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STOCK COMPOSITION AND TIMING OF SOCKEYE SALMON IN THE FALSE PASS FISHERY

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FINAL REPORT

TO

CONCERNED AREA M FISHERMEN

Approved

Date 5-13-90

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INTRODUCTION

In 1987, the Alaska Department of Fish and Game (ADF&G) conducted a tagging study to determine the stock composition and migratory timing of sockeye and chum salmon in the South Peninsula (False Pass) June fishery (Eggers et al. 1989). It had been well established from prior tagging studies that the majority of sockeye salmon caught in this fishery were of Bristol Bay origin, and the fishery is presently restricted to catching 8.3% of the forecasted Bristol Bay catch (ADF&G 1989A). Chum salmon had been caught incidental to the more valuable sockeye and much less was known about their origins; therefore, when chum salmon catches in the False Pass fisheries increased in the 1980s coincidental with some decrease in the abundance of northern Alaskan stocks, there was a need to determine if these stocks were uniquely vulnerable to the fishery. In addition, the study was to provide evidence for differential migratory timing among stocks in the fishery, e.g., the late Ugashik sockeye and the Yukon fall chum salmon.

Eggers et al. (1989) emphasized the chum salmon part of the study in their report. They concluded that Bristol Bay chum salmon were most abundant in the South Unimak area (40%), whereas Japanese hatchery-origin chum salmon were most abundant in the Shumagin area (36.5%); however, there was a diverse mixture of stocks. The Yukon fall chum salmon, for which there was a major conservation concern, were actually shown to be the least vulnerable of the western Alaskan stocks in the False Pass fishery in 1987. There was almost total overlap in the timing of western and central Alaskan chum salmon stocks in the areas of the fisheries (south of Unimak Island and in the Shumagin Islands, see map). In spite of these results, a chum salmon cap or quota of 500,000 was placed on the False Pass fishery in 1988 and 1989 by the Board of Fisheries (Shaul and Schwarz 1989). This was supposed to provide protection for western Alaskan chum salmon; however, in 1988 the chum salmon cap resulted in a loss of 669,000 sockeye salmon to the South Unimak fishery.

For sockeye salmon, the Bristol Bay stocks were preponderant as expected. They constituted 84% and 54% of the fish in the South Unimak and Shumagin areas, respectively. North Peninsula sockeye salmon were the second most abundant (7%) in the South Unimak area and early-run Chignik sockeye were second most abundant (15%) in the Shumagins. Run timing was examined by comparing mean dates of tagging and recovery for the contributing stocks. Bristol Bay stocks were about two days later than the combined area releases, whereas the North Peninsula and Chignik stocks were about two and four days earlier than the combined area releases. The mean date of tag release was three days later than the mean date of the False Pass fishery catches in 1987. With the apparently later timing of the Bristol Bay stocks, Eggers et al. (1989) concluded that the percentages of Bristol Bay stocks in the fishery were slightly overestimated; however, they did not consider the timing of the inshore fisheries, i.e. differential rates of exploitation during the course of the runs in 1987. Since tag recoveries were entirely dependent on the commercial fisheries, this could have had as much effect on the composition estimates as the differential timing of the tag releases.

The purpose of this report is to examine the major sockeye salmon stock compositions (individual Bristol Bay fishing districts, North Peninsula and Chignik) during the

course of the tagging study by considering the timing of the recovery effort (inshore catches) as well as the timing of the tagging. Based on this analysis, the present quota periods for the South Unimak and Shumagin June fisheries will be examined to determine their suitability with regard to exploitation rates on contributing stocks and whether a change in the quota periods might benefit all fisheries. For example, chum salmon are relatively more abundant than sockeye in early June (Shaul and Schwarz 1989). If more of the sockeye quota could be taken later in June, there would be a reduction in the catch of the less desirable chum salmon.

The specific objectives of this analysis were to: (1) estimate the daily runs (catch plus escapement, lagged back) of sockeye salmon in the fishing districts, (2) estimate stock compositions by the numbers of tags in the runs by date of tagging, (3) estimate travel times from the South Unimak and Shumagin areas to the inshore fishing districts, and (4) compare the timing of the contributing stocks in the False Pass fishery with the False Pass catches.

METHODS

Eggers et al. (1989) estimated the stock compositions of sockeye salmon in the South Unimak and Shumagin areas from the expanded tag recoveries in the contributing coastal fisheries. The number of tags turned in by fishermen in each fishery during the 1987 season was divided by the rate of exploitation in the fishery (catch divided by catch plus escapement). This number was then expanded for underreporting of tags based on an ADF&G fishery sampling program that examined 3% to 6% of the catch in the major Bristol Bay fishing districts. Finally, the number of tags in each run to a coastal fishery was expanded for "mortalities" (tagging, natural and tag loss). This adjustment was based on estimates of mortality from the relationship between the expanded number of tag recoveries and the numbers actually released and was dependent on the estimated average travel time to the particular coastal fishing area. All estimates were based on 1987 totals or averages, i.e., no daily or weekly statistics were utilized in the estimates of stock composition.

To estimate stock compositions and run timing during the course of the 1987 False Pass fisheries it was first necessary to estimate the daily runs in the major contributing inshore fishing districts. Daily catches and escapements for the Bristol Bay fishing districts in 1987 were taken from Cross and Stratton (1988), whereas those for Chignik came from Probasco and Fox (1987). The later provided daily run estimates, but the Bristol Bay runs had to be calculated assuming various travel times from the fishing districts to the counting towers, e.g. three days was used for Wood and Naknek Rivers, six days for Egegik, seven days for the Kvichak River and nine days for the Ugashik River. Catch and escapement statistics for Bristol Bay for years prior to 1987 were obtained from Technical Fishery Reports, those for 1988 from ADF&G (1989B) and those for 1989 were obtained from ADF&G staff (Anchorage).

Daily escapements were only partially available for the North Peninsula (Bear River and Nelson Lagoon) and catches were reported only by week in McCullough (1989) and Shaul and Schwarz (1989); therefore only rough estimates of the daily North Peninsula runs could be made. Fortunately, fishing in 1987 was fairly well distri-

buted throughout the Bear River and Nelson Lagoon runs. Since sockeye salmon commonly spend more than a day in a fishing district, a day's catch usually represents more than a day's run, i.e. the number of fish passing a fixed point in the district. A better presentation of the daily runs was obtained by smoothing the daily catch and lagged escapement by a moving average of three.

Tagging and recovery statistics were obtained from Eggers et al. (1988). As in Eggers et al. (1989), only tag returns with accompanying date and location of recovery were used; however, I also did not use tag returns when there was no fishing for more than one day from the reported date of recovery, nor when the date of recovery required an unrealistic travel time. The number of tags in the daily catches were expanded to the number in daily runs (tags per catch times run) when the daily catch was 200,000 or more. When the catch was smaller, adjacent days were combined to calculate the number of tags per fish in the catch prior to calculating the number in the daily run. These expanded numbers were used to estimate daily stock compositions in the False Pass fisheries (where tag returns were sufficient) and to estimate travel rates to the various inshore fishing districts. No attempt was made to expand the number of tags for possible under-reporting by fishermen because the daily sampling effort was believed to be insufficient to do this. Likewise, no expansion was made for mortalities because it was felt that differences in distances to the contributing stocks were insufficient to cause differential mortalities; however, a tagging or handling delay in the migration was examined before calculating the travel times to the inshore fisheries.

RESULTS

The annual sockeye salmon quota for the False Pass fisheries (8.3% of the forecasted Bristol Bay catch) is apportioned to the South Unimak drift gill net and purse seine fishery (6.8%) and the Shumagin purse seine and set net fishery (1.5%). The quota is further apportioned among four periods in June (Table 1). The regulations require that if a quota for a period is not achieved, the shortage cannot be made up in the following period; however, if the quota for a period is exceeded, the excess is deducted from the total allocation. One effect of these punitive regulations, which are unique for North American salmon fisheries, is that the catches are usually made earlier than the guideline allocation. Since 1981, an average of 7% of the seasonal quota has been taken in the final period (June 26-30), whereas the quota for the period is 16% (Table 1). During the 1980s the fishery has usually achieved the pre-season quota (1986 and 1988 exceptions were caused by chum salmon "caps"), but it has only caught 8.3% of the Bristol Bay catch in one year (1982) because pre-season forecasts have tended to be too low. Most of this "shortfall" has been at the expense of the South Unimak fishery.

There is little doubt that sockeye catches from the False Pass fisheries come primarily from a mixture of the abundant Bristol Bay stocks. The catch-per-unit-effort in the fisheries has long been used in Bristol Bay as an indicator or in-season forecast of the Bristol Bay run; and the age composition in the catches has typically matched the age composition in the Bristol Bay combined run even though there was usually con-

siderable variation among the districts in Bristol Bay (Table 2). Major exceptions occurred in 1986 and 1988 when catches were relatively small and chum catch quotas were in effect. In addition, tagging studies in the 1920s and 1960s demonstrated the strong presence of Bristol Bay stocks in the areas of the False Pass fisheries—fish returning to Bristol Bay from ocean rearing in the Gulf of Alaska (Rogers 1987). However, the 1987 tagging study was the most comprehensive to date and offered the first opportunity to examine possible differential run timing of stocks and to provide a basis for the distribution of the 8.3% quota other than the historical distribution of the catches which may have had no relationship to the stock compositions.

The numbers of sockeye salmon tagged by date in 1987 and subsequently recovered in the Unimak and Shumagin districts are given in Table 3. This provides one estimate of the directional movement of sockeye salmon through this region. Of the sockeye tagged south of Unimak Island, only eight were recovered in the Shumagin Islands and only one of those in June. In contrast, 108 tags were recovered in the Unimak fishery with 101 recovered in June. When the June recoveries were adjusted for numbers tagged and examined (catch), there was a 38 : 1 ratio of tags from the Shumagins to Unimak, which demonstrated a strong east to west migration through the region.

Tag recoveries in the Bristol Bay, North Peninsula and Chignik fisheries are given by date and location of tagging in Table 4. During the period of tagging (June 6 to July 2), tag recovery rates increased from early to late in Bristol Bay, decreased from early to late in the North Peninsula and at Chignik for the Shumagin tagging, but recovery rates were quite variable at Chignik for the Unimak tagging. The stock composition from the simple expanded numbers of tags (total tags recovered divided by rate of exploitation) was fairly close to the composition of the runs for the Unimak tagging but Chignik and North Peninsula stocks were overrepresented in the Shumagin tagging relative to their abundances.

During the 1987 Bristol Bay sockeye run, exploitation rates were quite variable both within and among the fishing districts (Table 5 and Figures 1 and 2). Most notable was the fact that almost no fishing occurred on the first half of Kvichak run. Fishing in the Naknek/Kvichak District was confined to the Naknek section until the evening of July 9 (the usual mid-point in the run is July 4) and the fishery targets mainly on Naknek sockeye in the Naknek section. The Kvichak run in 1987 of 9.6 million was by far the largest run that year in Bristol Bay or Alaska; however, for Kvichak sockeye tagged early at False Pass there was little opportunity for recovery. For example, for sockeye tagged at Unimak on June 13, the earliest recovery effort (catch) for Kvichak sockeye was 26 days later (Appendix Table 1). This is more than twice as long as it would take a Kvichak sockeye to migrate to the fishing district assuming an average swimming speed of 2.0-2.5 km/h which is typical for adult sockeye salmon (Quinn et al. 1989).

For all of the Bristol Bay districts there was less fishing effort in the early part of the run than later on, but this was not the case for the North Peninsula and Chignik fisheries where exploitation rates were more uniform throughout the runs (Appendix Table 2). The effects of variable fishing times on the distribution of tag recoveries in Bristol Bay is illustrated in Figures 3-5. The regression lines provide an estimate of travel times during the course of the tagging study and a regression slope of 1.0 would rep-

resent a constant travel time, whereas a slope of less than 1.0 indicates that travel time decreases with date of tagging. It appears that sockeye salmon take less time (swim faster) in late June than they do in early June to reach the Bristol Bay fishing districts; however this is undoubtedly influenced by the distribution of fishing effort. Egegik, with the most early and even distribution of fishing effort, showed the least change in travel time (slope closest to 1.0) and the highest correlation between date tagged and date recovered. In contrast, the Naknek/Kvichak with the most uneven distribution of fishing effort, exhibited the greatest change in travel time and the lowest correlation between date tagged and date recovered.

Estimates of stock composition by date of tagging are given in Table 6. Unfortunately, lack of early fishing in the Kvichak precluded complete estimates of stock composition prior to June 23 in the Unimak and June 22 in the Shumagins and after June 28, there were insufficient recoveries and numbers tagged to make meaningful estimates. From the Unimak District, where the numbers of tags were fairly large, there was relatively little variation in stock composition among the four dates and the composition for the total period was remarkably close to the composition of the runs. The Naknek/Kvichak tag recoveries were five percentage points higher and Chignik tag recoveries were five percentage points lower than the percentages in the total of all runs but tags in the other districts were within one percentage point of the run composition. Chignik sockeye appeared to be abundant in the early tagging in the Shumagins (June 16), but after June 22 they constituted only five percentage points above their composition in the total of all runs.

