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Summary of a Previously Unexamined 1939 Alaska Peninsula Salmon Tagging Study

by

Arnold R. Shaul

August 2005

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Measures (fisheries)

fork length	FL
mideye-to-fork	MEF
mideye-to-tail-fork	METF
standard length	SL
total length	TL

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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Arnold R. Shaul
Division of Commercial Fisheries, Kodiak

Alaska Department of Fish and Game
Division of Sport Fish, Research and Technical Services
333 Raspberry Road, Anchorage, Alaska, 99518-1599

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Arnold R. Shaul,
Alaska Department of Fish and Game, Division of Commercial Fisheries,
211 Mission Road, Kodiak, AK 99615, USA

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ABSTRACT

In 1939, under the leadership of Joseph Barnaby, personnel of the U.S. Bureau of Commercial Fisheries tagged approximately 5,700 sockeye *Oncorhynchus nerka* and 300 chum *O. keta* salmon along the south side of the Alaska Peninsula and Unimak Island. In addition, small numbers of salmon were tagged off the south side of Akutan Island, along the north side of Unimak Island, and between Cape Mordvinof and Cape Lieskof on the Alaska Peninsula. Also, approximately 953 sockeye, 55 chum, 2 Chinook *O. tshawytscha*, and 2 pink *O. gorbuscha* salmon were tagged in outer Bristol Bay between Cape Seniavin and Cape Newenham. This report is the first compilation of these heretofore unpublished data.

A total of 2,080 sockeye salmon were tagged in the Shumagin Islands during June. A total of 22.2% of the out-of-tagging-area recoveries during June came from locations to the east of the Shumagin Islands and 71.0% were from locations to the west (including all Bering Sea drainages). Recoveries of tags at Swedania Point (located on the Alaska Peninsula north of the Shumagin Islands) accounted for 6.8% of tags recovered outside of the tagging locations during June. The highest number of recoveries (140 tags) was from the south side of Unimak Island.

A total of 2,495 sockeye salmon were tagged at South Unimak during June of which 2,470 were tagged in Ikatan Bay and East Anchor Cove. The percentage of out-of-tagging area recoveries to the east of South Unimak was 11.1, while the percentage of tags recovered west of Ikatan Bay and East Anchor Cove was 88.9.

A total of 85 sockeye salmon were tagged in Morzhovoi Bay during June. In the tagging areas 2 tags were recovered, 46 tags were recovered to the west of Morzhovoi Bay and 2 tags were recovered to the east.

A total of 854 sockeye salmon were tagged at Swedania Point and San Diego Bay salmon traps during June, which were located in what is currently the Southwest Stepovak Section. A total of 186 tags were recovered outside of the tagging area with 40.8% recovered to the east (75 tags from Chignik and 1 from Kodiak Island). The percentage of tags recovered to the west of the Swedania Point was 21.5. The remaining recoveries (37.6%) were in the Shumagin Islands and their ultimate destination was unknown.

A total of 953 sockeye salmon were tagged in outer Bristol Bay between Cape Seniavin and Cape Newenham in June and July. There were 57 recoveries from inner Bristol Bay, predominated by the Nushagak and Naknek/Kvichak Rivers, 6 recoveries from the north side of the Alaska Peninsula Area (Ilnik and Bear/Sandy Rivers), and 3 recoveries in the Kuskokwim.

The balance of the tagging occurred in the Shumagin Islands during July, at Kupreanof Point and Fox Cape, Sarana Bay on the south side of Akutan Island, and between Cape Mordvinof and Cape Lieskof. Only small numbers of sockeye salmon were tagged in these locations, resulting in few recoveries. Few chum salmon were tagged in any location and the number of recoveries was very low.

Keywords: salmon, Alaska Peninsula, tagging

INTRODUCTION

In 1939 personnel of the U.S. Bureau of Commercial Fisheries, under the direction of Joseph Barnaby, tagged salmon in the Shumagin Islands, on both sides of the Alaska Peninsula and Unimak Island, at Sarana Bay on the south side of Akutan Island, and in the Bering Sea between Cape Seniavin and Cape Newenham (Figure 1). Tag returns were summarized but were not fully published because World War II interfered and the data primarily remained in storage. The Cape Seniavin to Cape Newenham tagging results were partially published (Rietze et al. 1957) but some of the data were incorrectly interpreted from the summary sheet, resulting in Chignik being listed incorrectly as a recovery location. Barnaby mentions the number of fish captured and the apparent direction of travel when gillnets were used in the Bering Sea during 1939, 1940, and 1941 but did not attempt to publish the tagging results (Barnaby 1952). The data were transferred between federal offices and eventually placed in the National Archives in Anchorage, Alaska.

The intent of this report is to summarize the unpublished data collected during the 1939 study and to compare these results with those of tagging projects conducted in 1923 (Gilbert and Rich 1925), 1961 (Thorsteinson and Merrell 1964), and 1987 (Eggers et al. 1988 and 1991). The 1923 sockeye *Oncorhynchus nerka* and chum *O. keta* salmon tagging was conducted at Ikatan Bay and East Anchor Cove on the southeast end of Unimak Island, at Morzhovoi Bay, and in the Shumagin Islands (Figures 2, 3, and 4). The 1961 study was conducted at South Unimak with small numbers of salmon (predominantly sockeye and chum salmon) tagged at nearby locations to the east (only the South Unimak sockeye salmon tagging was compared to the 1939 data). In 1987, sockeye and chum salmon were tagged at both South Unimak and in the Shumagin Islands. Other tagging studies conducted in the Alaska Peninsula Management Area, summarized briefly in this report, either involved too few fish to draw any conclusions, were conducted in locations different from the 1939 study, or only involved species other than sockeye salmon. Consequently, they do not constitute a particularly useful comparison to Barnaby's work.

BACKGROUND

In the early 1900s, large numbers of sockeye salmon were harvested during June in the Shumagin Islands and along the south side of Unimak Island. Sockeye salmon harvests increased from 58,000 fish in 1911 to 1,356,000 fish in 1917 (Connolly and Dinnocenzo 2002). In an effort to understand the origin and migration routes of the salmon, tagging studies were initiated in the early 1920s by Charles Gilbert and Willis Rich (Gilbert 1923; Gilbert and Rich 1925). These studies indicated that very few sockeye salmon were destined for locations to the east of what is now the Alaska Peninsula Management Area; most were headed westward. In later years, controversies arose among harvesters and processors along the south side of the Alaska Peninsula and Unimak Island and those in Bristol Bay over alleged interception of Bristol Bay destined sockeye salmon. In the 1980s harvesters and processors in the Arctic-Yukon-Kuskokwim (A-Y-K) region became concerned with the number of chum salmon *O. keta* being harvested during June along the south side of the Alaska Peninsula. From 1960 through 2000 (excluding 1974 when the fishery was closed) South Unimak-Shumagin Islands June sockeye salmon harvests ranged from 149,000 fish in 1963 to 3,206,000 fish in 1980 and chum salmon harvests ranged from 95,000 in 1960 to 1,095,000 fish in 1982 (Connolly and Dinnocenzo 2002). This led to tagging studies in 1964 (Thorsteinson and Merrell 1964) and 1987 (Eggers et al. 1991), a chum salmon scale pattern analysis study in 1983 (Conrad *unpuplished*), and a chum salmon genetic stock identification study (GSI) during 1993-1996 (Seeb et al. 1997).

Outside of South Unimak and the Shumagin Islands, other salmon tagging studies were conducted in what is now the Alaska Peninsula Management Area. These studies included Rich (1926), Rich and Ball (1928), Rietze et al. (1957), Thorsteinson and Tait (1957), Thorsteinson (1958), Davenport and Hennick (*unpublished*), Lall and Hennick (*unpublished*), Hennick and Davenport (*unpublished*), and Thorsteinson and Merrell (1964). Some of these studies were conducted to gain salmon migration knowledge to improve management while other work was done in an attempt to settle allocation disputes.

In the early 1920s, salmon processors in Bristol Bay were concerned that substantial numbers of Bristol Bay destined sockeye salmon were being intercepted in the vicinity of Port Moller on the North Alaska Peninsula. In 1922, sockeye salmon were tagged in Port Moller Bight and off the mouth of Sandy River (Gilbert 1923). In 1925, another sockeye salmon tagging experiment was conducted near Bear and Sandy Rivers (Rich 1926). In 1961, another tagging experiment was conducted in Port Moller Bay and near the mouth of Bear River with both sockeye and chum

salmon being tagged. All 3 studies were conducted in late June and early July, and there were a total of 1,209 recoveries from all 3 years combined (not including 90 tagged sockeye salmon observed passing the Bear River counting tower). Except for 1 sockeye salmon recovery in Bristol Bay (Naknek) in 1925, all recoveries were made near Port Moller, Bear River, and Sandy River.

In 1928, a small sockeye salmon tagging experiment was conducted between July 11 and July 17 at Nicholaski (Nikolaski) Spit at Moss Cape (Rich and Ball 1928). This study showed that sockeye salmon traveled in both easterly and westerly directions in this area during mid-July.

A sockeye salmon tagging study was conducted from June 22 through July 20, 1956 along the north side of the Alaska Peninsula approximately halfway between Port Heiden and Cape Menshikof (Reitze et al. 1957). All of the recoveries from this study were collected along the east side of the Bristol Bay Area.

In 1957, pink salmon *O. gorbuscha* and a few chum salmon were tagged in the Shumagin Islands from July 8 through August 1 and from July 13 through July 28 at the Swedania Point trap site. (Thorsteinson and Tait 1957). The results indicated that most pink salmon were traveling to the east of the tagging locations. The chum salmon tagging involved too few fish to draw any conclusions.

