

# Marine Ecosystem Management in the San Juan Archipelago

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Approach:

local, bottom-up planning process for  
ecosystem-based management

science to support decision-making





San  
Juan  
Archipelago



## Existing Protection Measures

NWR Wildlife Refuge (83 sites)

National Park (2 sites)

WDFW Urchin Closure

WDFW Research Reserves (5 sites)

SJC Bottomfish Reserves (8 sites)

Whale Watch Operators 'NO-BOAT' Zone

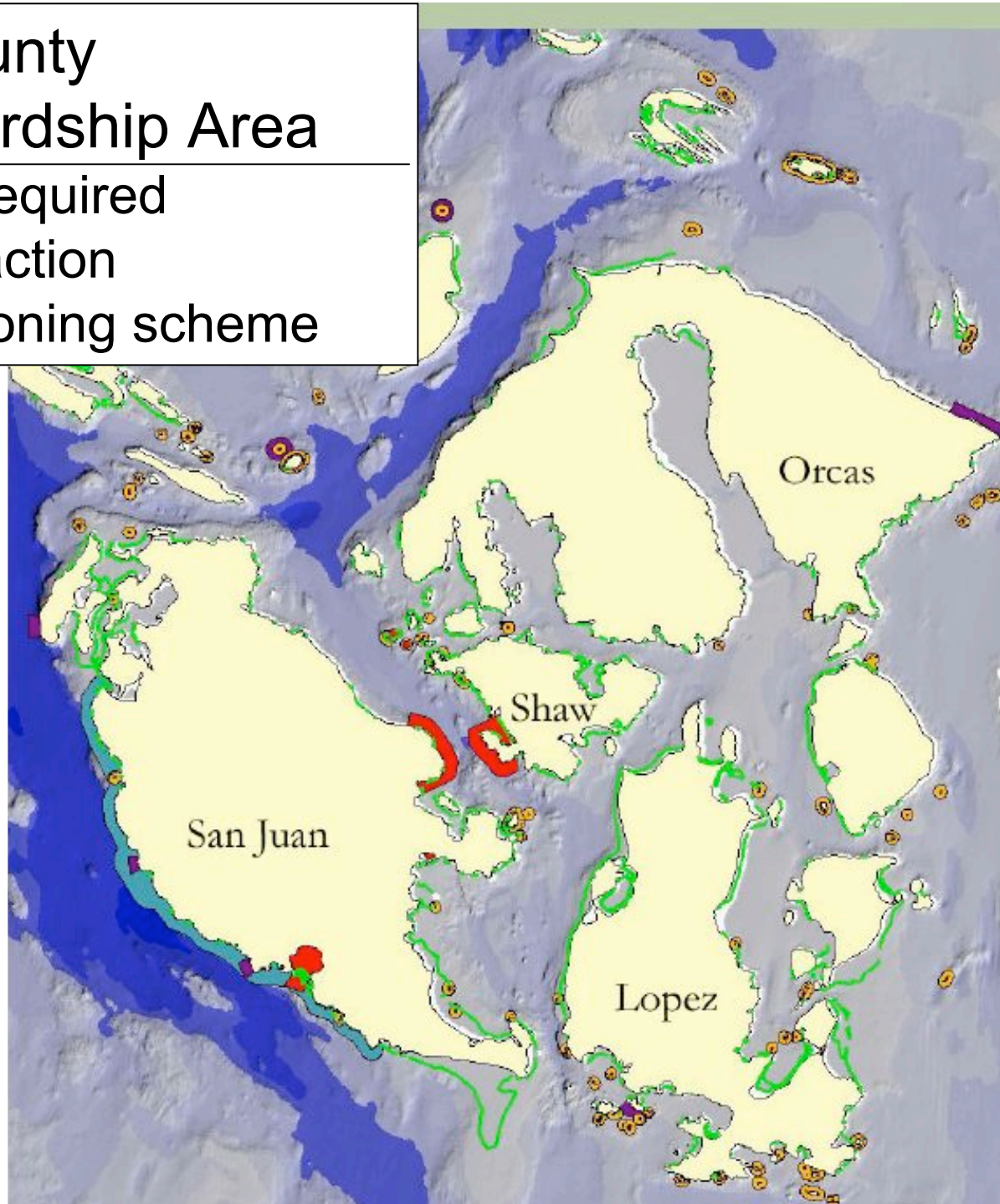


## Recent County Actions

Marine Stewardship Area declared  
Killer Whale Protection Ordinance adopted  
DNR Aquatic Reserve Status requested

# San Juan County Marine Stewardship Area

planning effort required  
to prioritize action  
to develop zoning scheme



# The Nature Conservancy's 5-S planning framework

science-based process for developing and evaluating the effectiveness of conservation strategies

planning performed by volunteer citizens advisory group  
'bottom-up' approach to ecosystem management



# The Nature Conservancy's 5-S planning framework

1. **SYSTEMS**: focal conservation targets and their key ecological attributes
2. **STRESSES**: most serious types of destruction or degradation affecting the conservation targets or key ecological attributes
3. **SOURCES** of stress: causes or agents of destruction or degradation
4. **STRATEGIES**: full array of actions necessary to abate the threats of enhance the viability of the conservation targets
5. **SUCCESS MEASURES**: monitoring process for assessing progress in abating threats