Average travel times (number of days from tagging to recovery) by date of tagging are given in Table 7. These estimates were calculated from the expanded tags, i.e. the number in the run, and for a sample size of at least five observations. Estimates prior to June 22 are probably unreliable because of the reduced fishing effort in Bristol Bay. For sockeye salmon tagged after June 22 in the Unimak District, those returning to the Naknek/Kvichak, Egegik, Ugashik and North Peninsula fishing districts took about 14 days, whereas those returning to the Nushagak and Togiak Districts took about 16 days and those to Chignik took about 13 days. Assuming that sockeye bound for Bristol Bay went through Unimak Pass and then directly in to the fishing districts and that they migrated at an average speed of 54 km/d (2.25 km/h), the sockeye should have reached the fishing districts in the following number of days: 6 to the North Peninsula, 9.5 to Ugashik, 10 to Egegik, 11 to the Naknek/ Kvichak, 12 to Nushagak and 13 to Togiak. From the difference in travel times to inshore fisheries from Unimak and Shumagin tagging it appeared that the fish took two to four days to travel between the tagging locations and at 54 km/d it should have taken three days.

There was some evidence for a tagging or handling delay from the relatively large number of tags recovered in the Unimak District (Fig.6). Many fish either took more than a day to clear the fishing district or they were delayed in their migration. There was no fishing during the first week of July, otherwise there would have been an even greater number of tags recovered in the district. I assumed a delay of one day and used a 13 day travel time for the Naknek/Kvichak, Egegik and Ugashik stocks and a 15 day travel time for the Nushagak stocks in order to project the timing of the Bristol Bay runs in the Unimak District.

The smoothed (by moving average of 3 days) daily Bristol Bay runs timed to the Unimak District are shown for the years 1981 to 1988 in Figures 7 and 8. The Nushagak runs appear somewhat earlier than the Egegik and Naknek/Kvichak runs (which have similar timing) and the Ugashik runs appear to be later than the other stocks. The timing of the Ugashik runs in the Unimak District is very suspect; because, according to the projected timing, there should have been few if any Ugashik sockeye south of Unimak until June 18 in 1987; however, Ugashik sockeye were well represented in the tagged population on June 13 (Table 6). This, plus the fact that Ugashik sockeye exhibited the greatest difference between observed travel time and theoretical travel time (about 5 days), suggests that Ugashik stocks pass through the False Pass fisheries at about the same time as the other Bristol Bay stocks but they spend some days in Bristol Bay before entering the Ugashik fishing district.

The peak of the Bristol Bay runs through South Unimak occurred between June 15 and 25, except for the late run in 1986. The timing of the False Pass sockeye salmon catches was compared to the estimated timing of the Bristol Bay runs by graphing two times the False Pass catch (so they would show better) with the Bristol Bay runs (Figs. 9 and 10). The Shumagin catches were lagged back two days and added to the Unimak catches. In most years the False Pass catches appeared to be centered on the early part of the Bristol Bay run. This was especially so during 1983-1986. Since the Nushagak stocks tended to be somewhat earlier than the other stocks migrating through South Unimak, they may have experienced somewhat higher exploitation rates than the other stocks, particularly in 1983-1986 (Figs. 11 and 12).

DISCUSSION

The analysis of the 1987 tagging study showed that tags released prior to about June 22 had little chance of recovery in the largest sockeye salmon run that year (Kvichak); therefore, estimates of stock composition in the South Unimak and Shumagin fisheries could only be made on a daily basis for the period June 22-28. During this period, the compositions of the Bristol Bay stocks in the tagged populations were very close to the composition of their numbers in the 1987 run. Eggers et al. (1989) had estimated that 83.8% of the South Unimak sockeye and 53.7% of the Shumagin sockeye were from Bristol Bay. Assuming the same 6.6% were from other than Bristol Bay, North Peninsula and Chignik stocks, this analysis estimated that Bristol Bay stocks constituted 85.6% of the South Unimak sockeye; and, assuming that 18.9% of the Shumagin sockeye were from other than the three areas, Bristol Bay stocks made up 60.0% of the sockeye in the Shumagin fishery. The percentage of Chignik early-run sockeye in the Shumagins dropped from about 15% to 9.7%.when only the period June 22-28 was used. However, the the early tagging on June 6 and 16 indicated a stronger presence of Chignik sockeye at that time.

Estimates of travel time or swimming speed from the number of days between tagging and recovery in a fishery always tend to be too high or underestimate the speed, because not all fish are caught as soon as they enter the fishery. Bristol Bay sockeye typically take more than one day to pass through a fishing district. It was of particular interest that North Peninsula and Ugashik stocks showed the greatest differences be-

tween the theoretical time to reach the fishery and the observed time from the tagged sockeye salmon. The current along the North Peninsula coast is in towards the Kvichak Bay (water flow is out towards the Bering Sea from Nushagak Bay), and freshwater from the North Peninsula rivers (Nelson, Bear and Ugashik) would likely flow into Bristol Bay closer to shore than the incoming adult sockeye salmon. These stocks may overshoot their home rivers because they don't encounter their home water until they are well into Bristol Bay. If this were the case, it would explain why these fish take so much longer to reach their home rivers than the other stocks and why they tend to approach their home rivers from the north (inner Bay). Naknek/Kvichak sockeye showed the shortest time (2.5 days) between observed and theoretical travel time and water from Kvichak Bay flows out almost directly into the offshore migratory route of Bristol Bay Sockeye salmon. Therefore, the Naknek/Kvichak stocks can probably detect their home rivers sooner than the other Bristol Bay or North Peninsula stocks.

The projected run timing of the Bristol Bay stocks to the South Unimak fishery suggested that the fishery had probably fished more on the early than the late portions of the run and that Nushagak stocks may have been more heavily fished than the other stocks. The apparent earlier timing of the Nushagak stocks was only partially substantiated by the tagging study by the relatively high percentages of Nushagak recoveries from early Shumagin tagging; however, the Unimak tagging did not show any significant difference in the occurrence of Nushagak sockeye during the study. The projected late timing of Ugashik sockeye through the South Unimak fishery was probably an artifact as discussed above, since the tagging study did not substantiate this.

It would seem that a change in the present quota periods for the False Pass fisheries is due and might benefit several fisheries. A suggestion is to take the 8.3% quota (6.8% to South Unimak and 1.5% to the Shumagins) in three periods as follows: June 15-19 (30%), June 20-25 (40%) and June 26-30 (30%). Fish not caught in one period's quota should be taken in the following periods and if more than a period's quota is taken it should be deducted from the following periods so as not to exceed the total quota (8.3%). This schedule would place the fishery more in line with the center of the Bristol Bay run, where removals would be the least noticeable to Bristol Bay fishermen and provide more fish in the early part of the run where fishing has been more limited in recent years (Appendix Table 3). This schedule would also likely reduce exploitation on early-run Chignik sockeye and on western Alaskan chum salmon stocks. The greatly reduced fishing time for the False Pass fisheries should not pose a problem for catching and processing the salmon in most years. Problems would likely arise only from a very large forecasted catch (as in 1980) when there might not be enough time to catch the quota, or in the case where the actual abundance was much lower than forecasted and sockeye were scarce. Then it would also be difficult to catch the quota, because the False Pass fisheries only fish on about 26% of the Bristol Bay run (Rogers 1987), and even with unrestricted fishing, the fisheries have always caught less than 10% of the run.

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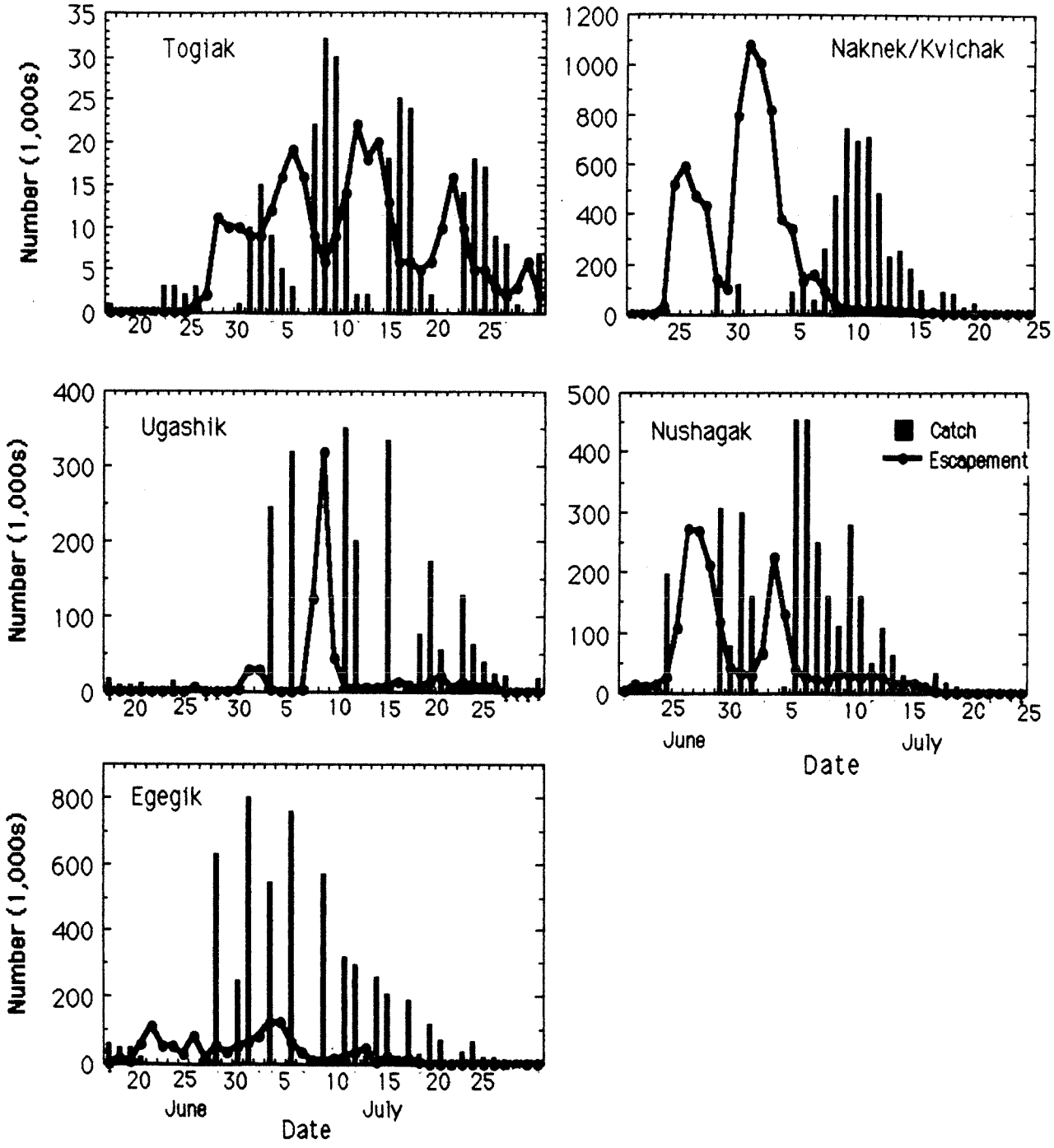

Figure 1. Daily catches of sockeye salmon in Bristol Bay fishing districts with the daily escapements (at towers) lagged back to the fishing districts in 1987.

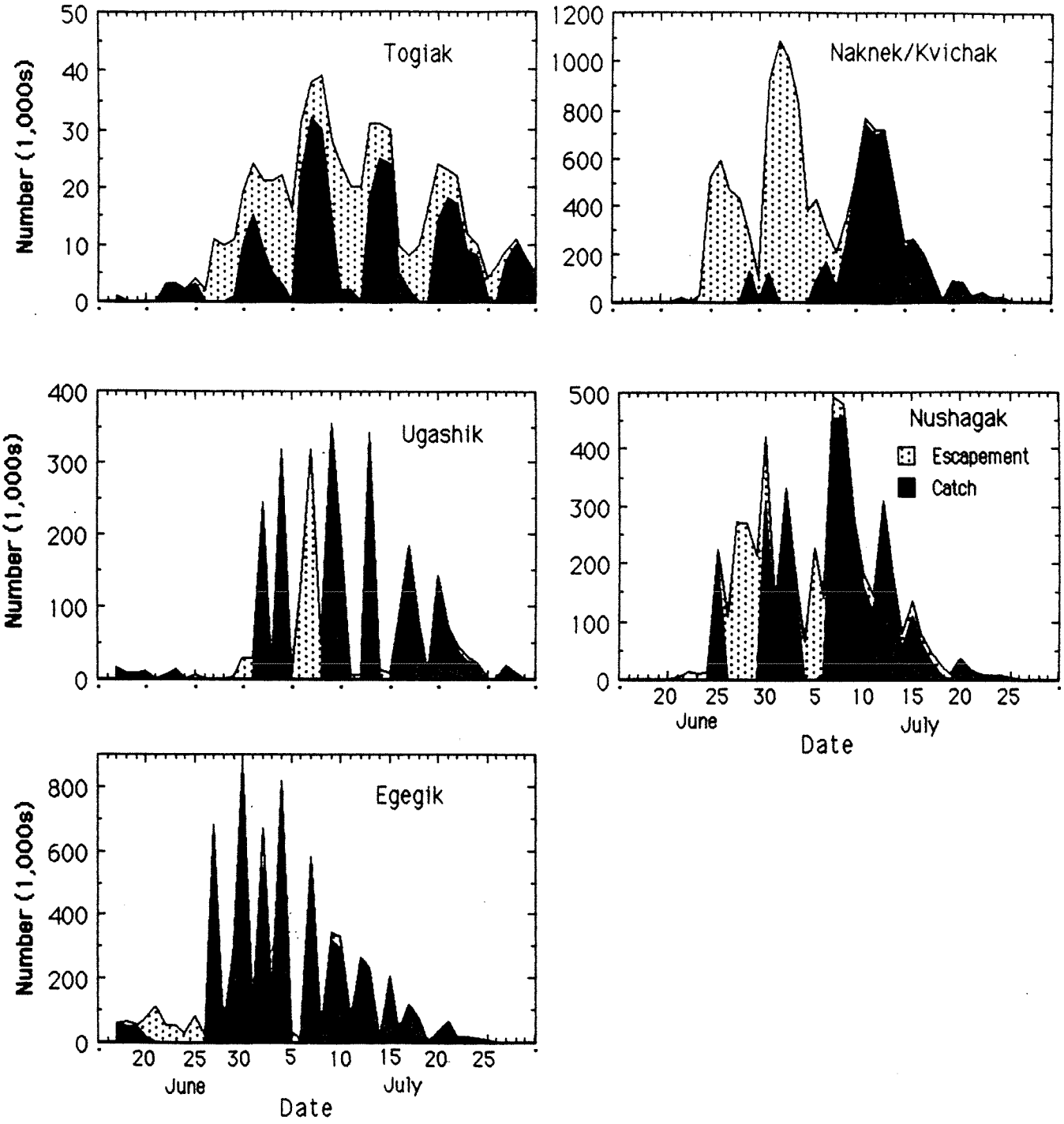

Figure 2. Daily runs of sockeye salmon (catch plus lagged escapements) in Bristol Bay fishing districts, 1987.