In 1958, pink salmon were tagged in a variety of locations along the south side of the Alaska Peninsula and Unimak Island from June 23 through August 3 (Thorsteinson 1958). The results indicated that there was little intermingling of fish west of King Cove with those of the Shumagin Islands and the Southeastern District Mainland. The complete results from this study were never finalized.

Small numbers of sockeye, pink, and chum salmon were tagged along the eastern side of Stepovak Bay during June 17-25, 1961 (Lall and Hennick *unpublished*). The results showed that nearly all of the fish were traveling to the east of the tagging location.

Attempts were made to tag all five species of Pacific salmon in the Unimak and Southwestern Districts of the Alaska Peninsula Area between June 15 and July 14, 1961 (Thorsteinson and Merrell 1964). The number of Chinook *O. tshawytscha* and coho *O. kisutch* salmon tagged was negligible and there were no recoveries. Recovery results of the tagged sockeye salmon suggested that the fish were primarily of Bristol Bay origin. Chum salmon tagged in June, were mostly of Bering Sea origin while those tagged in early July were a mixture of local and migratory fish. Pink salmon recoveries were too small to draw any conclusions; however, 1 fish tagged in June was recovered in East Kamchatka, Russia and 2 recoveries from early July tagging were recovered in the Kodiak Management Area located in the western Gulf of Alaska.

In June 1963, small numbers of pink salmon and chum salmon were tagged at Ikatan Bay and East Anchor Cove and small numbers of sockeye, pink, and chum salmon were tagged in the Shumagin Islands (Hennick and Davenport *unpublished*). The results indicated that all salmon were migrating to the west, and that pink and chum salmon of Russian origin were present along the south side of the Alaska Peninsula Area during June.

A large tagging project was conducted in 1987 at South Unimak and the Shumagin Islands during June through July 2, 1987 (Eggers et al. 1991). To aid in calculating chum salmon interception rates, sockeye salmon were also tagged. Results showed that both chum and sockeye

salmon were primarily destined for Bering Sea drainages and chum salmon were recovered as far west as Japan.

In addition to tagging, other methods have been used to separate stocks of chum salmon migrating by South Unimak and the Shumagin Islands. A scale pattern analysis project in 1983 (Conrad *unpublished*) indicated approximately 70% of chum salmon harvested at South Unimak and the Shumagin Islands during June were destined for A-Y-K and Bristol Bay. Similarly, a genetic stock identification (GSI) study conducted during 1993 through 1996 (Seeb et al. 1997) indicated that 38% to 60% of the chum salmon harvested in June along the South Peninsula were destined for A-Y-K, Bristol Bay and the North Peninsula and Asia was the second highest contributor (25% to 30%).

In 1996 and 1997, GSI work was performed to determine the origins of South Peninsula chum salmon harvests in July (Crane and Seeb 2000). This study indicated that most of the chum salmon harvested along the South Peninsula during July were destined for streams in the Alaska Peninsula/Kodiak Island area and the majority of the remainder were destined for locations farther east.

STUDY AREA

The 1939 tagging study area encompassed waters along the Alaska Peninsula and eastern Aleutian Islands extending from Fox Cape at the western end of what is now the Chignik Management Area along the south (Pacific) side of the Alaska Peninsula to Akutan Island in the Aleutians (Figure 1). It also encompassed waters on the north (Bering Sea) side of Unimak Island and the Alaska Peninsula to the vicinity of Cape Lieskof and in the Bering Sea waters between Cape Seniavin and Cape Newenham. Most of the tagging was done along the south side of the Alaska Peninsula (including the Shumagin Islands) and Unimak Island. Tagging effort was concentrated at the Shumagin Islands, Swedania Point and San Diego Bay along the mainland north of the Shumagin Group, Morzhovoi Bay, and the southeast end of Unimak Island.

METHODS

Tagging was conducted along the South Peninsula (Shumagin Islands, Southwest Stepovak Bay, Morzhovoi Bay, and South Unimak) from May 30 through June 19, 1939 (Figures 2 and 3). Tagged fish were released on June 20 off Sarana Bay, during June 23-24 between Cape Mordvinof and Cape Lieskof, and from June 27 through July 23 between Cape Seniavin and Cape Newenham (Figure 2). Fish traps were used to capture salmon for tagging from San Diego Bay and the Shumagin Islands west to Cape Pankof, while mobile net gear (likely seine) was used in the balance of the tagging locations (Figure 2). Apparently, 2 tagging crews worked simultaneously during June in the Shumagin Islands and South Unimak vicinity. Sockeye salmon was the predominant species tagged. The tags were of the type used for tagging livestock and the method and area (tail) of attachment were probably the same as described by Gilbert and Rich (1925).

Tag recovery was largely from commercial fishery harvests. Unfortunately, some tenders in the Shumagin Islands vicinity picked salmon from more than one trap and it was common to have Shumagin Islands fish mixed with fish from the adjacent mainland, particularly Swedania Point (Figure 3). Therefore, it was impossible to determine where some tags were recovered. Local recaptures were not included in the recovery summary.

In this report, the tagging period and raw tag release and recovery data are summarized by section and each section is defined by the tagging location and time. The percentage of recoveries was calculated by dividing the number of tags recovered in a designated section by the total number of tags recovered (outside of the immediate tagging area). The sections used for identification of tagging locations are listed as follows: Shumagin Islands June, South Unimak June sockeye salmon, South Unimak June chum salmon, Morzhovoi Bay June, Swedania Point-San Diego Bay June, Fox Cape-Cape John July, Shumagin Islands July, Sarana Bay June, Cape Mordvinof-Cape-Lieskov June, and between Cape Seniavin and Cape Newenham. All coordinates listed in this report are from the 1927 North American Datum (NAD 27). No attempt has been made to correct for factors that bias recovery rates such as differential tagging mortality, exploitation, or reporting rates.

RESULTS

TAG RECOVERIES

Shumagin Islands June

A total of 2,080 sockeye salmon were tagged during June 1939 in the Shumagin Islands (Table 1; Figure 5). An additional 20 sockeye salmon were tagged on May 30, but there were no recoveries from this group. A total of 581 tags were recovered, of which 222 were recovered in the Shumagin Islands and another 80 were recovered from harvests containing a mix of fish harvested in the Shumagin Islands and Swedania Point-Stepovak Bay. These 302 recoveries were not included in the percent recovery calculation because the direction of travel during June and/or exact recovery location was not known. Of the remaining 279 tags recovered, 198 (71.0%) were recovered to the west and 62 (22.2%) were recovered to the east with the balance (19 tags, 6.8%) from Swedania Point, directly north of the Shumagin Islands (Table 1; Figure 5).

Chum salmon, apparently mistaken for sockeye salmon, were tagged in the Shumagin Islands during June 1939 (Table 2). There were 7 tag recoveries from the Shumagin Islands chum salmon tagging and all were from tagging on June 5 and June 7. Tags were recovered in the Shumagin Islands (1 tag on July 20), South Unimak (2 tags), the Nushagak Bay area (1 tag), and the Kuskokwim River (3 tags).

South Unimak June

A total of 2,495 sockeye salmon were tagged at South Unimak in June 1939 (Table 3). Except for 25 sockeye salmon tagged at Cape Aksit, all of the sockeye salmon tagging at South Unimak was conducted in Ikatan Bay and at East Anchor Cove (Figure 4).

Excluding the 489 tags recovered in the tagging vicinity during June, 433 tags were recovered from sockeye salmon tagged at Ikatan Bay and East Anchor Cove (Table 4; Figure 5). Of the recoveries of fish tagged at Ikatan Bay and East Anchor Cove, only 48 tags were recovered to the east of the tagging locations and 22 of these were recovered at nearby Morzhovoi Bay (Figures 4 and 5). Of the recoveries made, most (264) were along the south side of Unimak Island west of Ikatan Bay and East Anchor Cove. Most, if not all, of these sockeye salmon were probably headed west through Aleutian Passes to the Bering Sea (including Bristol Bay), based on tagging done in 1923 (Gilbert and Rich 1925), in 1961 (Thorsteinson and Merrill 1964), and in 1987 (Eggers et al. 1991). The north side of the Alaska Peninsula and Unimak Island, Bristol Bay, and

the Kuskokwim River accounted for 3.7%, 23.3%, and 0.9% respectively, of the tag recoveries of fish initially moving west of Ikatan Bay and East Anchor Cove.

At least 11 chum salmon were tagged at South Unimak (west of Cape Pankof) during June 11 through June 19, 1939 (Table 5). A few more chum salmon were tagged from Ikatan Bay and East Anchor Cove fish traps, but were apparently mistaken for sockeye salmon. It appears that sockeye salmon were the only target species for tagging at Ikatan Bay and East Anchor Cove. There was a limited amount of tagging done west of Cape Pankof, targeting both sockeye and chum salmon. During June, 2 tagged chum salmon (tagged at East Anchor Cove) were recovered in the tagging area. Additionally, 2 tagged chum salmon (one tagged at East Anchor Cove and the other near Cape Aksit) were recovered from the Kuskokwim River.