## Sources of data used in assessment:

Friday Harbor Labs (100 yrs of biological and ecological studies)

US Department of Energy (intertidal baseline studies 1970s)

National Park Service (intertidal baselines and monitoring)

Washington Dept of Fish and Wildlife (harvested species)

Washington Dept of Natural Resources (habitat studies)

San Juan County (various studies)

NGOs (various studies)



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# Rocky intertidal community conservation target

identified key ecological attributes

e.g., rockweed abundance, age/stage structure

identified and ranked sources of stress to attributes

e.g., trampling, harvest, climate change

these based on 'best professional judgment'

informed by existing science



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next steps:

identify indicators of viability

determine current status with respect to indicators



target	attribute	indicator	poor	fair	good	very good	current status
rocky intertidal	abundance key species	rockweed abundance	<40	40-70	70-90	90-100	unknown
			percent historical abundance				

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			percent historical abundance				
rocky intertidal	age/stage structure	unidentified					

obstacles to assessment due to data deficiencies,  
unwillingness to guess

## Outcome:

completed the assessment for most indicators

failed to define indicators or determine current status of some indicators

- prioritization process stopped

- no recommendations made for those indicators

this outcome occurred despite considerable existing scientific data and local expertise

(interlude)

# Inability to prioritize conservation action results from mismatch between existing science and management needs

## existing science

process oriented, hypothesis driven

experimental studies  
short-term  
spatially constrained  
single factor  
time series  
multiple uncontrolled factors

## management needs

decision driven

status and trends  
viability of key species  
response to specific factors  
response to interactive factors  
estimates of uncertainty  
estimates of risk

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ecosystem approaches  
require this information

## Results of 5-S Evaluation Viability of Focal Targets

<u>Marine Biodiversity Targets</u>	<u>Viability</u>
rockfish, lingcod, greenling	fair
Pacific salmon	fair
marine mammals	fair
seabirds	fair
rocky intertidal	unknown
rocky subtidal	unknown
sand, mud, gravel	fair

## Results of 5-S Evaluation Top-Rated Threats to Biodiversity Targets

<u>Threat</u>	<u>Rating</u>
large oil spills	high
climate change	high
shoreline modification	high
regional threats to salmon popns.	high
invasive species	medium
persistent organic pollutants	medium
stormwater run-off	medium
septic system discharge	medium
predation by marine mammals	medium
historical fishing activities	medium
...and 6 others	

## Results of 5-S Evaluation Research Priorities

### Recommended research to determine

cumulative impacts of overwater structures

levels of contaminants in seawater

local sources of contaminants

maximum allowable concentrations of hydrocarbons, etc

abundance of forage fish

status of rocky intertidal and subtidal communities

current levels of greenhouse gas emissions in SJC

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**Report: Public and Marine Managers'  
Review of the San Juan County  
Marine Stewardship Area Plan**

Marine Stewardship Area Plan generated through 5-S process submitted to review by the public and marine managers

## The Nature Conservancy's 5-S planning framework selected

science-based process for developing and evaluating the effectiveness of conservation strategies

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## Outcome of Review

### Top strategies:

Foster a marine STEWARDSHIP ETHIC

Manage UPLAND AND NEARSHORE ACTIVITIES

Reduce HARVEST AND BYCATCH of selected species

Reduce BIOACCUMULATIVE TOXINS

Reduce the RISK OF LARGE OIL SPILLS

## Results of 5-S Evaluation Research Priorities

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**status of rocky intertidal and subtidal communities**