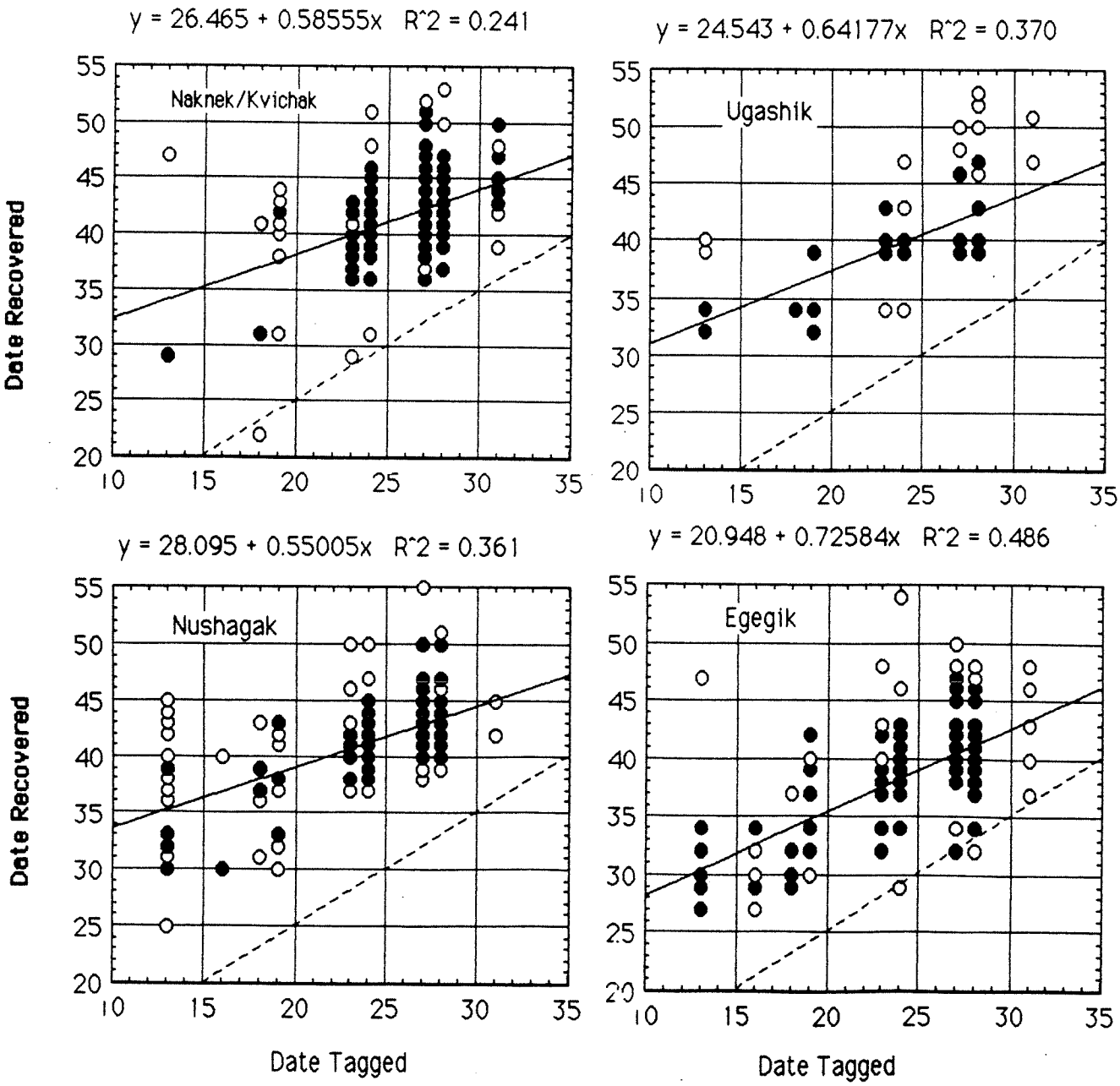

Figure 3. Plots of date recovered on date tagged for sockeye salmon tagged in the Unimak District during June 13 to July 1, 1987 (July 1 = 31, July 10 = 40, etc.). Open circles for single observations and solid circles for two or more observations. Dashed line at an interval (travel time) of 5 days and with a linear regression line fitted to the observations (solid line).

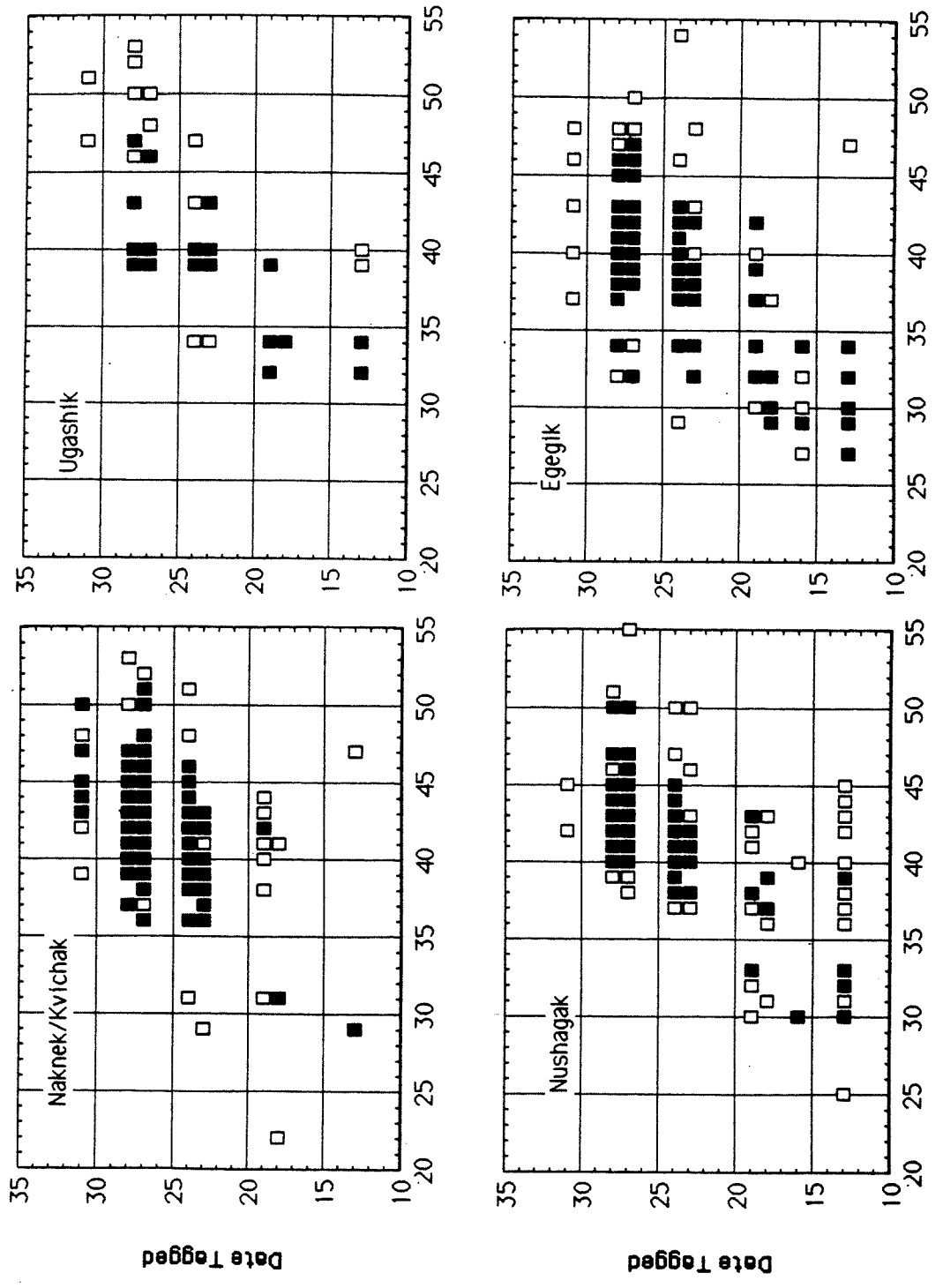

Figure 4. Plots of date tagged on date recovered for sockeye salmon tagged in the Unimak District during June 13 to July 1, 1987. Solid squares for two or more observations.

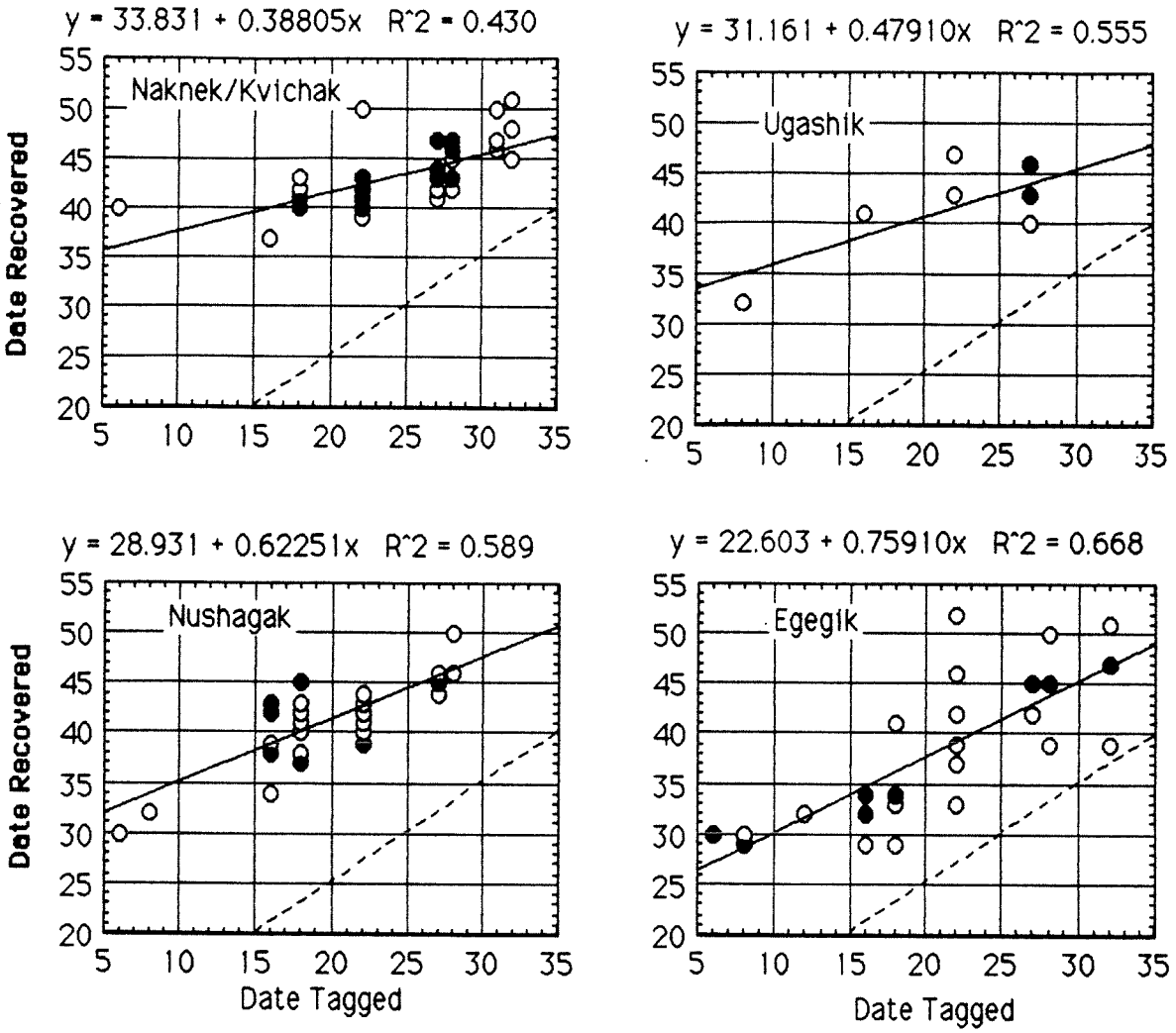

Figure 5. Plots of date recovered on date tagged for sockeye salmon tagged in the Shumagin District during June 6 to July 2, 1987. Solid circles are for 2 or more observations, dashed line for a travel time of 5 days and with a fitted linear regression line (solid).