Morzhovoi Bay

On June 15, 1939, 85 sockeye salmon were tagged at the Boiler Point trap in Morzhovoi Bay and 48 were recovered outside of Morzhovoi Bay (Table 6; Figure 4). On June 21, in Morzhovoi Bay, 2 tags were recovered and excluded from the results as the destination or direction of travel is unknown. Of the 48 tags recovered outside of Morzhovoi Bay, 44 (91.7%) were recovered in the South Unimak (Ikatan Bay to Scotch Cap) June fishery, to the southwest of the tagging location. For the purpose of this report, these fish are assumed by the author to be mostly destined for the Bering Sea drainages, based on the results of tagging in 1923 (Gilbert and Rich 1925) and 1987 (Eggers et al. 1991) as well as other results from the 1939 South Unimak tagging. Only 2 tags were recovered in terminal locations, one in Bristol Bay (Kvichak River) and the other in Urilia Bay on the north side of Unimak Island, which is considered part of the North Peninsula (Figure 1). The remaining 2 tags were recovered to the east of Morzhovoi Bay, one at Nikolaski (Moss Cape) and the other along the west shore of Pavlof Bay (Table 6; Figure 2). There are 2 small sockeye salmon producing systems on the west side of Pavlof Bay but it is not known if these fish were destined there.

Swedania Point and San Diego Bay June

In 1939, from June 12 - June 16, (Table 7; Figure 3) 854 sockeye salmon were tagged at the Swedania Point and San Diego Bay salmon traps. Excluding 123 fish that were recovered in the tagging area or from tender loads of mixed Mainland and Shumagin Islands fish, 186 tags were recovered (Table 7). In 1939, this was the only tagging of sockeye salmon at Swedania Point or along the west side of Stepovak Bay. There was 1 (0.5%) tag recovered along the west side of Kodiak Island and 75 (40.3%) tags were recovered in Chignik Lagoon and vicinity for a total of 76 (40.8%) tags recovered east of the tagging area (Figure 6). In Bristol Bay, 8 (4.3%) tags were recovered, 23 (12.4%) tags were recovered at South Unimak, and 9 (4.8%) tags were recovered in the Moss Cape-Pavlof Bay-North Dolgoi Island vicinity for a total of 40 (21.5%) tags recovered west of the tagging area. A total of 70 (37.6%) tag recoveries were recovered in the Shumagin Islands and their ultimate destination is unknown.

Shumagin Islands July

A total of 58 sockeye salmon were tagged on July 20, 1939 at the Pirate Cove trap (Figure 3). There were 4 recoveries, including 2 that were recovered the next day at Pirate Cove. On July 25, on the north side of Dolgoi Island (Figure 2) 1 tag was recovered. The final recovery was at Chignik on July 28.

Kupreanof Point and Fox Cape

From July 20 through July 31, a total of 31 sockeye salmon were tagged at the Kupreanof Point (also known as Cape John; Figure 2) trap. A sockeye salmon tagged on July 20 (Figure 3) was recovered at the tagging location on July 21. Another sockeye salmon tagged on July 26 was recovered in Pavlof Bay on July 29. A final sockeye salmon tagged on July 26 was recovered at Chignik on August 3. These were the only recoveries from the Kupreanof Point tagging.

At the Fox Cape trap 10 sockeye salmon were tagged on July 20. There was only 1 recovery, at Pirate Cove in the Shumagin Islands on July 21 (Figure 3).

A single chum salmon was tagged at Kupreanof Point on July 31 and was not recovered.

Akutan Island

A total of 42 sockeye and 41 chum salmon were tagged at Sarana Bay, Akutan Island on June 20, 1939 (Figure 1). In Bristol Bay (Nushagak) 2 of these sockeye salmon were recovered, both on July 21. Only 1 chum salmon tag was recovered, on July 15 in either the Shumagin Islands or San Diego Bay.

Cape Mordvinof to Cape Lieskof

During June 23 and 24, 1939 a total of 19 salmon were tagged along the north side of Unimak Island and Alaska Peninsula between Cape Mordvinof and Cape Lieskof (Figure 2). The salmon were all listed as sockeye salmon but there were identification problems as the only recovery was a chum salmon recovered in St. Catherine Cove on the northeast end of Unimak Island.

On June 23 there were 4 salmon were tagged southwest of Cape Mordvinof at 54° 51.50'N lat., 164° 35.00' W long. but there were no recoveries. A single salmon was tagged on June 23 at 55° 10.00' N lat., 163° 44.00' W long. and was not recovered. On June 24, 10 salmon were tagged off of Cape Leontovich (Figure 2) at 55° 42.00' N lat., 162° 26.00' W long. A single chum salmon was recovered on July 12 in St. Catherine Cove on the northwest end of Unimak Island. On June 24 there were 4 salmon tagged about 5 miles off Cape Lieskof at 55° 55.00' N lat., 161° 54.00' W long.; there were no recoveries.

Cape Seniavin to Cape Newenham

Salmon were tagged from June 27 through July 20, 1939 at locations (stations) in outer Bristol Bay offshore between Cape Seniavin and Cape Newenham (Figure 7). Tagging stations are listed in Table 8. Approximately 953 sockeye, 55 chum, 2 Chinook, and 2 pink salmon were tagged (Tables 9 and 10). However there apparently were some species identification problems because tagged chum salmon were recovered while Barnaby listed all salmon tagged in those specific tagging locations as sockeye salmon. There were no recoveries of Chinook or pink salmon. There was a total of 68 sockeye and 15 chum salmon tag recoveries (Tables 9 and 10). Sockeye salmon tags were recovered from the north side of the Alaska Peninsula, Bristol Bay, and from Kuskokwim Bay (including the Kuskokwim River). Chum salmon tags were recovered only from Bristol Bay and Kuskokwim Bay. North Peninsula sockeye salmon were found at least 40 nmi northwest of Cape Seniavin and Kuskokwim chum salmon were found as far south as 30 nmi northwest of Cape Seniavin (Figure 7).

No recoveries were made of either the sockeye (16) or chum salmon (13) tagged north of Station 8, which is approximately 79 nmi northwest of Cape Seniavin and 69 nmi southeast of Cape Newenham (Table 8; Figure 7).

MIGRATION TIMING

Swedania Point and San Diego Bay to Chignik

In 1939, 74 sockeye salmon tagged during June at the Swedania Point and San Diego Bay traps (Figure 3) were recovered in or just outside of Chignik Lagoon (Table 11). The median time between tagging and recovery in the commercial fishery was 11 days with a range of 4 to 22 days.

Shumagin Islands to Chignik

In 1939, 50 sockeye salmon tagged during June in the Shumagin Islands were recovered in or near Chignik Lagoon (Table 12; Figure 1). The median time between tagging and recovery was 14 days and ranged from 6 to 26 days.

Shumagin Islands to South Unimak

A total of 132 sockeye salmon with known recovery dates were tagged during June in the Shumagin Islands and recovered in the South Unimak fishery (Table 13). The median time between tagging and recovery from the Shumagin Islands to the South Unimak fishery was 6 days with a range from 2 to 21 days.

There were 72 Shumagin Islands tag recoveries from Ikatan Bay to Cape Pankof and 60 recoveries west of Cape Pankof from tagging during June (Table 13; Figure 2). The median time between tagging and recovery at Ikatan Bay and Cape Pankof was 7 days with a range of 3 to 21 days. The median time between tagging in the Shumagin Islands and recovery west of Cape Pankof was 5 days with a range of 2 to 13 days.

DISCUSSION

TAG RECOVERIES

Shumagin Islands June

Sockeye salmon tagging in the Shumagin Islands during June 1939 indicated that most fish were migrating to the west, which agrees with results from tagging done in 1923 and 1987 (Table 14). Recovery locations of tagged sockeye salmon ranged from Kodiak Island to the Kuskokwim River and most (not including June recoveries in the tagging area) were recovered along the south side of Unimak Island and the Alaska Peninsula west of the Shumagin Islands. The impact of tagging stress is hard to estimate (Burnham et al. 1987), but the most rapid recorded travel time in the 1939 study, between the Shumagin Islands and South Unimak, was 3 days (the shortest marine distance from Sand Point to Cape Pankof is about 97 nmi). Interestingly, travel time appears longer to Ikatan Bay and East Anchor Cove than to the area further westward between Cape Pankof and Scotch Cap. The shortest documented travel time for sockeye salmon tagged in the Shumagin Islands and recovered in the Chignik fishery in 1939 was 6 days with a median of 14 days (the shortest marine distance from Sand Point to the center of Chignik Lagoon is about 130 nmi).

It is possible that the recovery effort was high along the south side of the Alaska Peninsula area and in the Chignik area, but low in other locations (e.g., north side of the Alaska Peninsula and Bristol Bay). The recoveries at Chignik exceeded those of Bristol Bay and the North Peninsula combined. However, the study indicated that the majority of the sockeye salmon tagged in the Shumagin Islands (71.0%) were moving west (Table 1). The area between McGinty Point and

Scotch Cap (including South Unimak) produced 154 (55.2%) of the recoveries, with 41 (14.7%) coming from Bristol Bay and 2 (0.7%) from the North Peninsula (Table 14). These results were similar to those from a 1923 study (Gilbert and Rich 1925), in which 456 (62.6%) of 728 recoveries were from McGinty Point to Scotch Cap, 236 (32.4%) from Bristol Bay, and 23 (3.2%) from the North Peninsula. The 1987 tagging in the Shumagin Islands (Eggers et al. 1991) resulted in 121 (33.7%) recoveries from McGinty Point to Scotch Cap, 132 (36.8%) from Bristol Bay, and 25 (7.0%) from the North Peninsula. In all studies, the movements of sockeye salmon are predominantly westward, after the fish pass through the Shumagin Islands. The 1987 study made a strong effort to recover tags from all areas, including Bristol Bay.