current levels of greenhouse gas emissions in SJC

# Biological Invasion of Marine Reserves by Aquatic Nuisance Species

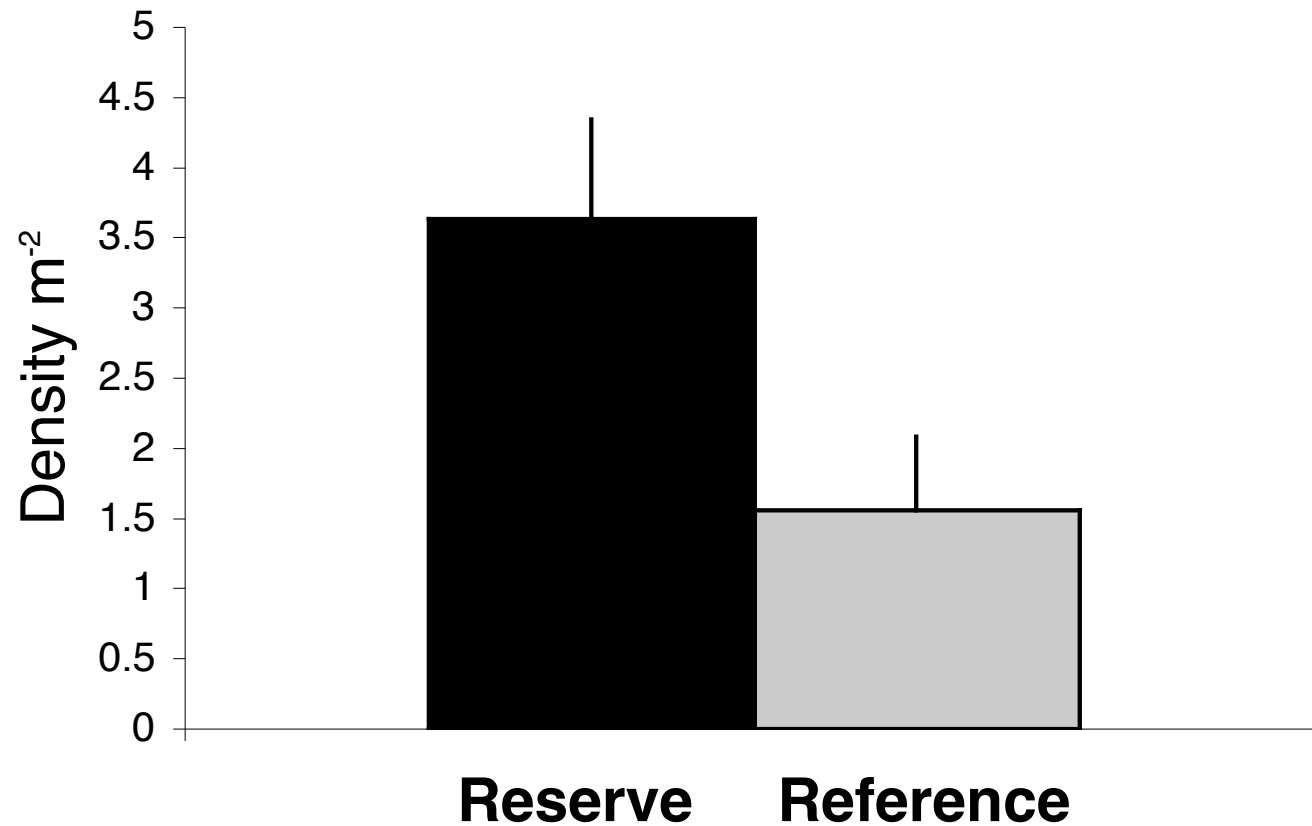
Terrie Klinger and Dianna Padilla

National Sea Grant Aquatic Nuisance Species Program

Students: Paul Bourdeau, Corrina Chase, Erin Cooper,  
Maris McEdward, Brian Moore, Amber Phillips,  
Kim Porter, Yuichi Saito



# Marine reserves significantly more invaded than reference sites



Oysters increase



limpets increase

rockweed declines



habitat complexity

algal species diversity

primary production

inputs of DOC, POC

all decline

ecosystem  
services

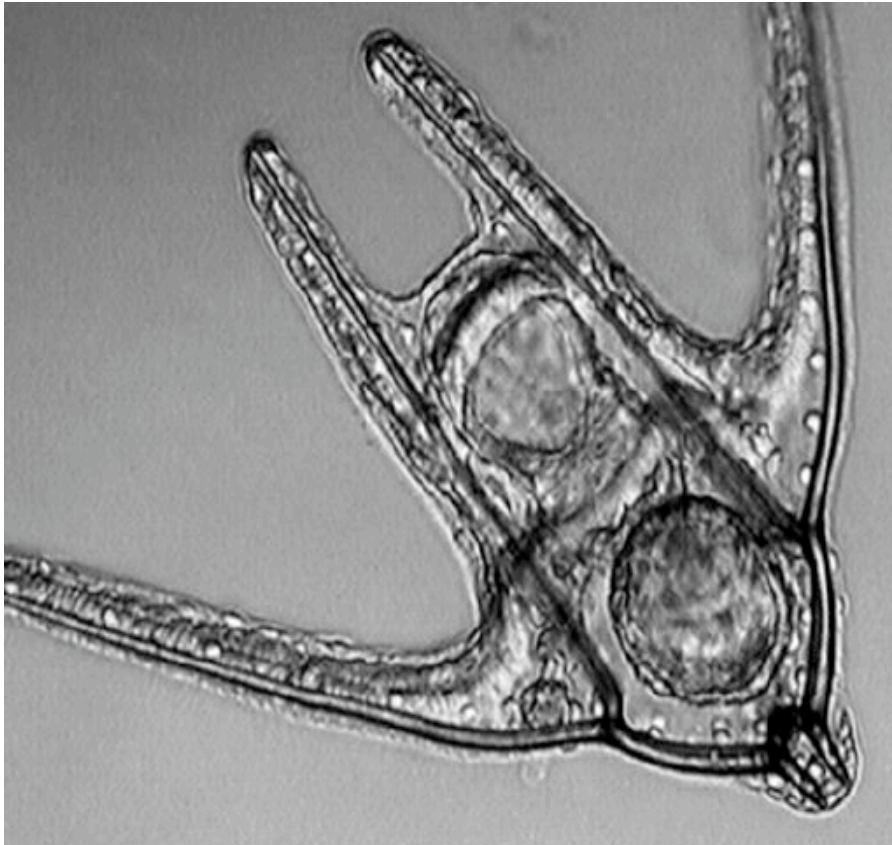
Implications:

algal biomass, primary productivity,  
associated ecosystem services  
appear to decline with increasing  
oyster density