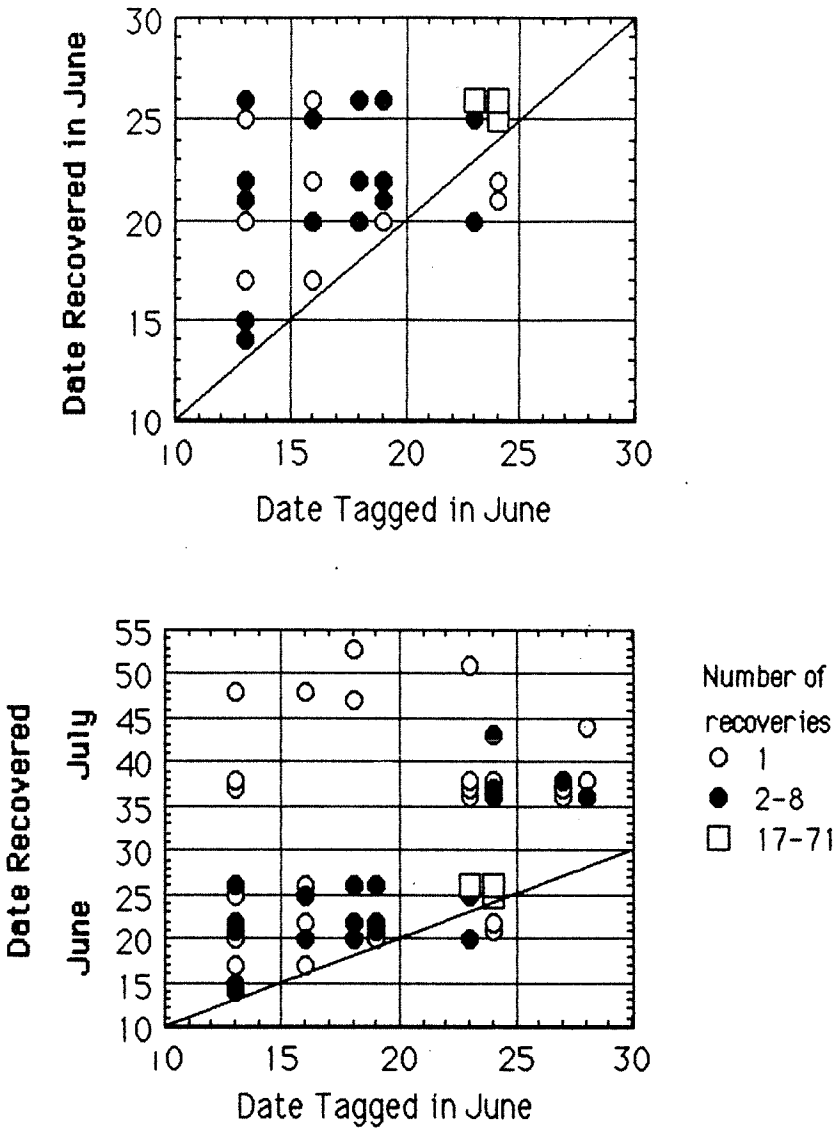

Figure 6. Plots of date recovered on date tagged for sockeye salmon tagged and recovered in the Unimak District for all dates of recoveries (bottom) and for only recoveries in the June fishery (top). Diagonal lines at equal dates.

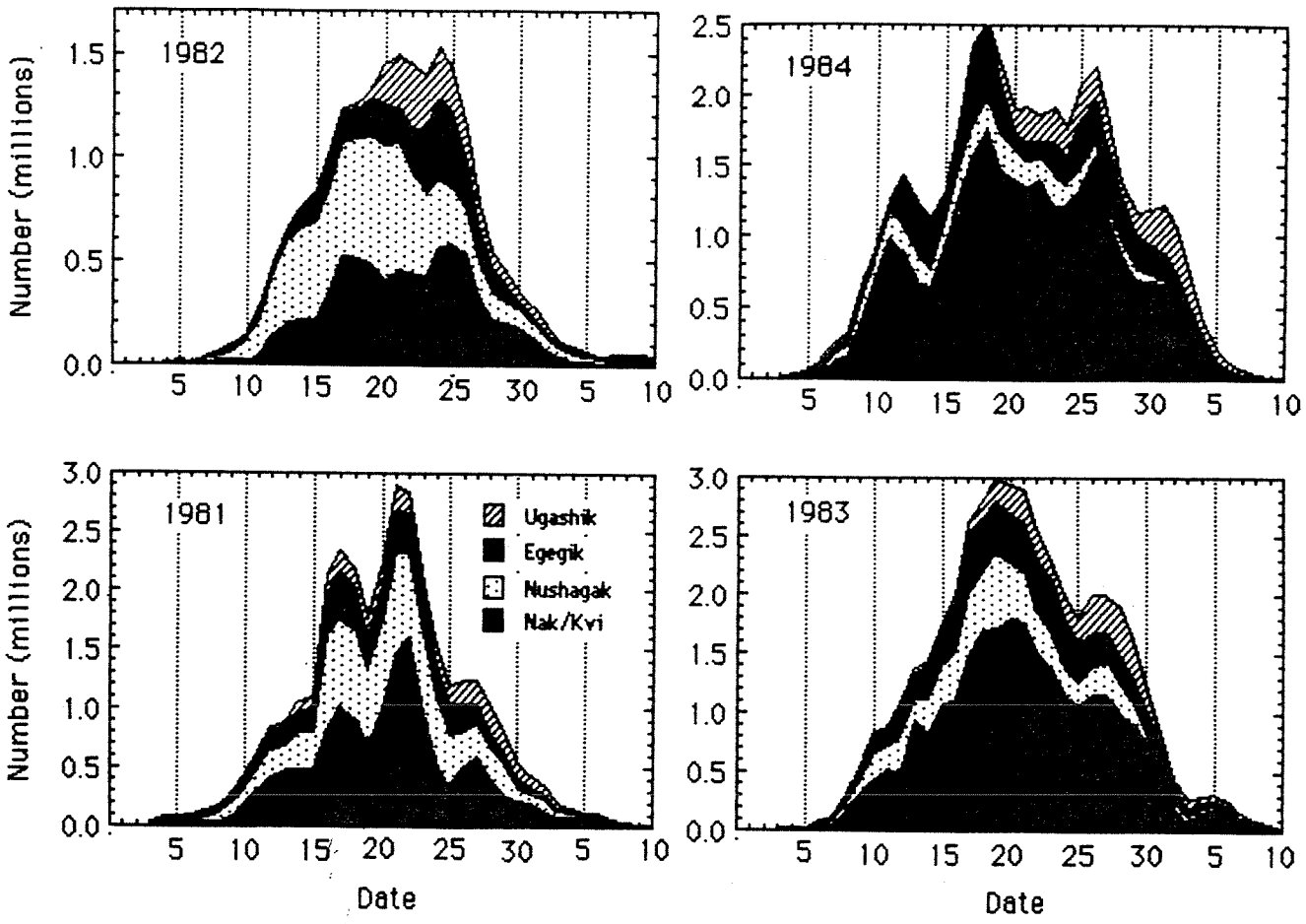

Figure 7. Bristol Bay sockeye salmon runs timed to the Unimak District of the South Peninsula, 1981-1984.

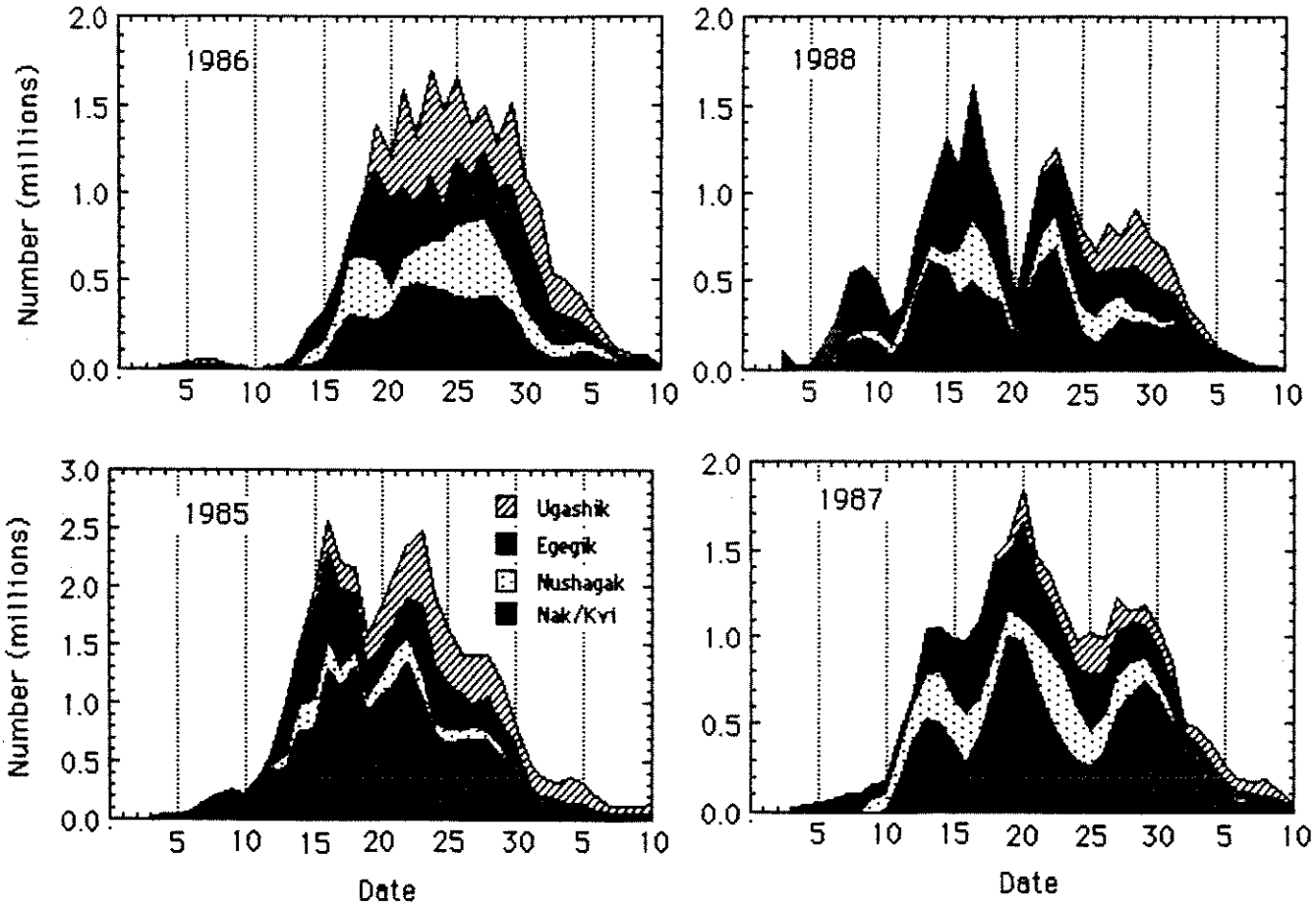

Figure 8. Bristol Bay sockeye salmon runs timed to the Unimak District of the South Peninsula, 1985-1988.