An unusual aspect of the 1939 tagging in the Shumagin Islands was the high number of recoveries in the vicinity of the tagging locations. A total of 222 (9.7%) of the 2,080 tagged sockeye salmon were recovered in the immediate tagging area and another 80 (Table 1) were a mixture of Shumagin Islands and Swedania Point-Stepovak Bay recoveries. In 1923, only 38 (1.4%) recoveries were made in Shumagin Islands and in 1987, 26 (1.7%) tags were recovered in the Shumagin Islands (Gilbert and Rich 1925; Eggers et al. 1988). Intensive fishing with traps may have been the reason for the number of tagging area recoveries in 1939; however, traps were also in use during 1923.

South Unimak

Most of the recoveries from sockeye salmon tagged at South Unimak during June 1939 were from systems draining into the Bering Sea. Tagging in 1923 and 1987 also indicated that most sockeye salmon were destined for systems draining into the Bering Sea (Table 15). All 3 studies resulted in only a small percentage of tags recovered from east of Morzhovoi Bay. One difference between the studies is that a considerable number of tags were recovered from Morzhovoi Bay in 1923 and 1939. In 1987, Morzhovoi Bay was closed to commercial fishing before July 7.

The 1923 tagging study (Gilbert and Rich 1925) indicated that sockeye salmon tagged at South Unimak were bound for Morzhovoi Bay (44.3%), Bristol Bay (41.8%) and the North Peninsula (12.7%; Table 15). The 1961 tagging study (Thorsteinson and Merrill 1964) resulted in 94.2% of the recoveries outside the tagging area being recovered in Bristol Bay, and the balance were recovered along the North Peninsula (3.8%) and Kodiak Island (1.9%). The much larger study in 1987 (Eggers et al. 1991) resulted in 86.3% and 8.6% of the recoveries coming from Bristol Bay and the North Peninsula respectively. All 4 studies resulted in low percentages of tag recoveries east of Morzhovoi Bay. The Gilbert and Rich (1925) study had 44.3% of the recoveries coming from Morzhovoi Bay while 13.0% of the 1939 South Unimak sockeye salmon tags were recovered in Morzhovoi Bay. No tags from the Thorsteinson and Merrill (1964) study were recovered in Morzhovoi Bay. In the Eggers et al. (1991) study, conducted in 1987, 0.4% of the out-of-tagging-area tags were recovered in Morzhovoi Bay. Morzhovoi Bay was open to commercial salmon fishing (without traps) in 1961 but was closed during June and early July 1987.

Morzhovoi Bay

Results from tagging sockeye salmon in Morzhovoi Bay during June 1939 indicated that the majority of the fish were migrating to the west. Tagging during June 1923 also resulted in the majority of the tagged sockeye salmon being recovered to the west, mostly from the systems draining into the Bering Sea.

In 1923, Gilbert and Rich tagged 1,392 sockeye salmon in Morzhovoi Bay during June (800 on June 20 and 592 on June 30). Recoveries in Morzhovoi Bay totaled 33 (Table 16). Recoveries in Ikatan Bay and East Anchor Cove totaled 279 (69.2%). Bristol Bay and North Alaska Peninsula recoveries totaled 106 (26.3%) and 14 (3.5%) respectively. Only 4 tags (2 each at Thin Point Cove and Cold Bay) were recovered to the east of Morzhovoi Bay. This suggests that most of the sockeye salmon entering Morzhovoi Bay during June are traveling west, probably to Bristol Bay and the North Alaska Peninsula.

Barnaby's tagging in Morzhovoi Bay (Table 6) substantiated the 1923 study (Gilbert and Rich 1925; Table 16) in that the predominant sockeye salmon migratory direction in June was to the west. Tagging done in July 1923 (Gilbert and Rich 1925) indicated that the percentage of eastward migrating sockeye salmon increased throughout July (Table 17).

Swedania Point and San Diego Bay

Sockeye salmon tagging at Swedania Point and San Diego Bay on the southwest side of Stepovak Bay in June 1939 resulted in 40.8% of the tags being recovered to the east of the tagging area (Table 7). A substantial amount (37.6%) of the sockeye salmon recoveries from tagging at Swedania Point and San Diego Bays were recovered in the Shumagin Islands and their location of origin is unknown. Some (21.5%) of the recoveries were west of Swedania Point and the origin of some of these fish is also unknown. The shortest time period required for tagged sockeye salmon to reach the Chignik fishery from Swedania Point and San Diego Bays in 1939 was 4 days with median travel time of 11 days (Table 11).

The 1939 results differ considerably from a small, unpublished tagging study done by the Alaska Department of Fish and Game in 1961 along the east side of Stepovak Bay (Lall and Hennick *unpublished*). In 1961, a total of 130 sockeye salmon were tagged along the east side of Stepovak Bay during June 17-25. A total of 17 tagged fish were recovered outside of the tagging area. Only 1 (5.9%) tag was recovered to the west (at San Diego Bay). The recoveries to the east of the tagging area included 14 (82.4%) recovered in or close to Chignik Lagoon (this includes 6 observed but not recovered tags passing through the Chignik River weir) and 1 each in Kodiak Island (5.9%) and Cook Inlet (5.9%) waters. It is not certain that all of the tags observed passing through Chignik weir were tagged on the east side of Stepovak Bay. These 2 sockeye salmon tagging studies (1939 and 1961) are the only studies known to have been conducted in the Alaska Peninsula Area's Southeastern District Mainland.

North Peninsula

Tagging on the north side of the Alaska Peninsula indicated that at least a few chum salmon entering St. Catherine Cove (northwest corner of Bechevin Bay) do so from Bering Sea waters well to the east of St. Catherine Cove. The late Lawrence Yatchmeneff, a longtime fishermen in the area, told the author that he believed most of St. Catherine Cove chum salmon arrived from the south from Ikatan Bay (Figure 2). Salmon probably enter St. Catherine Cove from both directions.

Cape Seniavin to Cape Newenham

Tagging between Cape Seniavin and Cape Newenham from late June to mid-July 1939 indicated that North Alaska Peninsula (Bear River to Ilnik) sockeye salmon were found from 11 nmi to 40 nmi offshore to the north of Cape Seniavin (Figure 7). Bristol Bay (Ugashik Bay to Nushagak Bay) sockeye salmon were present from 11 to 79 nmi north of Cape Seniavin. Kuskokwim

sockeye salmon were present from 50 nmi to 79 nmi north of Cape Seniavin. Bristol Bay chum salmon were present from 11 nmi to 79 nmi north of Cape Seniavin. Kuskokwim Bay chum salmon were present from 30 nmi to 70 nmi north of Cape Seniavin.

MIGRATION TIMING

Handling and tagging stress must be considered when analyzing tagging data to estimate migration rates (Burnham et al. 1987). It is also possible that a tagged salmon recovered in a fish trap may have been in the trap for an undetermined length of time before being removed. Therefore, the shortest time between tagging and recapture involving 2 locations may be expected to be more valid than the median or longest time between tagging and recovery. However, looking at the frequency of recovery times may give a realistic travel time for most salmon in some cases and may be used to compare travel time between more than one destination.

Swedania Point and San Diego Bay to Chignik

In 1939, 74 sockeye salmon tagged at the Swedania Point and San Diego Bay traps (Figure 3) were recovered at Chignik. The median time between tagging and recovery in the Chignik commercial fishery was 11 days with a range of 4 to 22 days (Table 11). The results from unpublished tagging data (Lall and Hennick *unpublished*) from the east side of Stepovak Bay in 1961 indicated that travel time from that tagging location to the Chignik commercial fishery ranged from 5 to 12 days with a median of 5 days. However only 7 tags were recovered from the 1961 East Stepovak tagging in the Chignik commercial fishery; all other reports of tagged sockeye salmon sighted or recovered in Chignik were observations of tagged fish passing through the weir or recovered on the spawning grounds.

Shumagin Islands to Chignik

In 1939, 50 sockeye salmon tagged in the Shumagin Islands were recovered at Chignik (Table 1). The median time between tagging and recovery was 14 days and ranged from 6 to 26 days (Table 12). The frequency of recoveries by the number of travel days from 1939 tagging is shown in Table 12. The median time between tagging and recovery from the 1987 tagging was 15 days and ranged from 5 to 47 days (Eggers et al. 1988).

Shumagin Islands to South Unimak

A total of 132 sockeye salmon with known recovery dates were tagged in the Shumagin Islands and recovered at South Unimak (Table 13). The median time between tagging and recovery from the Shumagin Islands to the South Unimak fishery was 6 days with a range from 2 to 21 days. The median number of travel days between the Shumagin Islands and South Unimak in 1923 was 6 days (Gilbert and Rich 1925) and 5 days in 1987 (Eggers et al. 1988) which is similar to the 1939 median (Table 18).

Table 19 lists the number of travel days from the Shumagin Islands to Ikatan Bay-East Anchor and to South Unimak west of Cape Pankof for the 1923, 1939, and 1987 studies. The 1939 study indicated less travel time to locations west of Cape Pankof than to Ikatan Bay and East Anchor Cove. The 1987 tagging study indicated that the travel time from the Shumagin Islands to Ikatan Bay and East Anchor Cove was the same as to the South Unimak fishery west of Cape Pankof. In 1923 there were no South Unimak recoveries west of Cape Pankof.