impacts significantly greater in reserves

# Are Marine Reserves Connected through Larval Dispersal?

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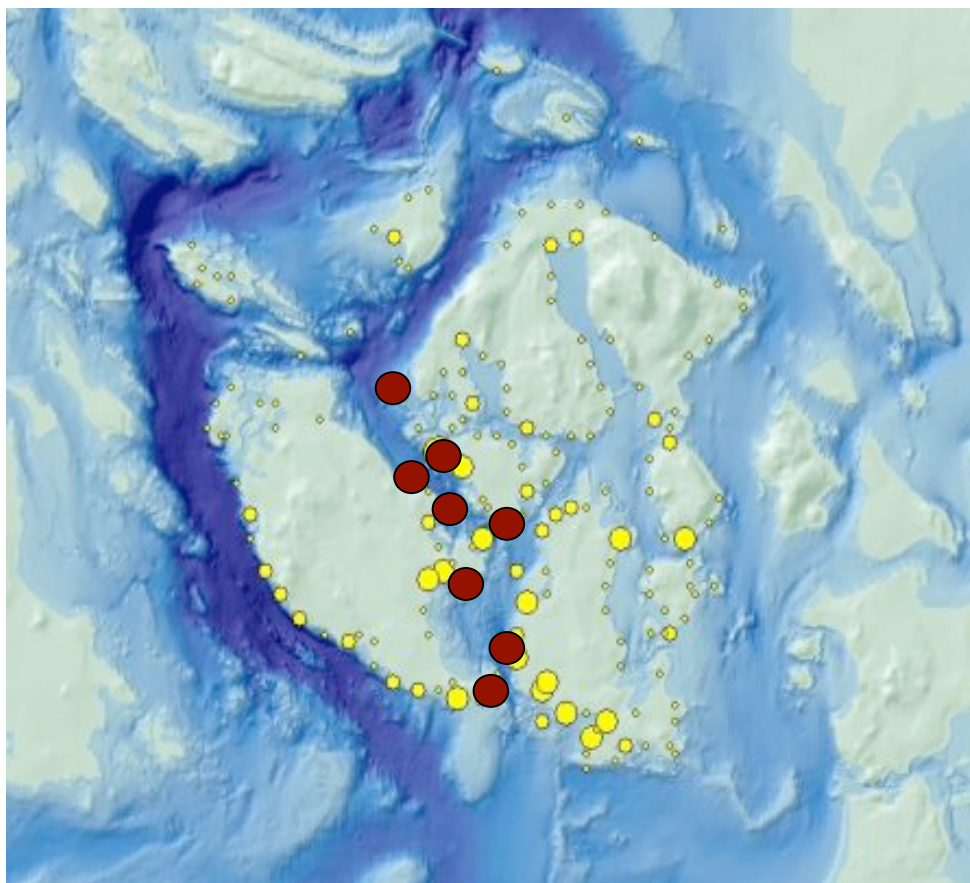


Janine Kido  
Curtis Ebbesmeyer  
Irit Altman, Sue Brady,  
Megan Ferguson, Rachel Hart,  
Daphne Pee, Heidi Theobald,  
Brie Van Cleve, Ellen Wilcox