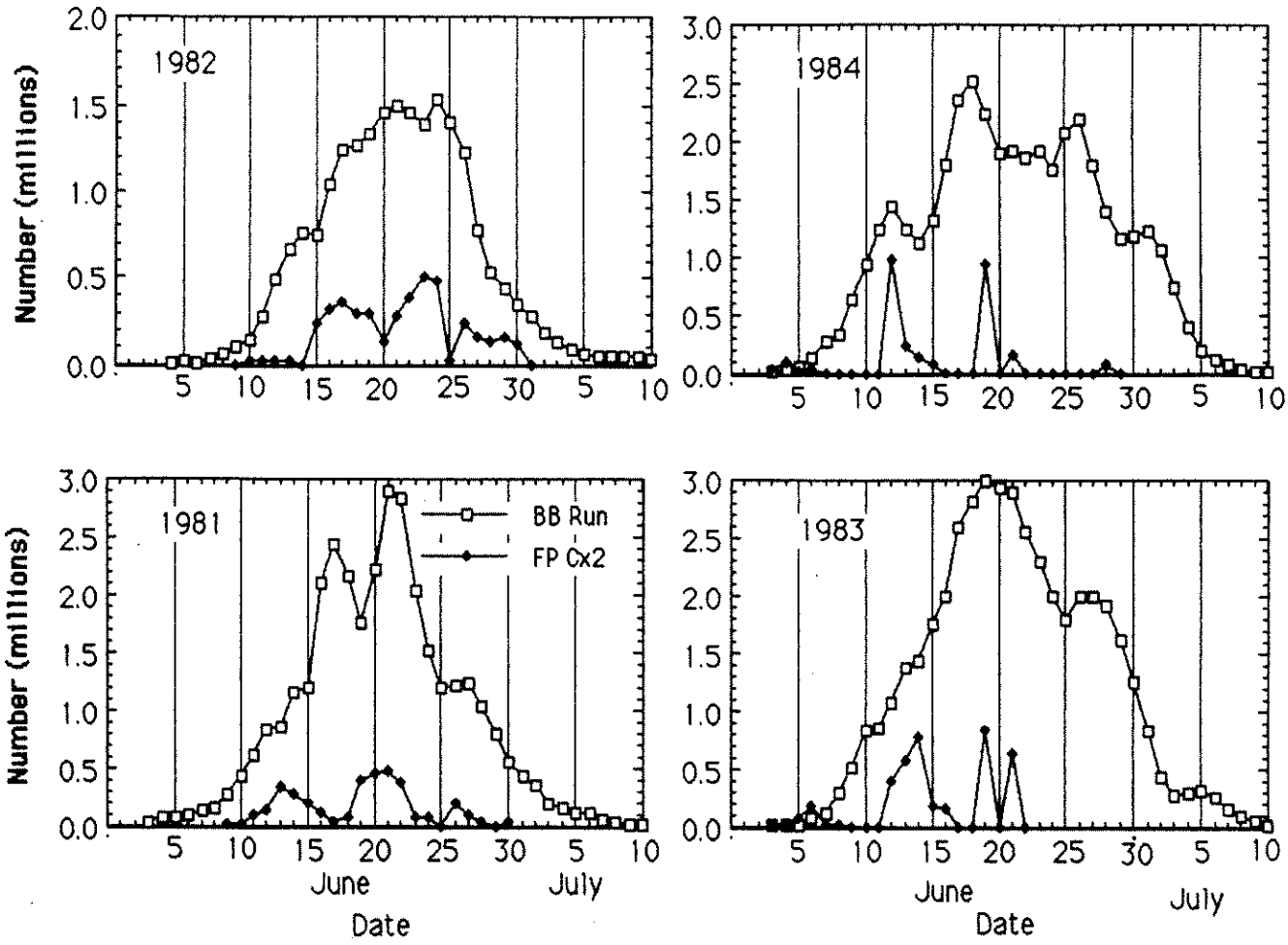

Figure 9. Double the daily False Pass sockeye salmon catches (Unimak and Shumagin districts) and the daily Bristol Bay sockeye runs timed to the Unimak District, 1981-1984.

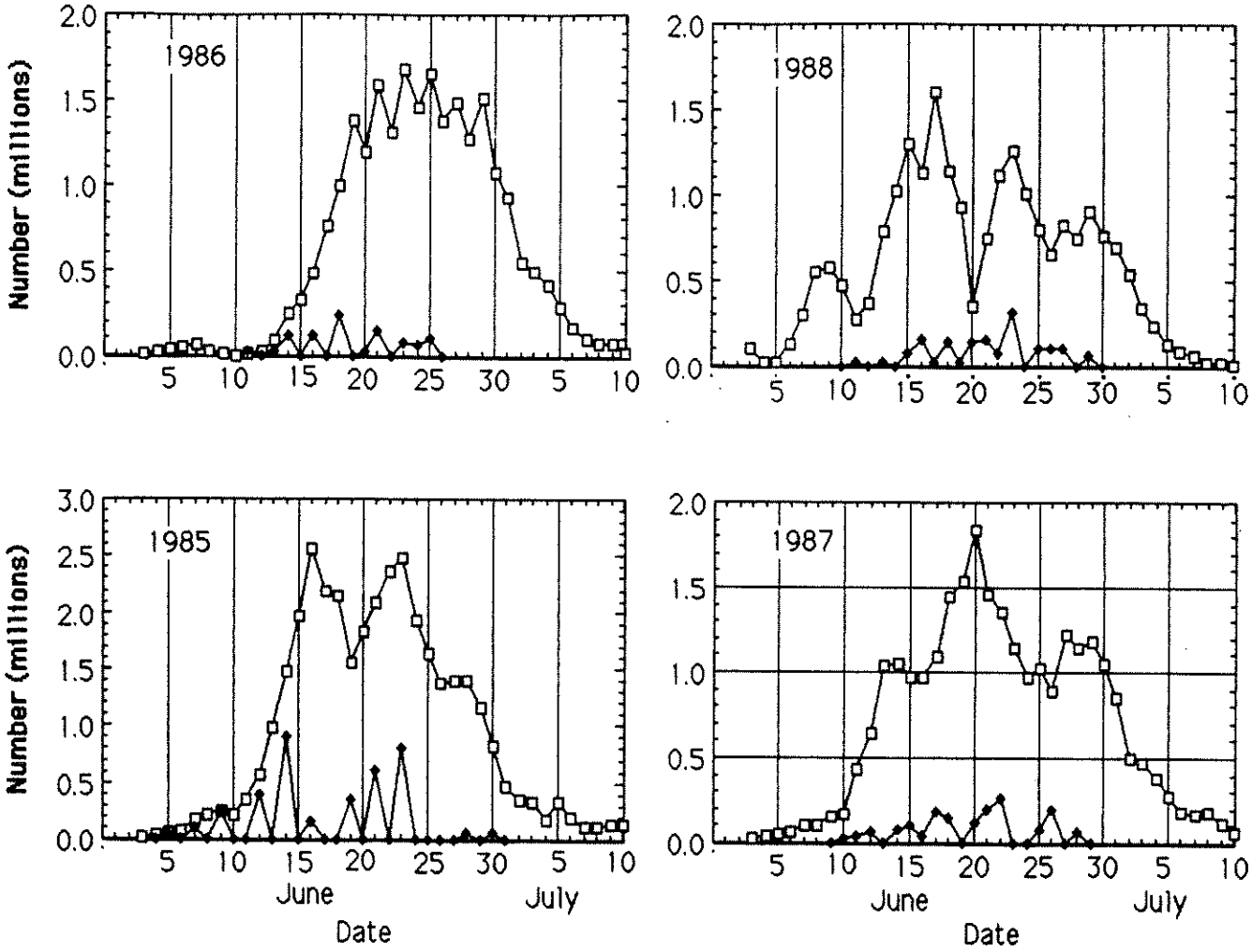

Figure 10. Double the daily False Pass sockeye salmon catches (Unimak and Shumagin districts) and the daily Bristol Bay sockeye runs timed to the Unimak District, 1985-1988.

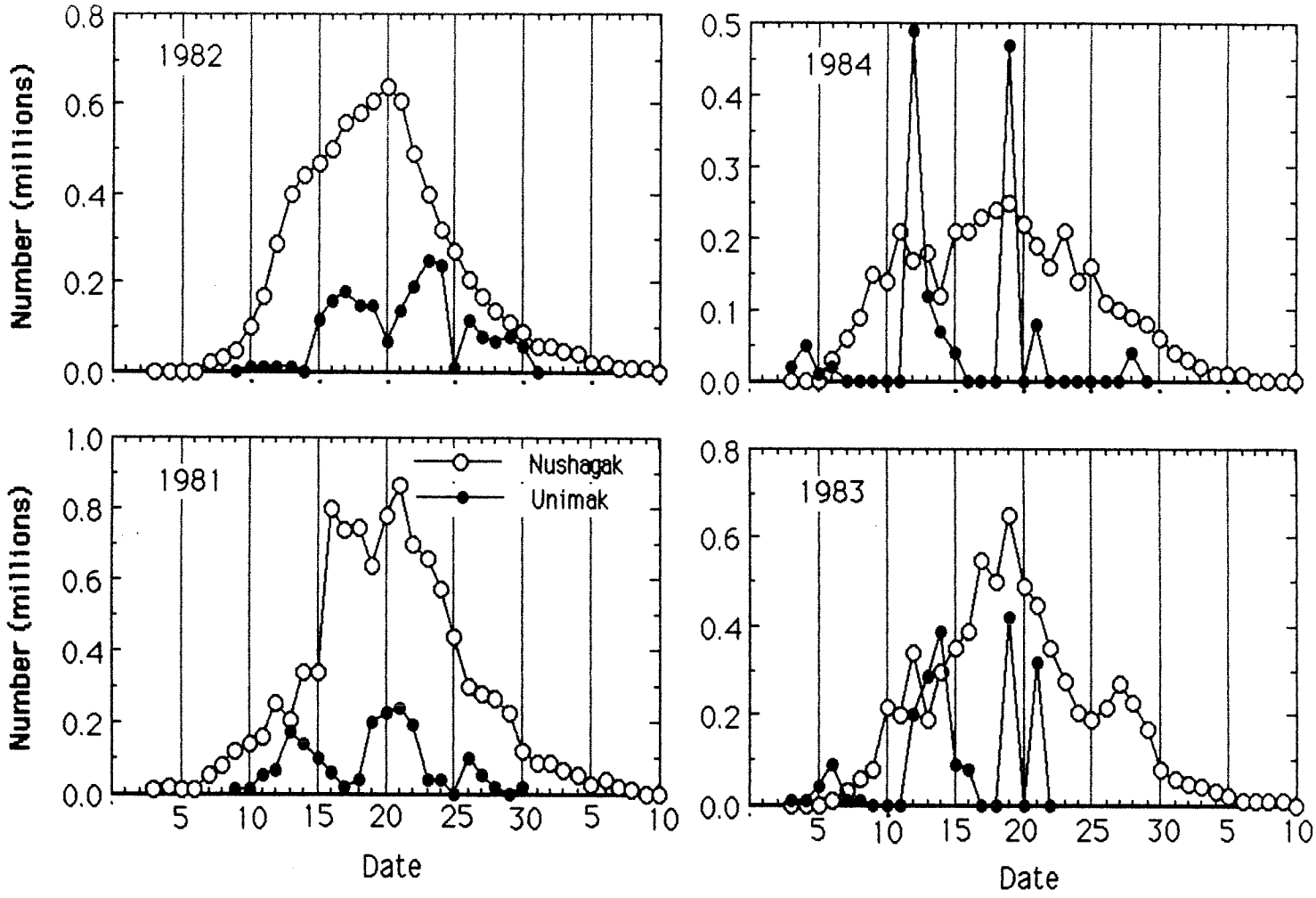

Figure 11. Daily False Pass catches and the Nushagak sockeye salmon runs timed to the Unimak District, 1981-1984.

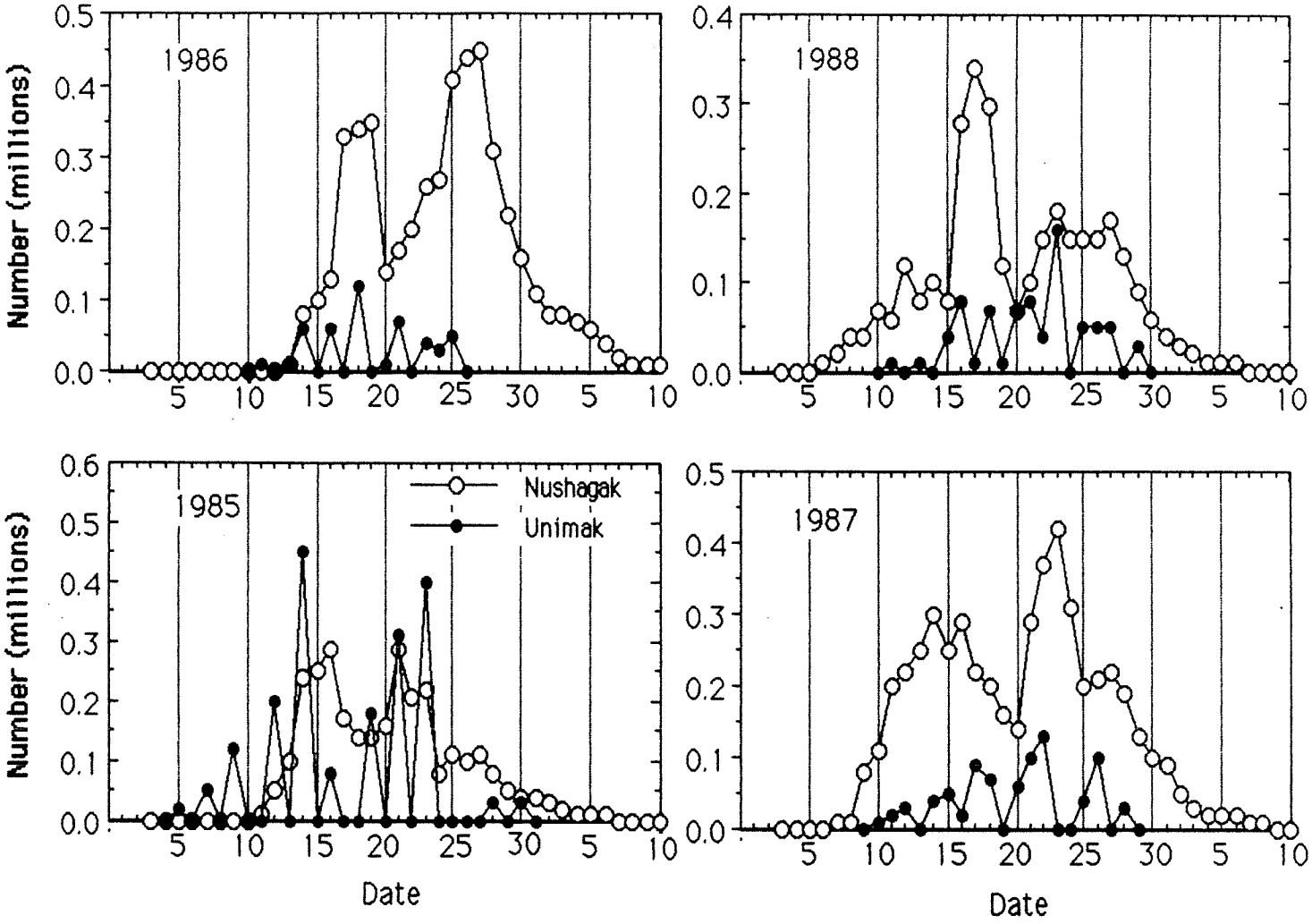

Figure 12. Daily False Pass catches and the Nushagak sockeye salmon runs timed to the Unimak District, 1985-1988.