CONCLUSIONS

In summary, the 1939 tagging study suggests:

1. The South Unimak and Shumagin Islands June fisheries were more effective at harvesting salmon in 1939 than in recent years as evidenced by the high number of recaptures in the tagging locations in 1939 compared to 1987.
2. Most sockeye salmon passing through the Shumagin Islands, Morzhovoi Bay, and along the south side of Unimak Island during June are headed west.
3. The median travel time between Swedania Point-San Diego Bay and the Chignik Lagoon vicinity is about 11 days.
4. The median travel time from the Shumagin Islands to the Chignik Lagoon vicinity is about 14 days.
5. The median travel time from the Shumagin Islands to South Unimak is about 6 days and the travel time to Ikatan-East Anchor Cove is longer than to the more distant area west of Cape Pankof.
6. North Peninsula sockeye salmon can be found at least 40 nmi northwest of Cape Seniavin.
7. Kuskokwim chum salmon may pass as close as 30 nmi of Cape Seniavin.
8. Some chum salmon enter Bechevin Bay from the Bering Sea.
9. When comparing the tagging results between the 1939 and 1961 tagging studies, it is apparent that the composition of sockeye salmon stocks moving through Stepovak Bay may vary among locations or among years.

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TABLES AND FIGURES

Table 1.-Shumagin Islands June 1939 sockeye salmon tagging and recovery.

Tagging Date	5-Jun	7-Jun	8-Jun	12-Jun	13-Jun	15-Jun	16-Jun	17-Jun	Total	Percentage of Recoveries[a]
Sockeye Salmon Tagged	106	399	247	271	264	131	560	102	2,080	
Tags Recovered East of Tagging Location										
Kodiak Island	0	0	1	3	3	0	2	0	9	3.2
Chignik	2	7	6	8	11	4	10	2	50	17.9
Stepovak Bay	0	0	0	0	1	0	0	0	1	0.4
San Diego Bay	0	0	0	0	0	0	2	0	2	0.7
Tags Reported from the East	2	7	7	11	15	4	14	2	62	22.2
Tags Reported from Swedania Point	0	5	3	4	3	0	4	0	19	6.8
Tags Recovered West of Tagging Location										
Pavlof Bay/Dolgoi Island	1	0	2	3	1	2	1	0	10	3.6
Nikolaski (Moss Cape)	0	0	1	0	1	0	0	0	2	0.7
Vodapoini Point	0	0	0	0	1	0	0	0	1	0.4
Morzhovoi Bay	0	0	0	1	0	0	0	0	1	0.4
South Unimak										
Ikatan Bay-East Anchor Cove	2	24	7	15	13	2	10	4	77	27.6
West of Cape Pankof	0	8	2	9	8	4	24	8	63	22.6
Total South Unimak	2	32	9	24	21	6	34	12	140	50.2
North Alaska Peninsula	0	0	0	0	0	1	1	0	2	0.7
Bristol Bay										
Egegik	0	0	0	0	1	0	0	0	1	0.4
Naknek-Kvichak	0	2	0	3	0	0	3	2	10	3.6
Nushagak	0	1	0	1	5	2	17	3	29	10.4
Ugashik	0	0	0	0	0	0	1	0	1	0.4
Total Bristol Bay	0	3	0	4	6	2	21	5	41	14.7
Kuskokwim Bay	1	0	0	0	0	0	0	0	1	0.4
Total Recovered to West	4	35	12	32	30	11	57	17	198	71.0
Total Recoveries[b]	6	47	22	47	48	15	75	19	279	
Recoveries Not Included Above										
Shumagin Islands (not included above)[c]	3	14	15	32	14	10	111	3	222	
Mixed Shumagin-Mainland Tender Loads (not included above)	0	8	9	9	10	2	41	1	80	

[a] Percent may not add up to 100% because of rounding.

[b] Shumagin Islands recoveries and tags from mixed tender loads of Shumagin Islands and Mainland fish were not included.

[c] There were 20 recoveries between July 2 and 14, all other recoveries were made in June.

Table 2.-Shumagin Islands chum salmon tagging and recoveries, June 1939.

		Recoveries				
Tagging Date	Salmon Tagged	Shumagin Islands July	South Unimak	Nushagak River	Kuskokwim River	Total
5-Jun	146	0	2	1	3	6
7-Jun	32	1	0	0	0	1
Totals	178	1	2	1	3	7

Table 3.-Number of sockeye salmon tagged at South Unimak and recoveries by location, June 1939.

	(Ikatan-E. Anchor C.)			(C. Aksit)	(Ikatan -E. Anchor C.)			
	7-Jun	10-Jun	11-Jun	11-Jun	13-Jun	14-Jun	17-Jun	Total
Fish Tagged	299	400	200	25	204	203	1,164	2,495
Recovery Location								
South Unimak	61	134	74	0	82	101	301	753
Morzhovoi Bay	1	12	3	0	2	4	0	22
Nikolaski	0	3	0	0	1	2	4	10
Pavlof Bay/N. Dolgoi	1	4	0	0	1	0	2	8
Swedania Point	0	0	1	0	0	0	0	1
Kelly Rock or Swedania Pt.	0	0	0	0	1	1	0	2
Shumagin Islands	0	0	1	0	0	0	2	3
Chignik	0	0	0	0	1	0	1	2
Total Gulf of Alaska	63	153	79	0	88	108	310	801
North Peninsula								
Urilia Bay	0	0	1	0	0	0	1	2
Nelson Lagoon	1	0	0	1	1	2	5	10
Bear & Sandy Rivers	0	2	0	0	0	1	0	3
Port Heiden	0	0	0	0	0	1	0	1
Total North Peninsula	1	2	1	1	1	4	6	16
Bristol Bay								
Ugashik	0	2	1	0	0	0	2	5
Egegik	1	0	0	0	0	0	2	3
Naknek-Kvichak	5	6	4	0	1	0	19	35
Nushagak	4	5	6	0	4	2	37	58
Total Bristol Bay	10	13	11	0	5	2	60	101
Kuskokwim River	0	0	0	0	1	0	3	4
Total	74	168	91	1	95	114	379	922

Table 4.-Ikatan Bay and East Anchor Cove June 1939 sockeye salmon tagging with recoveries listed as being to the east and west of the tagging locations with all Bering Sea drainages as west.

Tagging Date	7-Jun	10-Jun	11-Jun	13-Jun	14-Jun	17-Jun	Total	Percentage of
Sockeye Salmon Tagged[a]	299	400	200	204	203	1,164	2,470	Recoveries[b]
Tags Recovered East of Ikatan Bay and East Anchor Cove Tagging Locations								
Morzhovoi Bay	1	12	3	2	4	0	22	5.1
Nikolaski (Moss Cape)	0	3	0	1	2	4	10	2.3
Pavlof Bay/North Dolgoi	1	4	0	1	0	2	8	1.8
Shumagin Islands	0	0	1	0	0	2	3	0.7
Swedania Point	0	0	1	0	0	0	1	0.2
Shumagin/Swedania Pt.-Stepovak B. Mix	0	0	0	1	1	0	2	0.5
Chignik	0	0	0	1	0	1	2	0.5
Total Recovered to East	2	19	5	6	7	9	48	11.1
Tags Recovered West of Ikatan Bay and East Anchor Cove Tagging Locations								
West Anchor to Scotch Cap	4	20	11	12	13	204	264	61.0
North Alaska Peninsula	1	2	2	1	4	6	16	3.7
Bristol Bay	10	13	11	5	2	60	101	23.3
Kuskokwim River	0	0	0	1	0	3	4	0.9
Total Recovered to West	15	35	24	19	19	273	385	88.9
Total Recoveries Outside Tagging Area	17	54	29	25	26	282	433	
Ikatan Bay to Cape Pankof Recoveries[c] (Not included above)	57	114	63	70	88	97	489	

[a] The total includes only sockeye salmon tagged at Ikatan Bay and East Anchor Cove. An additional 64 were tagged near Cape Aksit and Arch Point on Unimak Island of which only two recoveries were outside the tagging area. One recovery was from Nelson Lagoon and the other was from the Kvichak system in Bristol Bay.

[b] The recovery percent may not total exactly 100% due to rounding.

[c] Includes nine recoveries in July and one in August, remainder were in June.

Table 5.-South Unimak chum salmon tagging, June 1939.

Tagging Location	Tagging Date	Salmon Tagged	Recoveries			
			Tagging Vicinity	Kvichak Bay	Kuskokwim River	Yukon River
East Anchor Cove	7-Jun	[a]	0	0	1, June 26	0
Cape Aksit	11-Jun	11	0	0	1, July 7	0
East Anchor Cove	17-Jun	[a]	1, June 17/1, July 21	0	0	0
Totals		11	2	0	2	0

[a] Apparently mistaken as sockeye salmon when tagged.

Table 6.-Morzhovoi Bay (Boiler Point trap) sockeye salmon tagging, June 15, 1939.

Recovery Location	Recoveries	
	Number	Percentage
East of Tagging Location		
Nikolaski (Moss Cape)	1	2.1
Pavlof Bay	1	2.1
Total Recovered to East	2	4.2
West of Tagging Location		
Ikatan Bay and East Anchor Cove	38	79.2
West Anchor Cove to Scotch Cap	6	12.5
North Alaska Peninsula (Urilia Bay)	1	2.1
Bristol Bay (Kvichak River)	1	2.1
Total Recovered to West	46	95.8
Total Recoveries[a, b]	48	100.1[c]

[a] Eighty-five sockeye salmon were tagged.

[b] Two recoveries, both on June 21 in Morzhovoi Bay, were not included above.

[c] The recovery percentage may not total exactly 100% due to rounding.

Table 7.-Swedania Point and San Diego Bay sockeye salmon tagging, June 1939.

