Tribe
Olympia, WA

Bob Zeigler [1,3]
Washington Department of Wildlife
Olympia, WA

Gordy Zilliges [3]
Washington Department of Fisheries
Olympia, WA

1 = UEMWG participant
2 = Attribute Questionnaire respondent
3 = Workshop participant