Table 1. False Pass sockeye catches (1,000s) by quota period and district, 1981-1989.

Year	District	Dates in June: -11	12 to 18	19 to 25	26 to 30	Total catch	Pre-season quota	Percent of Bristol Bay catch
1981	Unimak	64	430	786	194	1474	1442	5.4
	Shumagin	31	153	158	0	351	318	1.4
	Total (%)	5	32	52	11			
1982	Unimak	36	548	721	366	1670	1850	10.0
	Shumagin	3	106	294	48	451	408	2.9
	Total (%)	2	31	48	19			
1983	Unimak	141	793	613	0	1547	1469	4.0
	Shumagin	32	257	128	0	417	324	1.1
	Total (%)	9	53	38	0			
1984	Unimak	75	593	464	0	1132	1111	4.4
	Shumagin	23	116	76	42	257	245	1.0
	Total (%)	7	51	39	3			
1985	Unimak	133	589	773	0	1495	1380	5.9
	Shumagin	59	135	115	56	367	305	1.5
	Total (%)	11	34	52	3			
1986	Unimak	8	177	129	0	314	907	1.9
	Shumagin	6	67	82	0	155	200	1.0
	Total (%)	3	52	45	0			
1987	Unimak	32	244	276	100	652	635	3.9
	Shumagin	32	24	55	30	141	140	0.9
	Total (%)	8	34	42	16			
1988	Unimak	12	181	233	49	475	1263	3.3
	Shumagin	8	99	141	34	282	279	2.0
	Total (%)	3	37	49	11			
1989	Unimak	148	366	784	0	1298	1197	4.3
	Shumagin	55	86	255	0	396	264	1.4
	Total(%)	12	27	61	0			
	Average (%)	7	39	47	7			6.3
	Quota (%)	6	29	49	16			8.3

Table 2. Age compositions (%) in the Bristol Bay runs and False Pass fishery with runs and catches (millions).

		District				Bristol Bay	False Pass
Year	Age	Naknek/Kvichak	Egegik	Ugashik	Nushagak	Combined	June fishery
1981	1.2	17	15	16	15	17	19
	2.2	36	56	34	8	30	37
	1.3	32	14	41	64	40	31
	2.3	14	14	9	13	13	12
	other	1	1	0	0	0	1
	Run	14.6	5.1	3.4	10.3	34.5	1.8
1982	1.2	27	10	10	18	19	21
	2.2	3	17	10	1	5	8
	1.3	47	51	62	71	58	53
	2.3	21	21	17	9	16	18
	other	2	1	1	1	2	0
	Run	7.5	3.5	2.3	7.9	22.1	2.1
1983	1.2	78	9	68	47	60	55
	2.2	9	76	19	12	21	30
	1.3	11	6	9	37	15	9
	2.3	2	8	4	1	3	5
	other	0	1	0	3	1	1
	Run	26.1	7.5	4.4	7.0	45.8	2.0
1984	1.2	13	12	29	16	15	18
	2.2	68	46	36	1	55	57
	1.3	13	8	21	79	19	16
	2.3	5	33	13	4	10	8
	other	1	1	1	0	1	1
	Run	26.5	6.4	3.9	3.8	41.1	1.4
1985	1.2	9	6	21	33	13	12
	2.2	51	51	43	6	46	39
	1.3	18	24	29	59	25	32
	2.3	21	18	7	1	16	15
	other	1	1	0	1	0	2
	Run	17.4	8.6	7.5	3.0	36.9	1.7
1986	1.2	13	16	7	14	12	4
	2.2	23	54	37	2	30	29
	1.3	46	15	42	78	43	30
	2.3	18	14	13	6	13	34
	other	0	1	1	0	2	3
	Run	6.3	6.2	5.9	4.9	23.8	0.5
1987	1.2	71	26	23	44	50	35
	2.2	6	26	21	3	12	13
	1.3	14	27	24	49	25	33
	2.3	9	21	32	4	13	14
	other	0	0	0	0	0	5
	Run	12.2	6.7	2.8	5.1	27.5	0.8
1988	1.2	35	7	21	20	21	23
	2.2	17	38	27	1	22	42
	1.3	41	34	16	65	42	24
	2.3	7	20	33	1	13	9
	other	0	1	3	3	2	2
	Run	8.9	8.0	2.2	3.2	23.3	0.8

Table 3. Numbers of sockeye tagged and recovered in South Peninsula fisheries.

Tagging			Number recovered				Percent
Location	Date	Number	Unimak	Shumagin	Other	Total	recovered
Unimak	7	4	0	0	0	0	0.0
	13	486	24	2	3	29	6.0
	16	165	10	0	2	12	7.3
	18	173	11	0	2	13	7.5
	19	513	24	0	4	28	5.5
	23	659	30	1	5	36	5.5
	24	1238	113	0	13	126	10.2
	27	998	4	1	3	8	0.8
	28	1061	6	4	1	11	1.0
	1	145	3	0	3	6	4.1
Shumagin	6	123	5	1	3	9	7.3
	8	41	0	0	0	0	0.0
	12	35	1	1	1	3	8.6
	16	447	48	8	18	74	16.6
	18	203	14	8	5	27	13.3
	22	326	34	5	4	43	13.2
	27	172	1	0	0	1	0.6
	28	100	1	0	0	1	1.0
	1	56	3	3	1	7	12.5
	2	42	1	0	0	1	2.4

Table 4. Numbers of sockeye tagged at False Pass and recovered in Bristol Bay, North Peninsula and Chignik fisheries.

			Bristol Bay						North Peninsula		Chignik (early)	
Tagging			Number recovered					Percent	Number	Percent	Number	Percent
Location	Date	Number*	Nak/Kvi	Nushagak	Egegik	Ugashik	Togiak	recov.	recov.	recov.	recov.	recov.
Unimak	7	4	0	0	0	0	0	0.0	1	25.0	0	0.0
	13	457	6	20	23	6	1	12.3	9	2.0	2	0.4
	16	153	1	4	9	0	0	9.2	7	4.6	1	0.7
	18	160	4	8	9	2	2	15.6	4	2.5	1	0.6
	19	485	8	13	22	9	0	10.7	17	3.5	2	0.4
	23	623	28	18	34	14	2	15.4	12	1.9	5	0.8
	24	1112	82	56	66	14	3	19.9	28	2.5	13	1.2
	27	990	98	40	50	20	3	21.3	8	0.8	0	0.0
	28	1050	124	61	71	36	2	28.0	12	1.1	3	0.3
	1	139	21	2	8	2	0	23.7	2	1.4	2	1.4
	Totals		372	222	292	103	13		100		29	
Shumagin	6	114	1	1	2	1	1	5.3	4	3.5	4	3.5
	8	41	0	1	3	1	0	12.2	2	4.9	0	0.0
	12	32	0	0	1	0	0	3.1	0	0.0	2	6.2
	16	373	1	8	6	1	0	4.3	6	1.6	21	5.6
	18	176	6	9	5	0	1	11.9	0	0.0	0	0.0
	22	283	12	7	6	2	1	9.9	10	3.5	8	2.8
	27	171	13	4	3	8	0	16.4	2	1.2	1	0.6
	28	99	11	2	4	0	0	17.2	0	0.0	0	0.0
	1	49	3	0	0	0	0	6.1	0	0.0	1	2.0
	2	41	3	0	4	0	0	17.1	0	0.0	0	0.0
	Totals		50	32	34	13	3		24		37	
Runs (1,000s)			12231	5149	6660	2806	656		1846		2161	
Exploitation rate			0.405	0.632	0.809	0.755	0.518		0.655		0.746	
Unimak expand. tags			919	351	361	136	25		152		39	
Shumagin expand. tags			123	51	42	17	6		36		50	

* Number tagged minus those recovered in South Peninsula

Table 5. Sockeye salmon catches (1,000s) and rates of exploitation (%) by quartiles of the runs in the fisheries and by dates in 1987.

	Nushagak		Naknek/ Kvichak		Egegik		Ugashik		Togiak	
Run segment	Catch	Rate	Catch	Rate	Catch	Rate	Catch	Rate	Catch	Rate
1st quarter	196	17	284	8	1039	64	626	90	55	32
2nd quarter	844	62	0	0	1344	83	350	42	100	62
3rd quarter	1169	84	1775	60	1333	85	612	93	76	48
4th quarter	1044	82	2890	96	1668	92	531	88	109	66
6/20-6/29	196	17	149	6	889	62	30	77	12	26
6/30-7/5	844	62	117	3	2099	81	563	90	42	34
7/6-7/10	1331	85	1034	58	1195	92	551	53	100	62
7/11-	882	81	3631	96	1051	90	942	89	185	57

Table 6. Estimated numbers of tags in the Bristol Bay, North Peninsula and Chignik runs and the stock composition (%).

Tagging			Bristol Bay					North	
Location	Date	Number	Nak/Kvi	Nushagak	Egegik	Ugashik	Togiak	Peninsula	Chignik
Unimak	13	457	- -	22 ( )	27 ( )	6 ( )	2 ( )	12 ( )	3 ( )
	19	485	- -	16 ( )	24 ( )	11 ( )	0 ( )	21 ( )	3 ( )
16-18 total(%)			- -	28 (21)	51 (37)	17 (12)	2 (2)	33 (24)	6 (4)
Run composition, percent			- -	27	34	15	3	10	11
	23	623	89 (49)	17 (9)	35 (20)	20 (11)	2 (1)	12 (7)	6 (3)
	24	1112	142 (42)	59 (17)	69 (20)	16 (5)	5 (2)	33 (10)	15 (4)
	27	994	136 (49)	48 (17)	54 (20)	26 (9)	4 (1)	9 (3)	0 ( )
	28	1050	134 (39)	72 (21)	72 (21)	43 (13)	2 (1)	15 (4)	4 (1)
23-28 total (%)			501 (44)	196 (17)	230 (20)	105 (9)	13 (1)	69 (6)	25 (2)
Run composition, percent			39	16	21	9	2	6	7
Unadjusted tags, percent			33	20	26	9	1	9	3
Expanded total, percent			46	18	18	7	1	8	2
Shumagin	16	373	- -	8 ( )	6 ( )	1 ( )	0 ( )	8 ( )	23 ( )
	18	176	- -	12 ( )	5 ( )	0 ( )	1 ( )	0 ( )	0 ( )
16-18 total (%)				20 (31)	11 (17)	1 (2)	1 (2)	8 (12)	23 (36)
Run composition, percent				27	34	15	3	10	11
	22	283	12 (24)	7 (14)	6 (12)	2 (4)	1 (2)	12 (24)	10 (20)
	27	171	14 (43)	4 (12)	3 (9)	8 (24)	0 (0)	2 (6)	2 (6)
	28	99	11 (64)	2 (12)	4 (24)	0 (0)	0 (0)	0 (0)	0 (0)
22-28 total (%)			37 (37)	13 (13)	13 (13)	10 (10)	1 (1)	14 (14)	12 (12)
Run composition, percent			39	16	21	9	1	6	7
Unadjusted tags, percent			26	17	18	7	2	12	19
Expanded total, percent			38	16	13	5	2	11	15

Table 7. Travel times (days) from the South Peninsula to inshore fisheries by date of tagging (minimum n = 5).

Tagging Location	Date	Naknek/ Kvichak	Nushagak	Egegik	Ugashik	Togiak	North Peninsula	Chignik
Unimak	13	- -	18.9	16.7	- -	- -	13.0	- -
	19	- -	17.4	16.7	15.9	- -	17.4	- -
	23	12.8	17.4	13.9	16.0	- -	15.8	12.8
	24	13.8	17.1	14.8	14.9	- -	14.6	12.4
	27	13.3	16.4	14.3	13.7	- -	12.1	- -
	28	14.0	15.3	12.4	13.5	- -	14.6	- -
	23-28	13.5	16.3	13.8	14.3	15.9	14.5	12.6
Shumagin	16	- -	23.7	16.5	- -	- -	20.7	14.8
	18	- -	22.3	15.8	- -	- -	- -	- -
	22	18.1	19.1	15.4	- -	- -	15.6	12.7
	27	16.6	17.8	- -	16.4	- -	- -	- -
	28	16.4	- -	- -	- -	- -	- -	- -
	22-28	17.3	18.8	16.3	16.9	- -	16.0	12.2
	Shumagin-Unimak	3.8	2.5	2.5	2.6		1.5	-0.4

APPENDIX TABLES

Appendix Table 1. Frequency distributions of travel times by tags recovered from Unimak tegging (catch and run in 1,000s).