Sockeye Salmon Tagged	285 June 12 at Swedania Pt.	281 June 16 at Swedania Pt.	288 June 16 at San Diego B.	854 Total Tagged	Percent[a] of Recoveries
Tags Recovered East of Tagging Location					
Kodiak	0	0	1	1	0.5
Chignik	21	33	21	75	40.3
Total Recovered to East	21	33	22	76	40.8
Tags Recovered in Shumagin Islands	25	14	31	70	37.6
Tags Recovered West of Tagging Location and Shumagin Islands					
Pavlof Bay-North Dolgoi Island	2	2	2	6	3.2
Moss Cape	2	0	1	3	1.6
South Unimak	8	7	8	23	12.4
Bristol Bay	1	4	3	8	4.3
Total Recovered to West	13	13	14	40	21.5
Total Recoveries	59	60	67	186	99.9
Recoveries Not Included Above					
Swedania-San Diego Bay	7	12	21	40	
Mixed Mainland-Shumagin Islands Tender Loads	31	27	25	83	

[a] Percentages may not add to 100% due to rounding.

Table 8.-Cape Seniavin to Cape Newenham salmon tagging stations and numbers of salmon tagged, 1939.

Station Number	Location
1	56° 34.00' N. lat., 160° 15.00' W. long., approx. 11 nautical miles NW of Cape Seniavin. June 27, 80 salmon, mostly sockeye salmon but included at least one chum salmon. July 16, 23 sockeye salmon. July 17, 25 sockeye salmon.
3	56° 52.00' N. lat., 160° 31.00' W. long., approx. 30 nautical miles NW of Cape Seniavin. June 28, 163 sockeye and 1 chum salmon. July 3, 23 sockeye salmon. July 23, 8 sockeye salmon.
4	57° 01.00' N. lat., 160° 38.00' W. long., approx. 40 nautical miles NW of Cape Seniavin. July 14, 89 sockeye, 7 chum, and 2 Chinook salmon.
5	57° 10.00' N. lat., 160° 47.00' W. long., approx. 50 nautical miles NW of Cape Seniavin. June 30, 135 sockeye and chum salmon. July 20, 134 sockeye, 18 chum, and 2 pink salmon.
6	57° 34.00' N. lat., 160° 38.00' W. long., approx. 70 nautical miles of Cape Seniavin and approx. 90 nautical miles SE of Cape Newenham. July 13, 178 sockeye and 17 chum salmon.
7	57° 28.00' N. lat., 161° 03' W. long. approx. 70 nautical miles of Cape Seniavin and approx. 80 nautical miles SE of Cape Newenham. July 21, one chum salmon.
7 1/2	57° 32.00' N. lat., 161° 07' W. long., approx. 70 nautical miles NW of Cape Seniavin and approx. 78 miles SE of Cape Newenham. July 2, 67 salmon, mostly sockeye but included at least one chum salmon.
8	57° 37.00' N. lat., 161° 11.00' W. long., approx. 79 nautical miles NW of Cape Seniavin and approx. 69 nautical miles SE of Cape Newenham. July 12, 9 sockeye and 23 chum salmon.
9	56° 46.00' N. lat., 161° 19.00' W. long., approx. 44 nautical miles NW of Cape Seniavin. July 23, 8 sockeye and 8 chum salmon.
10	57° 55.00' N. lat., 161° 27.00' W. long., approx. 101 nautical miles NW of Cape Seniavin and approx. 49 nautical miles SE of Cape Newenham. July 3, one sockeye salmon. July 11, two sockeye salmon.
12	58° 13.00' N. lat., 161° 43.00' W. long., approx. 124 nautical miles NW of Cape Seniavin and approx. 25 nautical miles SE of Cape Newenham. July 10, five sockeye and two chum salmon.
13 1/2	58° 26.00' N. lat., 161° 55.00' W. long., approx. 15 nautical miles SE of Cape Newenham. July 7, three chum salmon.

Table 9.-Cape Seniavin to Cape Newenham sockeye salmon tagging results, 1939.

			Recovery Locations								
Station	Tagging Date	Salmon Tagged	Bear and Sandy Rivers	Ilnik	Ugashik	Egegik	Naknek/ Kvichak	Nushagak	Bristol Bay Unspecified	Kuskokwim	Total
1	27-Jun	80 [a]	1	0	1	0	1	2	0	0	5
	16-Jul	23	2	2	0	0	1	1	0	0	6
	17-Jul	25	0	0	1	0	0	1	0	0	2
	Total	128	3	2	2	0	2	4	0	0	13
3	28-Jun	163	0	0	0	1	4	9	0	0	14
	3-Jul	23	0	0	0	0	0	0	0	0	0
	23-Jul	8	0	0	0	0	0	0	0	0	0
	Total	194	0	0	0	1	4	9	0	0	14
4	14-Jul	89	1	0	0	0	1	1	0	0	3
5	30-Jun	135	0	0	0	1	1	1	0	0	3
	20-Jul	134	0	0	0	0	1	2	0	1 [b]	4
	Total	269	0	0	0	1	2	3	0	1	7
6	13-Jul	178	0	0	0	6	11	10	1	0	28
7 1/2	2-Jul	67	0	0	0	0	0	0	0	1 [b]	1
8	12-Jul	9	0	0	0	0	1	0	0	1 [c]	2
9	23-Jul	8	0	0	0	0	0	0	0	0	0
10	3-Jul	1	0	0	0	0	0	0	0	0	0
	11-Jul	2	0	0	0	0	0	0	0	0	0
	Total	3	0	0	0	0	0	0	0	0	0
12	10-Jul	5	0	0	0	0	0	0	0	0	0
13 1/2	7-Jul	3	0	0	0	0	0	0	0	0	0
Grand Total		953	4	2	2	8	21	26	1	3	68

[a] There were apparently identification problems as one of the recoveries was a chum salmon.

[b] Kanektok River.

[c] Kuskokwim Bay.

Table 9.-Cape Seniavin to Cape Newenham chum salmon tagging results, 1939.

Tagging Station	Tagging Date	Salmon Tagged	Recovery Locations				Total
			Nushagak	Naknek/ Kvichak	Kaneotok	Kuskokwim	
1	27-Jun	[a]	1	0	0	0	1
3	28-Jun	1	0	0	0	1	1
5	30-Jun	[a]	7	1	0	0	8
	20-Jul	18	0	0	1	0	1
	Total	18+	7	1	1	0	9
7 1/2	2-Jul	[a]	0	0	0	1	1
8	12-Jul	23	3	0	0	0	3
9	23-Jul	8	0	0	0	0	0
12	10-Jul	2	0	0	0	0	0
13 1/2	7-Jul	3	0	0	0	0	0
Totals		55+	11	1	1	2	15

[a] All tagged salmon were listed as sockeye salmon but there apparently were identification problems because tags were recovered from chum salmon.

Table 10.-Sockeye salmon tagged at Swedania Point and San Diego Bay and recovered in Chignik Lagoon and vicinity, by number of travel days, June 1939.

Travel Days[a]	Recoveries	Percentage	Cumulative Percentage
4	1	1.4	1.4
5	1	1.4	2.8
6	2	2.7	5.5
7	5	6.8	12.3
8	12	16.2	28.5
9	3	4.1	32.6
10	4	5.4	38.0
11	17	23.0	61.0
12	10	13.5	74.5
13	1	1.4	75.9
14	6	8.1	84.0
15	1	1.4	85.4
16	4	5.4	90.8
17	2	2.7	93.5
18	0	0.0	93.5
19	4	5.4	98.9
20	0	0.0	98.9
21	0	0.0	98.9
22	1	1.4	100.3
Total Chignik Recoveries	74 [b]	100.3 [c]	

[a] The median travel time was 11 days and travel time ranged from 4 to 22 days.

[b] Only tags listing the recovery day were used in calculating travel times.

[c] The recovery percentages may not add to 100% due to rounding.

Table 11.-Sockeye salmon tagged in the Shumagin Islands and recovered in Chignik Lagoon and vicinity, by number of travel days, June 1939.

Travel Days [a,b]	Recoveries	Percentage	Cumulative Percentage
6	1	2.0	2.0
7	2	4.0	6.0
8	3	6.0	12.0
9	3	6.0	18.0
10	3	6.0	24.0
11	3	6.0	30.0
12	6	12.0	42.0
13	2	4.0	46.0
14	4	8.0	54.0
15	5	10.0	64.0
16	4	8.0	72.0
17	3	6.0	78.0
18	2	4.0	82.0
19	3	6.0	88.0
20	2	4.0	92.0
21	1	2.0	94.0
22	1	2.0	96.0
23	0	0.0	96.0
24	0	0.0	96.0
25	1	2.0	98.0
26	1	2.0	100.0
Total	50	100.0	

[a] The median travel time was 14 days and travel time ranged from 6 to 26 days.

[b] Only tags listing the recovery day were used in calculating travel times.

Table 12.-Sockeye salmon tagged in the Shumagin Islands and recovered at South Unimak, by number of travel days, 1939.