Kim Engie

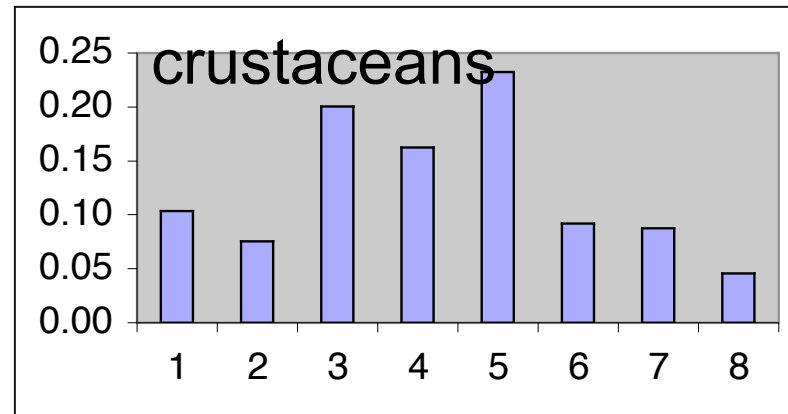
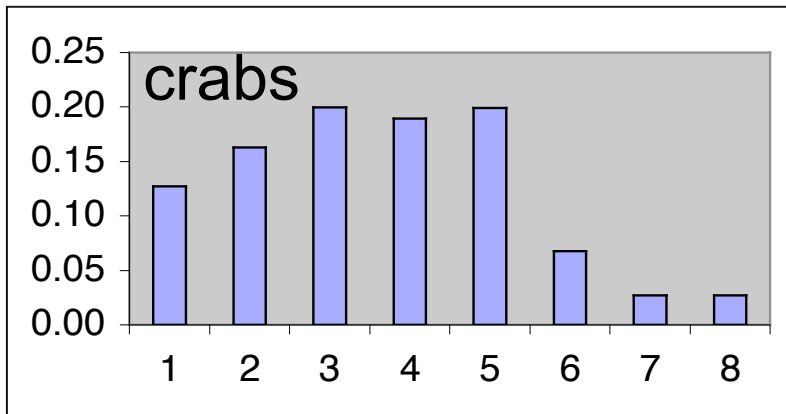
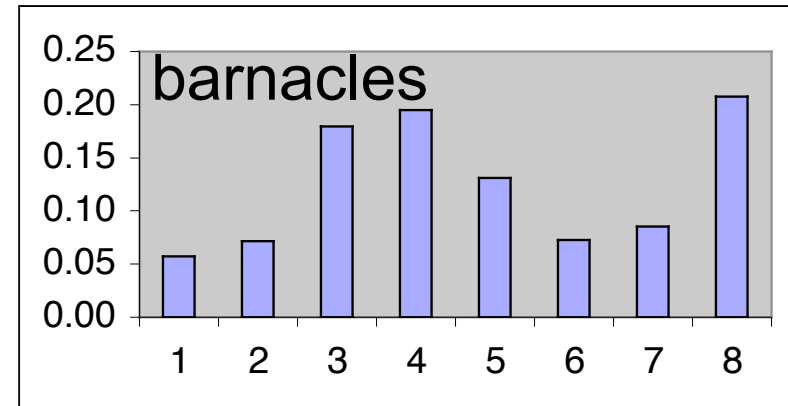
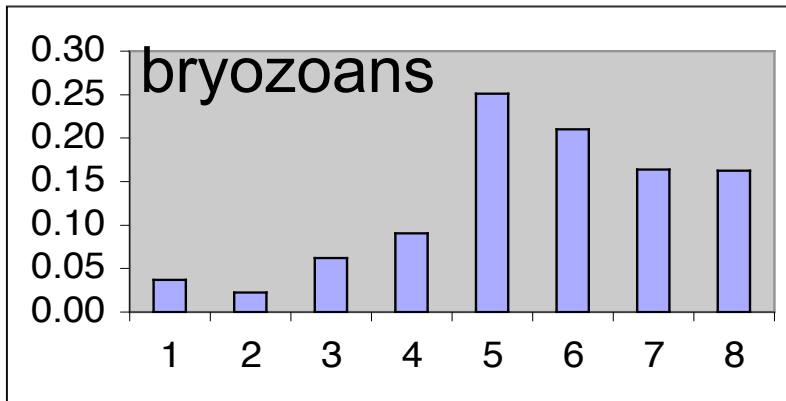
Sponsors:  
Packard Foundation  
Dickenson Foundation

# Larval Recruitment Study



- Drifter accumulation
- Larval sampling site

## Larval abundance by site



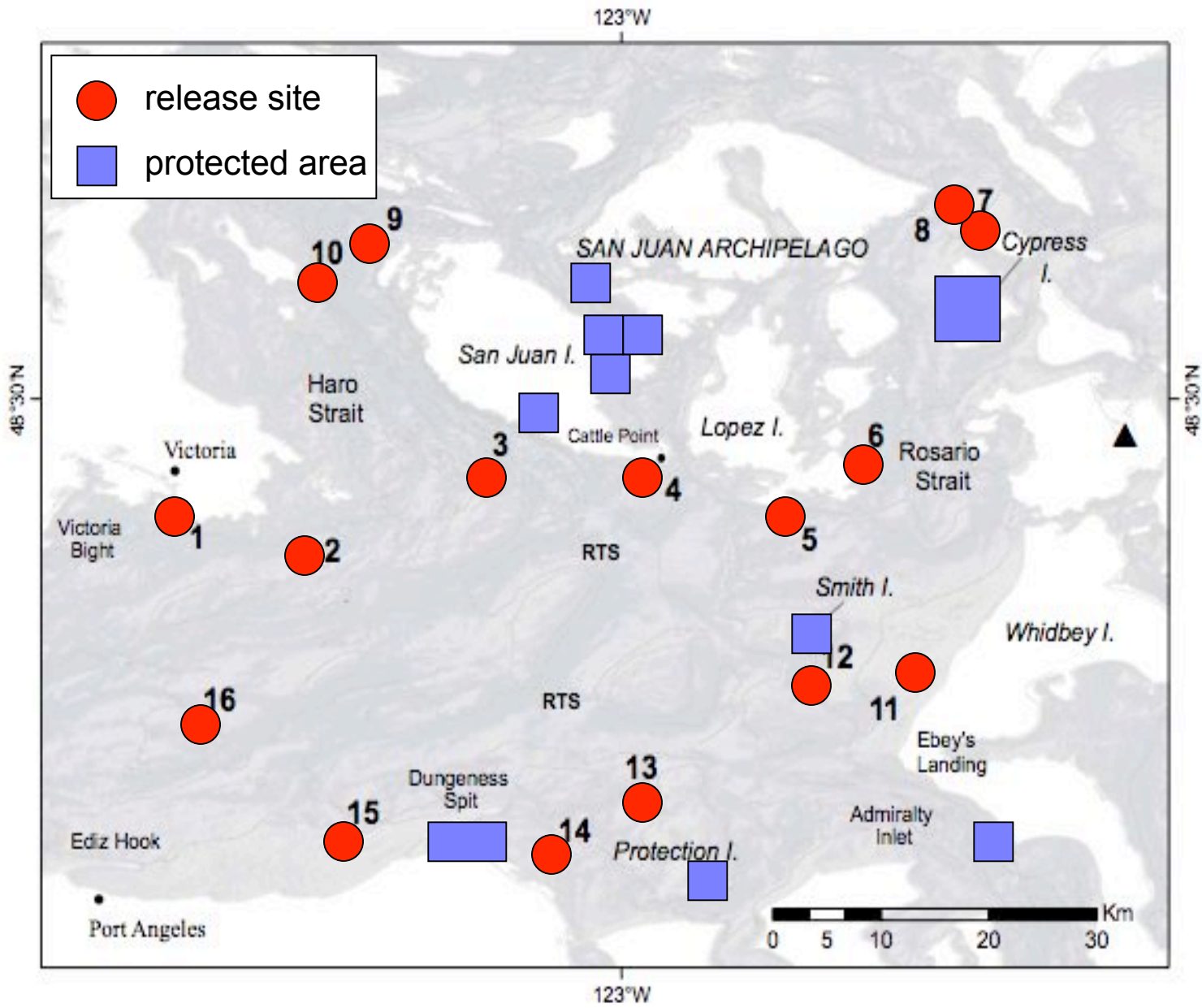
No correlation with drifter accumulation