Travel Time	13-Jun (486 tagged)											
	Nak/Kvi			Nushagak			Egegik			Ugashik		
(days)	Tags	Catch	Run	Tags	Catch	Run	Tags	Catch	Run	Tags	Catch	Run
4		3	3		0	0	0	33	33	0	8	8
5		3	3		0	0	0	48	67	0	8	8
6		5	5		0	0	0	45	51	0	9	9
7		1	1		0	0	0	15	76	0	11	11
8		0	0		0	0		0	110		0	0
9	0	19	19		0	0		0	51	0	6	6
10		0	0		0	0		0	54	0	12	12
11		0	31		0	14		0	28		0	0
12		0	518	1	196	223		0	83		0	4
13		0	593		0	108		0	19		0	1
14		0	470		0	274	6	626	679		0	1
15		0	431		0	271		0	37		0	1
16	3	130	271		0	215	5	248	300		0	3
17		0	102	2	305	422	4	801	868		0	30
18	0	117	917	1	78	120		0	80		0	29
19		0	1079	2	299	331	4	543	667	2	244	246
20		0	1010	3	162	192		0	123		0	0
21		0	820		0	65	3	755	820	2	319	319
22		0	381		0	226		0	35		0	3
23	0	84	427		11	141		0	11		0	123
24	0	167	299	2	455	493	0	571	582		0	318
25	0	52	206	1	454	480		7	27		0	47
26	0	260	357	3	249	272	0	321	343	1	349	355
27	0	471	508	1	162	183	0	296	329	1	201	205
28	0	741	763	0	113	146	0	25	72		0	5
29	0	695	715	1	278	309	0	262	269		0	6
30	0	708	722	1	160	186	0	208	229	0	334	342
31	0	478	498	1	49	78		0	10		0	13
32	0	226	251	1	109	134	0	189	206		0	7
33	0	249	264	0	61	79	0	28	35	0	77	82
34	1	179	195	0	31	46	1	117	119	0	173	185
35	0	92	97	0	7	24	0	69	69	0	54	74

Appendix Table 1. Continued

Travel Time (days)	19 June (513 tagged)											
	Nak/Kvi			Nush.			Egegik			Ugashik		
	Tags	Catch	Run	Tags	Catch	Run	Tags	Catch	Run	Tags	Catch	Run
4		0	0		0	10		0	54		0	12
5		0	31		0	14		0	28		0	0
6		0	518	0	196	223		0	83		0	4
7		0	593		0	108		0	19		0	1
8		0	470		0	274	0	626	679		0	1
9		0	431		0	271		0	37		0	1
10	0	130	271		0	215	0	248	300		0	3
11		0	102	1	305	422	1	801	868		0	30
12	1	117	917	0	78	120		0	80		0	29
13		0	1079	1	299	331	2	543	667	4	244	246
14		0	1010	2	162	192		0	123		0	0
15		0	820		0	65	8	755	820	2	319	319
16		0	381		0	226		0	35		0	3
17	0	84	427	0	11	141		0	11		0	123
18	0	167	299	1	455	493	6	571	582		0	318
19	1	52	206	3	454	480	0	7	27		0	47
20	0	260	357	0	249	272	2	321	343	2	349	355
21	1	471	508	0	162	183	1	296	329	0	201	205
22	1	741	763	1	113	146	0	25	72		0	5
23	2	695	715	1	278	309	2	262	269		0	6
24	1	708	722	2	160	186	0	208	229	0	334	342
25	1	478	498	0	49	78		0	10		0	13
26	0	226	251	0	109	134	0	189	206		0	7
27	0	249	264	0	61	79	0	28	35	0	77	82
28	0	179	195	0	31	46	0	117	119	0	173	185
29	0	92	97	0	7	24	0	69	69	0	54	74
30		0	4		0	9		0	0		0	6
31	0	88	90	0	33	36	0	38	38	0	130	142
32	0	76	76	0	16	17	0	63	63	0	62	71
33	0	24	24	0	10	11	0	17	17	0	40	47
34	0	40	40	0	6	7	0	17	17	0	24	31
35	0	15	15	0	5	6	0	11	11	0	20	20

Appendix Table 1. Continued

Travel Time (days)	23 June (659 tagged)											
	Nak/Kvi			Nush.			Egegik			Ugashik		
	Tags	Catch	Run	Tags	Catch	Run	Tags	Catch	Run	Tags	Catch	Run
4		0	470		0	274	0	626	679		0	1
5		0	431		0	271		0	37		0	1
6	1	130	271		0	215	0	248	300		0	3
7		0	102	0	305	422	0	801	868		0	30
8	0	117	917	0	73	120		0	80		0	29
9		0	1079	0	299	331	2	543	667	0	244	246
10		0	1010	0	162	192		0	123		0	0
11		0	820		0	65	7	755	820	1	319	319
12		0	381		0	226		0	35		0	3
13	2	84	427	0	11	141		0	11		0	123
14	2	167	299	1	455	493	11	571	582		0	318
15	3	52	206	5	454	480	2	7	27		0	47
16	4	260	357	0	249	272	4	321	343	7	349	355
17	6	471	508	2	162	183	1	296	329	2	201	205
18	1	741	763	3	113	146	0	25	72		0	5
19	4	695	715	3	278	309	2	262	269		0	6
20	4	708	722	1	160	186	1	208	229	4	334	342
21	0	478	498	0	49	78		0	10		0	13
22	0	226	251	0	109	134	0	189	206		0	7
23	0	249	264	1	61	79	0	28	35	0	77	82
24	0	179	195	0	31	46	0	117	119	0	173	185
25	0	92	97	0	7	24	1	69	69	0	54	74
26		0	4		0	9		0	0		0	6
27	0	88	90	1	33	36	0	38	38	0	130	142
28	0	76	76	0	16	17	0	63	63	0	62	71
29	0	24	24	0	10	11	0	17	17	0	40	47
30	0	40	40	0	6	7	0	17	17	0	24	31
31	0	15	15	0	5	6	0	11	11	0	20	20
32	0	14	14	0	2	3	0	3	3		0	0
33		0	0		0	1		0	0		0	0

Appendix Table 1. Continued

Travel Time	24 June (1238 tagged)											
	Nak/Kvi			Nush.			Egegik			Ugashik		
(days)	Tags	Catch	Run	Tags	Catch	Run	Tags	Catch	Run	Tags	Catch	Run
4		0	431	1?	0	271		0	37		0	1
5	0	130	271		0	215	1	248	300		0	3
6		0	102	0	305	422	0	801	868		0	30
7	2	117	917	0	78	120		0	80		0	29
8		0	1079	0	299	331	0	543	667	0	244	246
9		0	1010	0	162	192		0	123		0	0
10		0	820		0	65	6	755	820	1	319	319
11		0	381		0	226		0	35		0	3
12	3	84	427	0	11	141		0	11		0	123
13	0	167	299	1	455	493	16	571	582		0	318
14	2	52	206	11	454	480	3	7	27		0	47
15	19	260	357	5	249	272	11	321	343	6	349	355
16	10	471	508	10	162	183	12	296	329	2	201	205
17	10	741	763	2	113	146	2	25	72		0	5
18	7	695	715	5	278	309	2	262	269		0	6
19	14	708	722	8	160	186	5	208	229	1	334	342
20	4	478	498	2	49	78		0	10		0	13
21	2	226	251	4	109	134	2	189	206		0	7
22	3	249	264	0	61	79	1	28	35	0	77	82
23	0	179	195	1	31	46	0	117	119	1	173	185
24	1	92	97	0	7	24	0	69	69	0	54	74
25		0	4		0	9		0	0		0	6
26	0	88	90	2	33	36	0	38	38	0	130	142
27	1	76	76	0	16	17	0	63	63	0	62	71
28	0	24	24	0	10	11	0	17	17	0	40	47
29	0	40	40	0	6	7	0	17	17	0	24	31
30	0	15	15	0	5	6	1	11	11	0	20	20
31	0	14	14	0	2	3	0	3	3		0	0
32		0	0		0	1		0	0		0	0

Appendix Table 1. Continued

Travel Time (days)	27 June (998 tagged)											
	Nak/Kvi			Nush.			Egegik			Ugashik		
	Tags	Catch	Run	Tags	Catch	Run	Tags	Catch	Run	Tags	Catch	Run
4	0	117	917	0	78	120		0	80		0	29
5		0	1079	0	299	331	2	543	667	0	244	246
6		0	1010	0	162	192		0	123		0	0
7		0	820		0	65	1	755	820	0	319	319
8		0	381		0	226		0	35		0	3
9	2	84	427	0	11	141		0	11		0	123
10	1	167	299	0	455	493	2	571	582	1?	0	318
11	2	52	206	1	454	480	0	7	27		0	47
12	3	260	357	1	249	272	4	321	343	7	349	355
13	11	471	508	3	162	183	13	296	329	6	201	205
14	14	741	763	5	113	146	3	25	72		0	5
15	23	695	715	5	278	309	6	262	269		0	6
16	17	708	722	8	160	186	6	208	229	0	334	342
17	7	478	498	3	49	78		0	10		0	13
18	6	226	251	6	109	134	2	189	206		0	7
19	3	249	264	3	61	79	3	28	35	4	77	82
20	3	179	195	2	31	46	2	117	119	0	173	185
21	1	92	97	0	7	24	1	69	69	1	54	74
22		0	4		0	9		0	0		0	6
23	1	88	90	2	33	36	1	38	38	1	130	142
24	2	76	76	0	16	17	1	63	63	0	62	71
25	1	24	24	0	10	11	0	17	17	0	40	47
26	0	40	40	0	6	7	0	17	17	0	24	31
27	0	15	15	0	5	6	0	11	11	0	20	20
28	0	14	14	1	2	3	0	3	3		0	0
29		0	0		0	1		0	0		0	0
30	1	2	2	0	1	1	0		2	0	18	18
31	0	1	1	0	1	1	0		1	0	7	7

Appendix Table 1. Continued

Travel Time (days)	28 June (1061 tagged)											
	Nak/Kvi			Nush.			Egegik			Ugashik		
	Tags	Catch	Run	Tags	Catch	Run	Tags	Catch	Run	Tags	Catch	Run
4		0	1079	0	299	331	1	543	667	0	244	246
5		0	1010	0	162	192		0	123		0	0
6		0	820		0	65	5	755	820	0	319	319
7		0	381		0	226		0	35		0	3
8	0	84	427	0	11	141		0	11		0	123
9	2	167	299	0	455	493	4	571	582		0	318
10	0	52	206	0	454	480	2	7	27		0	47
11	3	260	357	1	249	272	5	321	343	9	349	355
12	10	471	508	5	162	183	15	296	329	11	201	205
13	19	741	763	7	113	146	7	25	72		0	5
14	33	695	715	15	278	309	6	262	269		0	6
15	25	708	722	13	160	186	12	208	229	8	334	342
16	12	478	498	5	49	78		0	10		0	13
17	6	226	251	4	109	134	3	189	206		0	7
18	4	249	264	1	61	79	3	28	35	1	77	82
19	4	179	195	2	31	46	1	117	119	3	173	185
20	0	92	97	0	7	24	1	69	69	0	54	74
21		0	4		0	9		0	0		0	6
22	1	88	90	4	33	36	0	38	38	1	130	142
23	0	76	76	1	16	17	0	63	63	0	62	71
24	0	24	24	0	10	11	0	17	17	1	40	47
25	1	40	40	0	6	7	0	17	17	1	24	31
26	0	15	15	0	5	6	0	11	11	0	20	20
27	0	14	14	0	2	3	0	3	3		0	0
28		0	0		0	1		0	0		0	0
29	0	2	2	0	1	1	0	2	2	0	18	18
30	0	1	1	0	1	1	0	1	1	0	7	7

Appendix Table 2. Frequency distributions of travel times by tags recovered from Shumagin tagging (catches and runs in 1,000s).