	Recovery Location					
Travel	Ikatan Bay to Cape Pankof		West of Cape Pankof		Total South Unimak	
Days	Recoveries	Percentage[a]	Recoveries	Percentage[a]	Recoveries	Percentage[a]
2	0	0.0	2	3.3	2	1.5
3	1	1.4	1	1.7	2	1.5
4	13	18.1	12	20.0	25	18.9
5	11	15.3	15	25.5	26	19.7
6	7	9.7	16	26.7	23	17.4
7	11	15.3	6	10.0	17	12.9
8	8	11.3	3	5.0	11	8.3
9	4	5.6	2	3.3	6	4.5
10	3	4.2	1	1.7	4	3.0
11	2	2.8	0	0.0	2	1.5
12	2	2.8	0	0.0	2	1.5
13	2	2.8	2	3.3	4	3.0
14	1	1.4	0	0.0	1	0.8
15	2	2.8	0	0.0	2	1.5
16	0	0.0	0	0.0	0	0.0
17	1	1.4	0	0.0	1	0.8
18	0	0.0	0	0.0	0	0.0
19	2	2.8	0	0.0	2	1.5
20	1	1.4	0	0.0	1	0.8
21	1	1.4	0	0.0	1	0.8
Total Recoveries[b]	72	100.5	60	100.5	132	99.9
Median Travel Time	7 Days		5 Days		6 Days	
Range	3 to 21 days		2 to 13 days		2 to 21 days	

[a] The recovery percentages may not add to 100% due to rounding

[b] Only tags listing the recovery day were used in calculating travel times

Table 13.-Shumagin Islands June sockeye salmon tagging studies, 1939 vs 1923 and 1987.

	1923		1939		1987	
	2,689 Tagged		2,080 Tagged		1,545 Tagged [a]	
Recovery Location	Number of Recoveries	Percentage of Recoveries [b]	Number of Recoveries	Percentage of Recoveries [b]	Number of Recoveries	Percentage of Recoveries [b]
Cook Inlet	2	0.3	0	0.0	2	0.6
Kodiak Island	2	0.3	9	3.2	17	4.7
Chignik	6	0.8	50	17.9	46	12.8
Balboa-Stepovak	1	0.1	22	7.9	16	4.5
McGinty Pt. To Scotch Cap	456	62.6	154	55.2	121	33.7
North Alaska Peninsula	23	3.2	2	0.7	25	7.0
Bristol Bay	236	32.4	41	14.7	132	36.8
Good News Bay	1	0.1	0	0.0	0	0.0
Kuskokwim River	1	0.1	1	0.4	0	0.0
Total Recoveries	728	99.9	279	100.0	359	100.1
Recoveries Not Included Above						
Shumagin Islands	38		222		26	
Shumagin/Swedania Pt. Mix	0		80		0	

[a] Includes 98 sockeye salmon tagged during July 1 and 2 of which 9 were recovered in Bristol Bay, 4 at South Unimak, 3 in the Shumagin Islands, and 1 in Stepovak Bay.

[b] The recovery percentage not total 100% due to rounding.

Table 14.-South Unimak June sockeye salmon tagging studies, 1939 vs 1923, 1961, and 1987.

	1923		1939		1961		1987	
	799 Tagged		2,495 Tagged		1,269 Tagged [a]		5,442 Tagged [b]	
	Recoveries							
Recovery Location	Number	Percentage [c]	Number	Percentage [c]	Number	Percentage [c]	Number	Percentage [c]
Prince Willian Sound	0	0.0	0	0.0	0	0.0	1	0.1
Cook Inlet	0	0.0	0	0.0	0	0.0	2	0.2
Kodiak & Afognak Islands	0	0.0	0	0.0	1	1.9	6	0.5
Chignik	0	0.0	2	1.2	0	0.0	32	2.7
Balboa & Stepovak Bays	0	0.0	1	0.6	0	0.0	7	0.6
Shumagin Islands	0	0.0	3	1.8	0	0.0	1	0.1
Shumagin Is.-Swedania Pt. Mix	0	0.0	2	1.2	0	0.0	0	0.0
Moss Cape to McGinty Pt.	0	0.0	18	10.7	0	0.0	0	0.0
Morzhovoi Bay	35	44.3	22	13.0	0	0.0	5	0.4
North Alaska Peninsula	10	12.7	16	9.5	2	3.8	100	8.6
Bristol Bay	33	41.8	101	60.1	49	94.2	1,008	86.3
Kuskokwim Bay	1	1.2	4	2.4	0	0.0	5	0.4
Norton Sound	0	0.0	0	0.0	0	0.0	1	0.1
Total Recoveries	79	100.0	169	100.5	52	99.9	1,168	100.0
Recoveries Not Included Above								
Ikatan B. to C. Pankof	138		489		0		0	
W. Anchor Cove	0		264		0		0	
Total South Unimak	138		753		21		250	
Unknown Area	0		0		0		75	

[a] Includes 61 sockeye salmon tagged from July 2 through July 9.

[b] Includes 145 sockeye salmon tagged on July 1 of which 34 were recovered in Bristol Bay, 2 along the North Peninsula, 3 in Morzhovoi Bay, 3 at Chignik 3 from Ikatan Bay to Scotch Cap.

[c] The recovery percentage may not total 100% due to rounding.

Table 15.-Morzhovoi Bay sockeye salmon tagging results during June, 1923.

Recovery Locations[a]	Recoveries	
	Number	Percentage[b]
Morzhovoi Bay (Recoveries not included below)	33	0.1
Recoveries East of Tagging Area		
Thin Point Cove	2	0.5
Cold Bay	2	0.5
Total Recovered East of Tagging Area	4	1.0
Recoveries West ot Tagging Area		
Ikatan Bay-East Anchor Cove	279	69.2
North Peninsula	14	3.5
Bristol Bay	106	26.3
Total Recovered West of Tagging Area	399	99.0
Total Recoveries Outside of Tagging Area	403	

[a] A total of 1,392 sockeye salmon were tagged, of which 800 were tagged on June 20 and 592 were tagged on June 30.

[b] The recovery percentage may not total 100% due to rounding.

Table 16.-Morzhovoi Bay sockeye salmon tagging results during July, 1923.

Tagging Date and Number of Sockeye Salmon Tagged	8-Jul 546	13-Jul 279	18-Jul 170	20-Jul 198	Total 1,193	Percentage of Recoveries
Recoveries Near Tagging Area						
Morzhovoi Bay (tagging area)	13	46	17	22	98	
Morzhovoi Lake	12	9	4	4	29	9.2
Recoveries East of Tagging Area						
Thin Point Cove	3	29	32	10	74	23.4
Cold Bay	14	18	14	4	50	15.8
Belkofski Bay to Pavlof Bay	4	8	3	2	17	5.4
Total Recovered East of Tagging Area	21	55	49	16	141	44.6
Recoveries West of Tagging Area						
South Unimak	39	23	9	16	87	27.5
North Alaska Peninsula	1	0	0	3	4	1.3
Bristol Bay Area	51	2	0	2	55	17.4
Total Recovered West of Tagging Area	91	25	9	21	146	46.2
Total Recoveries Outside of Tagging Area	124	89	62	41	316	100.0

Table 17.-Median number of days between release of sockeye salmon tagged in the Shumagin Islands and recovery at South Unimak in 1923, 1939, and 1987.

Year	Recovered Tags	Median Number of Travel Days	Range
1923	189	6	3 to 27 Days
1939	115	6	3 to 20 Days
1987	95	5	3 to 35 Days

Table 18.-Median number of days between release of sockeye salmon tagged in the Shumagin Islands and recovery in Ikatan Bay-East Anchor Cove and west of Cape Pankof in 1923, 1939, and 1987.

		Median Number of Travel Days	
Year	Recovered Tags	Ikatan Bay and East Anchor Cove	West of Cape Pankof
1923	189	6	no recoveries
1939	132	7	5
1987	93	5	5