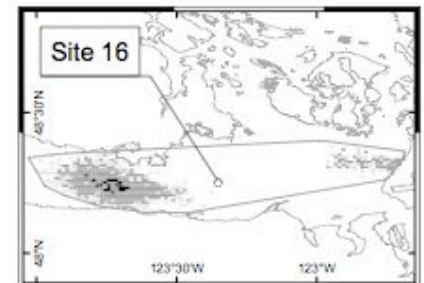
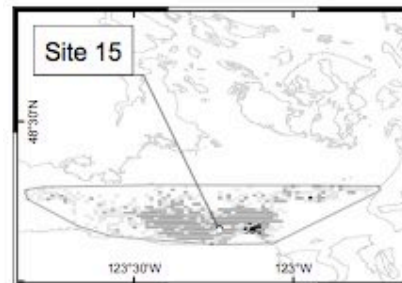
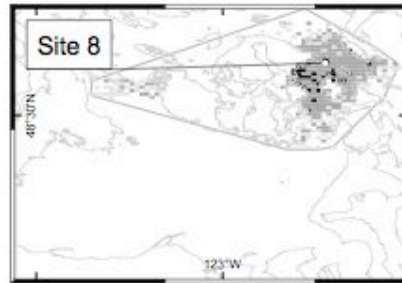
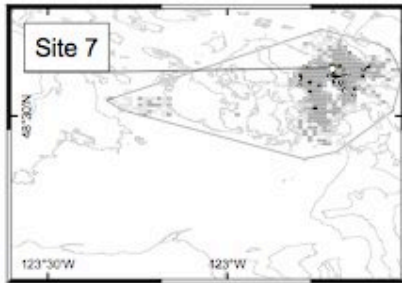
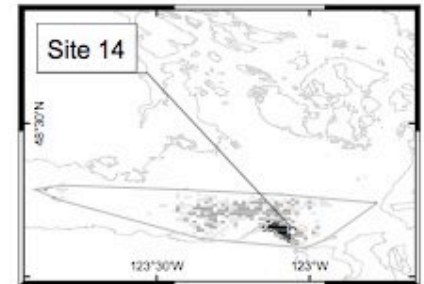
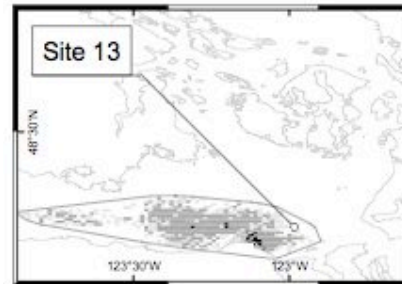
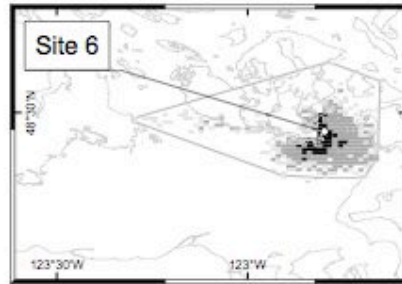
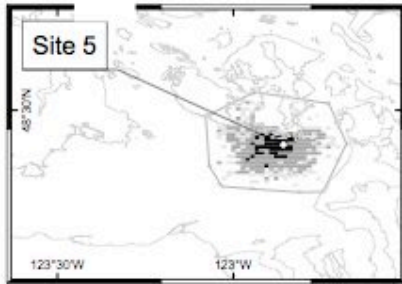
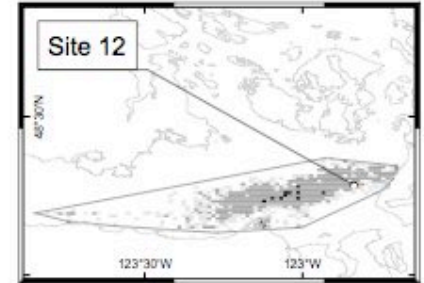
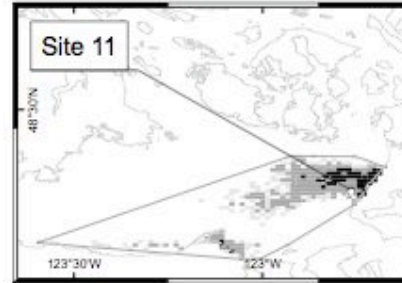
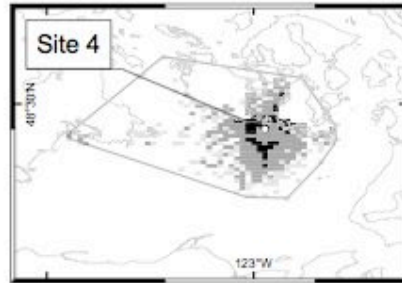
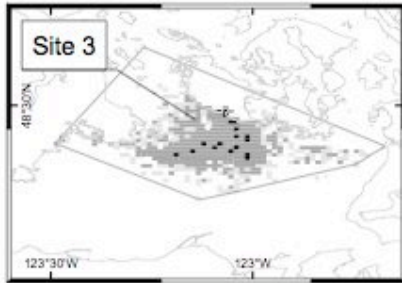
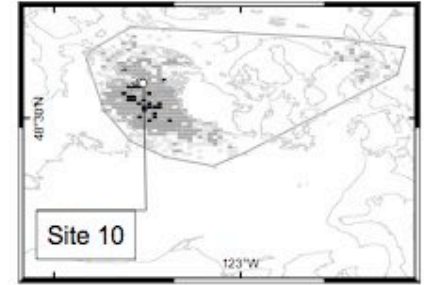
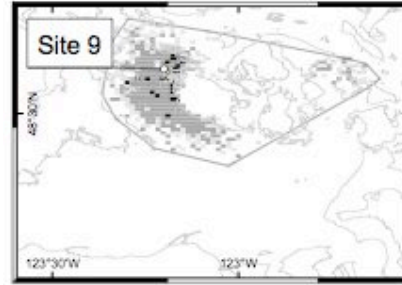
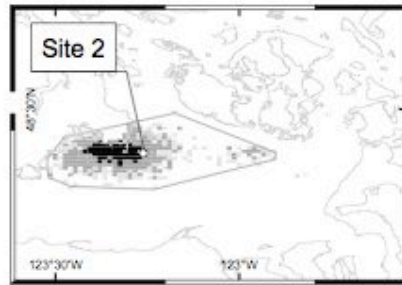
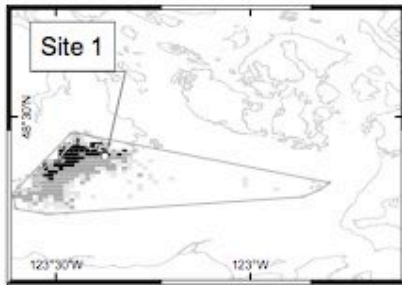
Results of larval recruitment studies:

no relationship between coarse measures of oceanography and larval recruitment;  
difficult to determine linkages

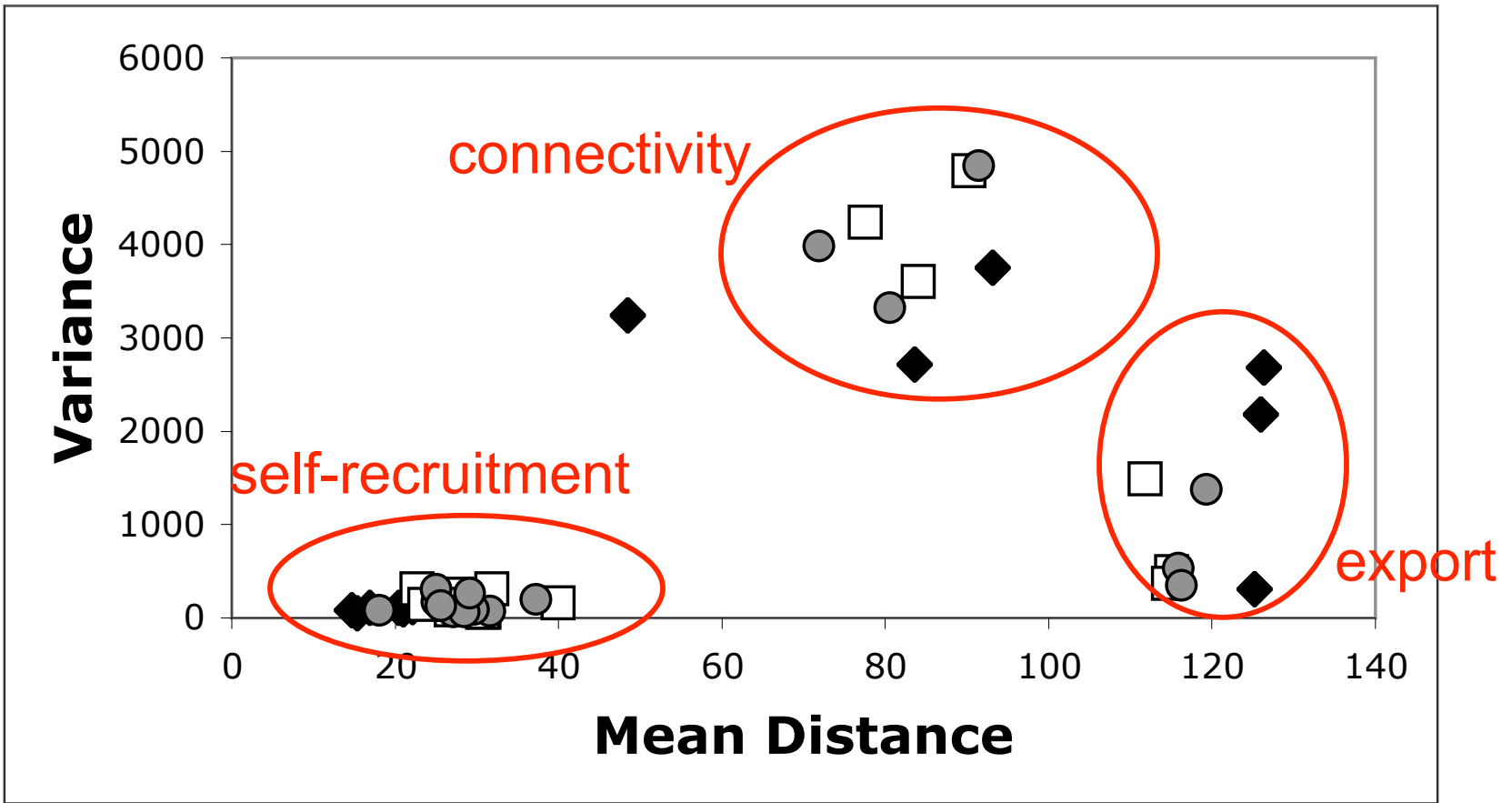
Alternative approach:

used oceanographic models to project dispersal envelopes





## Dispersal after 30 days



Engie and Klinger 2007

Paul Chitarro, NWFSC  
Lance Morgan & John Guinotte, MCB  
Kevin Telmer & Mike Sanborn, University of Victoria

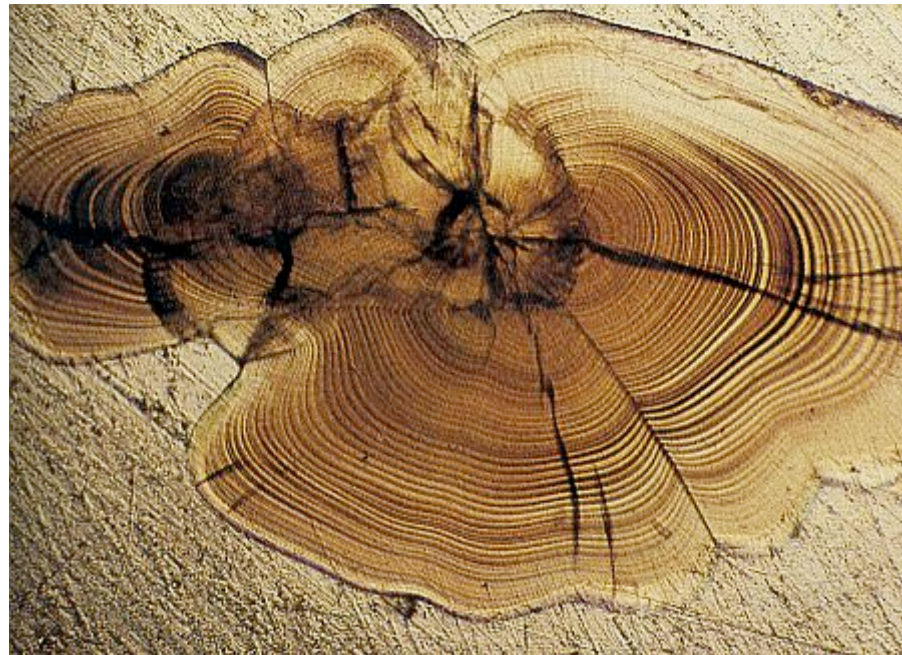


Marine Ecosystem Health Program  
Russell Family Foundation

Wayne Palsson, WDFW  
Jim West, WDFW  
Lynne Yamanaka, DFO

© Takako Uno

Trace element signatures of otoliths can be used as natural geochemical tags to infer spatial structure in fish populations





The image shows a map of the Mediterranean Sea region with a red grid overlay. The sea is colored in shades of blue, while the landmasses are black. Five distinct regions are highlighted with red ovals, each containing several green dots representing sampling locations. The regions are: 1) The northern part of the sea, near the Balkans and Greece. 2) The western coast of the sea, near the Iberian Peninsula. 3) The central part of the sea, near the Italian Peninsula. 4) The eastern part of the sea, near the Levant. 5) The southern part of the sea, near the African coast. The text 'Samples of opportunity' is located in the upper right, and 'N=110 fish from 5 regions' is located in the lower right.

**Samples of opportunity**

**N=110 fish from 5 regions**

## Result:

spatial structure detectable  
despite high degree of variability

## Implication:

dispersal of juveniles probably limited  
movement of adults limited



but: still difficult to determine  
linkages between  
protected areas

# Science Attributes

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short-term

spatially constrained

single factor

time series

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# Acknowledgements

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Russell Family Foundation

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