Travel Time	16 June (447 tagged)														
	Nak/Kvi			Nushagak			Egegik			Ugashik			Chignik		
(days)	Tags	Catch	Run	Tags	Catch	Run	Tags	Catch	Run	Tags	Catch	Run	Tags	Catch	Run
4		1	1		0	0		15	76		11	11	0	15	57
5		0	0		0	0		0	110		0	0	1	90	97
6		19	19		0	0		0	51		6	6	0	85	86
7		0	0		0	0		0	54		12	12	1	47	63
8		0	31		0	14		0	28		0	0		0	29
9		0	518	0	196	223		0	83		0	4		0	55
10		0	593		0	108		0	19		0	1		0	59
11		0	470		0	274	0	626	679		0	1	0	92	98
12		0	431		0	271		0	37		0	1	0	70	74
13	0	130	271		0	215	1	248	300		0	3	3	58	60
14		0	102	0	305	422	0	801	868		0	30	4	46	48
15	0	117	917	0	78	120		0	80		0	29	2	78	81
16		0	1079	0	299	331	2	543	667	0	244	246	3	74	76
17		0	1010	0	162	192		0	123		0	0	0	62	63
18		0	820	1	0	65	3	755	820	0	319	319	0	80	84
19		0	381		0	226		0	35		0	3	4	67	69
20	0	84	427		11	141		0	11		0	123	1	55	56
21	1	167	299	0	455	493	0	571	582		0	318	1	30	35
22	0	52	206	2	454	480		7	27		0	47		0	38
23	0	260	357	1	249	272	0	321	343	0	349	355		0	43
24	0	471	508	0	162	183	0	296	329	0	201	205	0	32	38
25	0	741	763	0	113	146	0	25	72	1	0	5		3	10
26	0	695	715	2	278	309	0	262	269		0	6	0	44	46
27	0	708	722	2	160	186	0	208	229	0	334	342	0	26	27
28	0	478	498	0	49	78		0	10		0	13	0	27	28
29	0	226	251	0	109	134	0	189	206		0	7	0	32	33
30	0	249	264	0	61	79	0	28	35	0	77	82		7	13

Appendix Table 2. Continued

Travel Time (days)	18 June (203 tagged)														
	Nak/Kvi			Nushagak			Egegik			Ugashik			Chignik		
	Tags	Catch	Run	Tags	Catch	Run	Tags	Catch	Run	Tags	Catch	Run	Tags	Catch	Run
4		19	19					0	51		6	6	0	85	86
5		0	0					0	54		12	12	0	47	63
6		0	31			14		0	28		0	0		0	29
7		0	518	0	196	223		0	83		0	4		0	55
8		0	593		0	108		0	19		0	1		0	59
9		0	470		0	274	0	626	679		0	1	0	92	98
10		0	431		0	271		0	37		0	1	0	70	74
11	0	130	271		0	215	1	248	300		0	3	0	58	60
12		0	102	0	305	422	0	801	868		0	30	0	46	48
13	0	117	917	0	78	120		0	80		0	29	0	78	81
14		0	1079	0	299	331	0	543	667	0	244	246	0	74	76
15		0	1010	0	162	192	1	0	123		0	0	0	62	63
16		0	820		0	65	2	755	820	0	319	319	0	80	84
17		0	381		0	226		0	35		0	3	0	67	69
18	0	84	427		11	141		0	11		0	123	1	55	56
19	0	167	299	2	455	493	0	571	582		0	318	0	30	35
20	0	52	206	1	454	480		7	27		0	47		0	38
21	0	260	357	0	249	272	0	321	343	0	349	355		0	43
22	2	471	508	1	162	183	0	296	329	0	201	205	0	32	38
23	2	741	763	1	113	146	1	25	72		0	5		3	10
24	1	695	715	1	278	309	0	262	269		0	6	0	44	46
25	1	708	722	1	160	186	0	208	229	0	334	342	0	26	27
26	0	478	498	0	49	78		0	10		0	13	0	27	28
27	0	226	251	2	109	134	0	189	206		0	7	0	32	33
28	0	249	264	0	61	79	0	28	35	0	77	82		7	13
29	0	179	195	0	31	46	0	117	119	0	173	185		4	12
30	0	92	97		7	24	0	69	69	0	54	74		0	8

Appendix Table 2. Continued

Travel Time (days)	22 June (326 tagged)														
	Nak/Kvi			Nushagak			Egegik			Ugashik			Chignik		
	Tags	Catch	Run	Tags	Catch	Run	Tags	Catch	Run	Tags	Catch	Run	Tags	Catch	Run
4		0	593		0	108		0	19		0	1		0	59
5		0	470		0	274	0	626	679		0	1	0	92	98
6		0	431		0	271		0	37		0	1	0	70	74
7	0	130	271		0	215	0	248	300		0	3	0	58	60
8		0	102	0	305	422	0	801	868		0	30	0	46	48
9	0	117	917	0	78	120		0	80		0	29	3	78	81
10		0	1079	0	299	331	0	543	667	0	244	246	0	74	76
11		0	1010	0	162	192	1	0	123		0	0	1	62	63
12		0	820		0	65	0	755	820	0	319	319	0	80	84
13		0	381		0	226		0	35		0	3	2	67	69
14	0	84	427		11	141		0	11		0	123	1	55	56
15	0	167	299	0	455	493	1	571	582		0	318	1	30	35
16	0	52	206	0	454	480	1	7	27		0	47		0	38
17	1	260	357	2	249	272	1	321	343	0	349	355		0	43
18	2	471	508	1	162	183	0	296	329	0	201	205	0	32	38
19	3	741	763	1	113	146	0	25	72		0	5		3	10
20	2	695	715	1	278	309	1	262	269		0	6	0	44	46
21	2	708	722	1	160	186	0	208	229	1	334	342	0	26	27
22	0	478	498	1	49	78		0	10		0	13	0	27	28
23	0	226	251	0	109	134	0	189	206		0	7	0	32	33
24	0	249	264	0	61	79	0	28	35	0	77	82	1	7	13
25	0	179	195	0	31	46	0	117	119	1	173	185		4	12
26	0	92	97		7	24	0	69	69	0	54	74		0	8
27		0	4		0	9		0	0		0	6		0	16
28	1	88	90	0	33	36	0	38	38	0	130	142		0	19
29	0	76	76		16	17	0	63	63	0	62	71		0	20
30	0	24	24		10	11		17	17	0	40	47		0	24

Appendix Table 2. Continued

Travel Time (days)	27 June (172 tagged)														
	Nak/Kvi			Nushagak			Egegik			Ugashik			Chignik		
	Tags	Catch	Run	Tags	Catch	Run	Tags	Catch	Run	Tags	Catch	Run	Tags	Catch	Run
4	0	117	917	0	78	120		0	80		0	29	0	78	81
5		0	1079	0	299	331	0	543	667	0	244	246	0	74	76
6		0	1010	0	162	192		0	123		0	0	0	62	63
7		0	820		0	65	0	755	820	0	319	319	1	80	84
8		0	381		0	226		0	35		0	3	0	67	69
9	0	84	427		11	141		0	11		0	123	0	55	56
10	0	167	299	0	455	493	0	571	582		0	318	0	30	35
11	0	52	206	0	454	480		7	27		0	47		0	38
12	0	260	357	0	249	272	0	321	343	0	349	355		0	43
13	0	471	508	0	162	183	0	296	329	1	201	205	0	32	38
14	2	741	763	0	113	146	0	25	72		0	5		3	10
15	1	695	715	0	278	309	1	262	269		0	6	0	44	46
16	3	708	722	0	160	186	0	208	229	5	334	342	0	26	27
17	5	478	498	1	49	78		0	10		0	13	0	27	28
18	0	226	251	2	109	134	2	189	206		0	7	0	32	33
19	0	249	264	1	61	79	0	28	35	2	77	82		7	13
20	2	179	195	0	31	46	0	117	119	0	173	185		4	8
21	0	92	97		7	24	0	69	69	0	54	74		0	8
22		0	4		0	9		0	0		0	6		0	16
23	0	88	90	0	33	36	0	38	38	0	130	142		0	19
24	0	76	76		16	17	0	63	63	0	62	71		0	20
25	0	24	24		10	11		17	17	0	40	47		0	24
26	0	40	40		6	7		17	17	0	24	31		0	19
27		15	15		5	6		11	11	0	20	20		0	21
28		14	14		2	3		3	3		0	0		0	10
29		0	0		0	1		0	0		0	0		0	44
30		2	2		1	1		2	2		18	18		0	16

Appendix Table 3. Fishing time (percent of time open to fishing by 5-day periods) in Bristol Bay.

	Naknek/Kvichak						Nushagak					
Year	Run in millions	21-Jun 25-Jun	26-Jun 30-Jun	1-Jul 5-Jul	6-Jul 10-Jul	11-Jul 15-Jul	Run in millions	21-Jun 25-Jun	26-Jun 30-Jun	1-Jul 5-Jul	6-Jul 10-Jul	11-Jul 15-Jul
1955	3.3	60	35	60	60	50	3.0	65	30	30	20	65
56	19.1	50	40	38	50	38	2.5	50	40	38	28	25
57	6.6	40	20	40	28	32	1.0	40	20	40	20	32
58	2.2	20	32	28	28	18	2.4	20	32	32	38	32
59	5.4	38	38	25	50	32	4.8	32	28	28	58	40
60	26.5	88	28	45	66	100	3.2	88	32	40	36	100
61	12.3	88	60	80	65	40	1.4	68	40	48	100	100
62	5.7	62	15	10	46	100	2.4	62	5	36	90	100
63	2.4	48	10	10	20	22	1.9	48	30	52	38	34
64	4.8	30	28	20	60	40	2.8	30	30	20	10	90
65	44.4	92	58	30	60	100	1.9	92	18	10	51	80
66	10.4	68	13	27	30	20	2.8	53	25	31	80	100
67	6.5	38	10	10	10	16	1.5	48	10	20	52	100
68	5.0	40	20	27	*90*	50	1.7	32	30	*35*	*80*	55
69	14.6	62	35	79	100	100	2.0	34	36	36	100	100
70	32.6	100	100	100	100	100	3.2	82	100	100	100	100
71	9.4	78	50	40	31	89	2.6	48	55	32	69	25
72	2.9	80	28	10	10	0	0.9	40	40	10	30	0
73	0.8	48	10	10	0	0	0.9	10	20	10	0	0
74	6.4	28	0	10	100	100	2.8	0	0	32	87	100
75	18.4	10	0	2	71	90	2.9	0	0	10	57	100
76	5.9	50	20	20	32	100	2.8	20	10	10	10	42
77	4.7	60	*30*	*70*	*100*	*100*	1.8	*20*	*20*	10	10	52
78	10.3	68	22	0	90	100	6.6	10	10	51	100	100
79	27.4	100	100	100	100	100	6.4	29	88	100	100	100
80	40.6	100	100	100	100	100	12.8	30	100	100	100	100
81	14.6	80	46	68	67	100	10.3	68	90	68	100	100
82	7.5	92	100	100	100	100	7.9	54	100	100	100	100
83	26.1	48	38	100	88	100	7.1	*20*	20	55	100	100
84	26.2	48	*20*	46	74	82	4.0	*20*	31	20	42	100
85	17.3	20	*25*	*68*	46	*34*	3.0	0	10	20	34	*100*
86	6.3	*8*	0	*52*	*46*	*70*	4.9	0	10	10	*37*	100
87	12.2	*20*	*8*	*8*	52	100	5.1	10	5	*40*	65	92
88	8.8	48	8	28	10	59	3.2	0	15	11	0	77
89	23.5		18	55	69	78	5.0	0	20	59	100	100

Italics = over 50% of the fishing time was in the Naknek or Igushik sections only.

Appendix Table 3. Continued

	Egegik						Ugashik					
Year	Run in millions	21-Jun 25-Jun	26-Jun 30-Jun	1-Jul 5-Jul	6-Jul 10-Jul	11-Jul 15-Jul	Run in millions	26-Jun 30-Jun	1-Jul 5-Jul	6-Jul 10-Jul	11-Jul 15-Jul	16-Jul 20-Jul
1955	0.9	65	55	60	45	50	0.3	60	60	45	50	0
56	3.2	50	40	38	42	30	0.7	50	42	48	30	48
57	1.2	45	25	60	25	38	0.6	20	40	25	38	38
58	0.7	20	32	33	38	32	0.7	32	32	38	32	10
59	1.8	38	38	25	50	40	0.6	38	25	50	30	38
60	3.2	88	32	28	40	92	3.1	32	28	81	100	100
61	3.4	68	72	72	100	20	0.8	40	60	40	29	72
62	1.6	62	29	33	36	100	0.5	8	20	18	10	55
63	1.7	48	11	20	65	68	0.6	17	14	5	20	20
64	1.9	32	38	20	60	50	1.1	38	20	48	72	100
65	4.6	92	68	40	53	78	1.9	62	78	38	32	32
66	2.9	68	20	51	46	100	1.1	32	31	20	20	52
67	1.7	48	20	10	0	16	0.4	10	12	12	0	72
68	1.0	40	20	10	0	12	0.2	30	30	230	12	48
69	1.9	76	34	10	77	90	0.3	44	48	22	10	0
70	2.3	70	100	78	59	90	0.9	100	100	100	100	100
71	1.9	71	49	40	30	20	1.5	49	50	95	48	48
72	1.4	68	20	38	55	100	0.1	38	10	20	10	72
73	0.6	48	20	8	12	0	<0.1	0	0	0	0	72
74	1.4	28	0	10	99	98	0.1	10	0	0	0	0
75	2.1	20	10	10	90	100	0.4	0	0	10	0	40
76	1.8	50	20	30	30	10	0.5	20	20	30	30	40
77	2.5	40	20	62	100	100	0.3	0	0	0	0	50
78	2.1	70	20	0	71	100	0.1	0	0	0	0	20
79	3.3	80	40	78	100	100	2.1	30	10	10	100	28
80	3.7	100	100	100	100	100	4.2	100	100	100	100	100
81	5.1	80	63	62	100	100	3.4	63	92	100	100	80
82	3.5	82	63	30	92	100	2.3	63	52	92	100	100
83	7.5	48	62	100	100	100	4.4	41	53	44	100	100
84	6.5	48	40	22	46	100	3.9	41	37	26	71	92
85	8.6	28	41	20	72	85	7.4	41	39	83	52	88
86	6.2	0	9	30	21	77	5.9	0	20	23	78	68
87	6.7	0	29	19	29	28	2.8	0	20	20	10	48
88	8.0	48	20	18	26	42	2.2	0	10	10	31	11
89	10.3	15	22	18	77	100	4.9	0	41	72	67	100