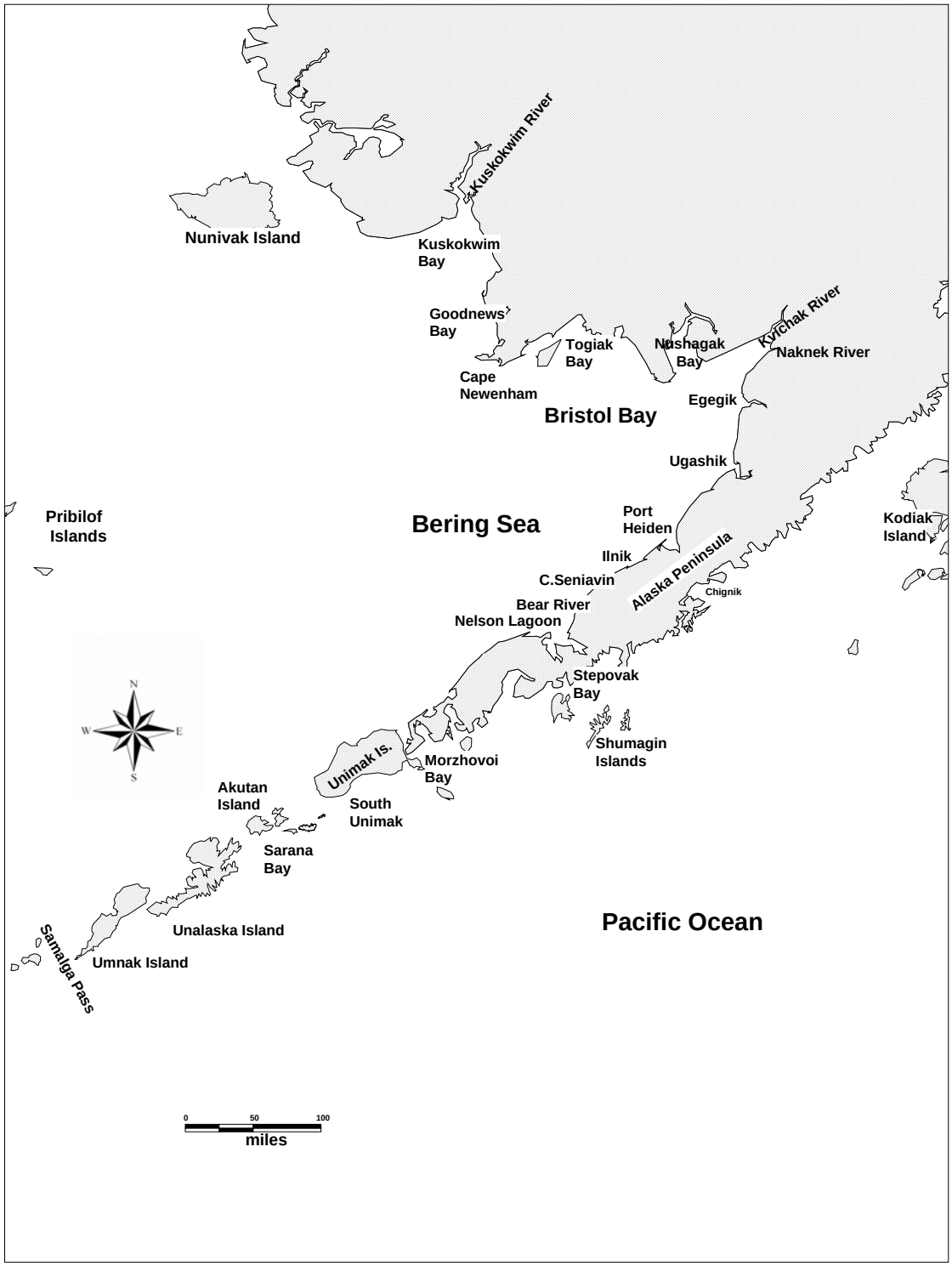

Figure 1.-Map of Southwestern Alaska from Kodiak Island to Samalga Pass.

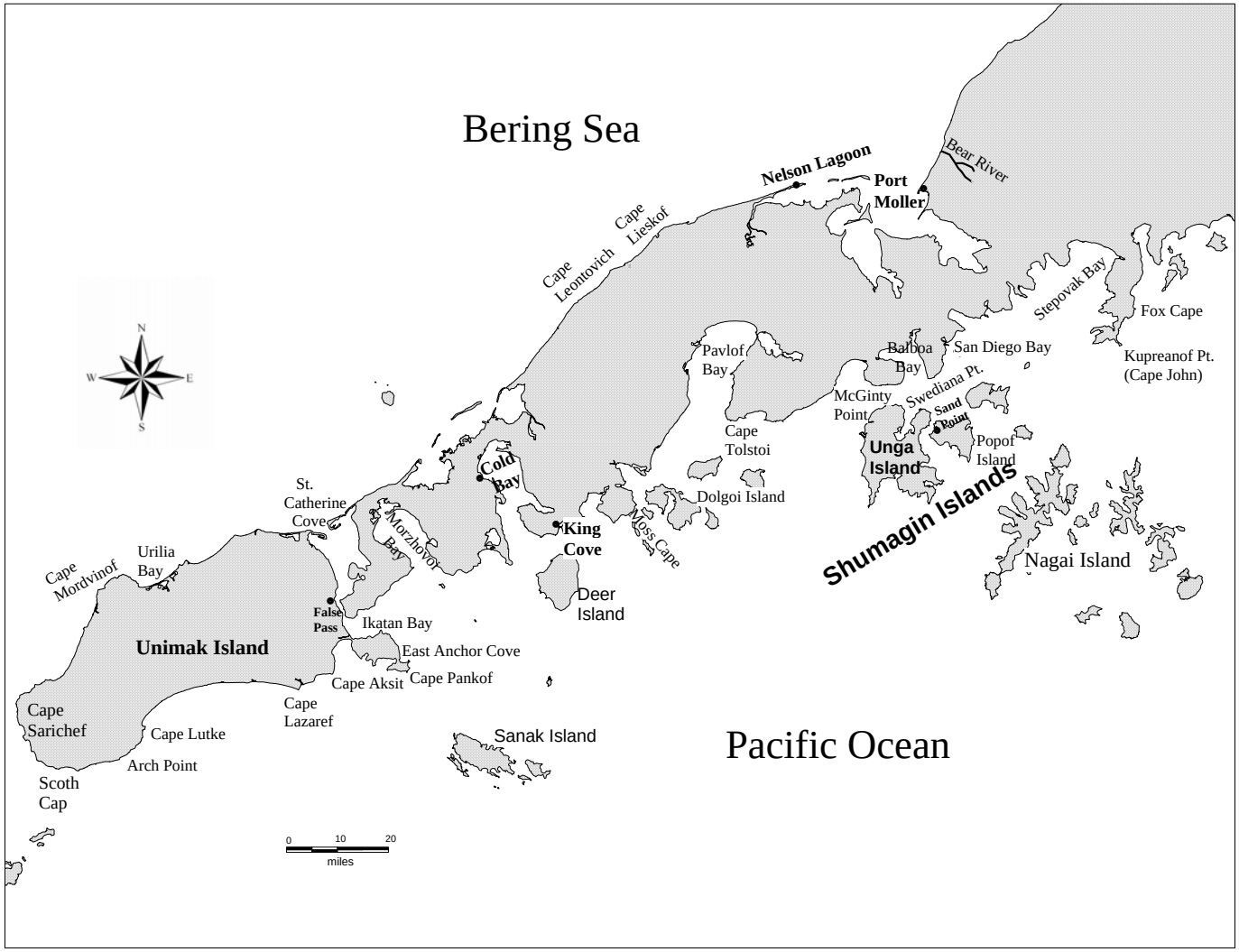

Figure 2.-Map of Unimak Island and the western reach of the Alaska Peninsula.

Figure 3. – Map of the Shumagin Islands and the Alaska Peninsula from Ivanof Bay to Beaver Bay

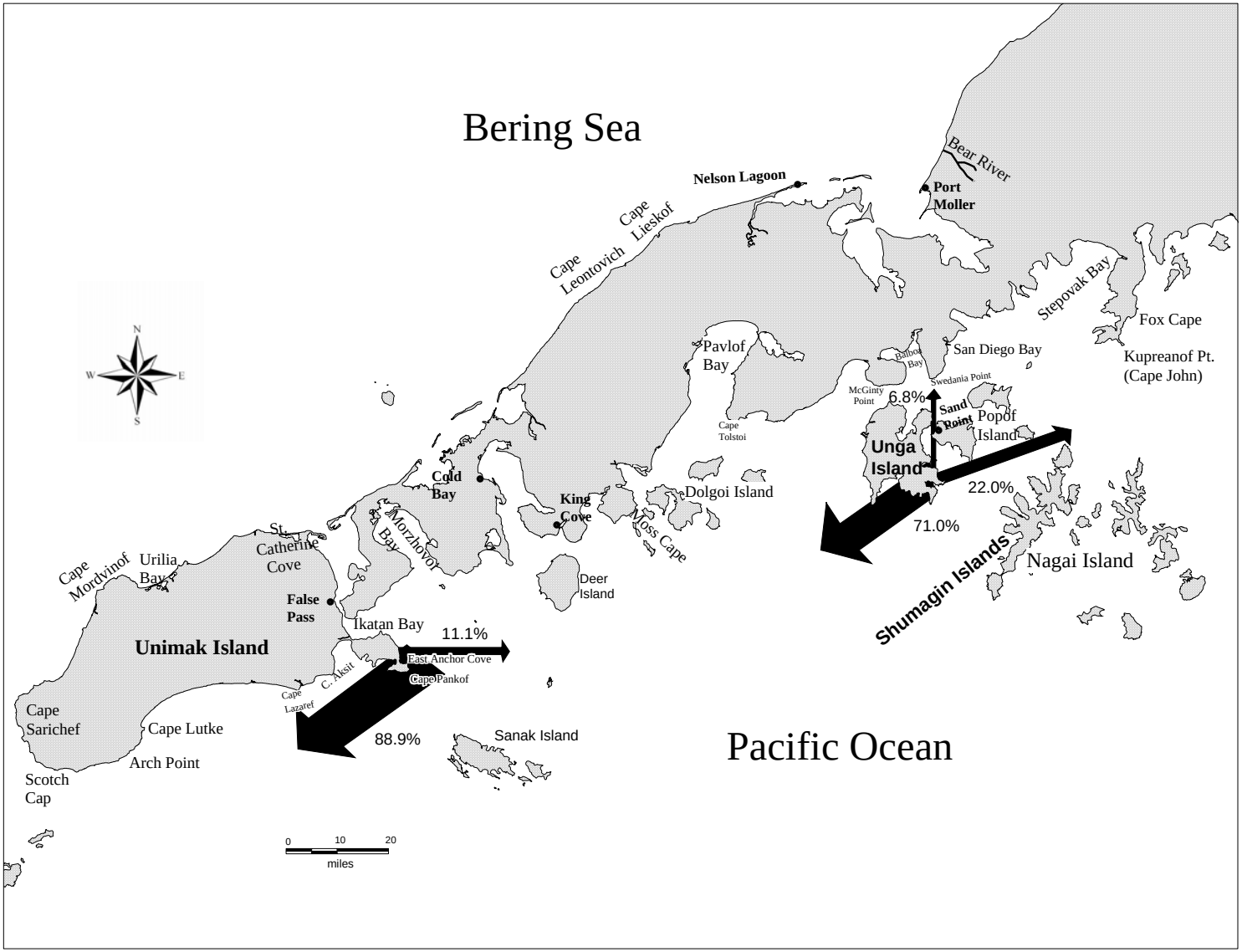

Figure 4.-Map of Unimak Island and the western reach of the Alaska Peninsula showing direction of sockeye salmon migration from tag recoveries to the east and west of the Shumagin Islands and Ikatan Bay – East Anchor Cove tagging locations, June 1939.

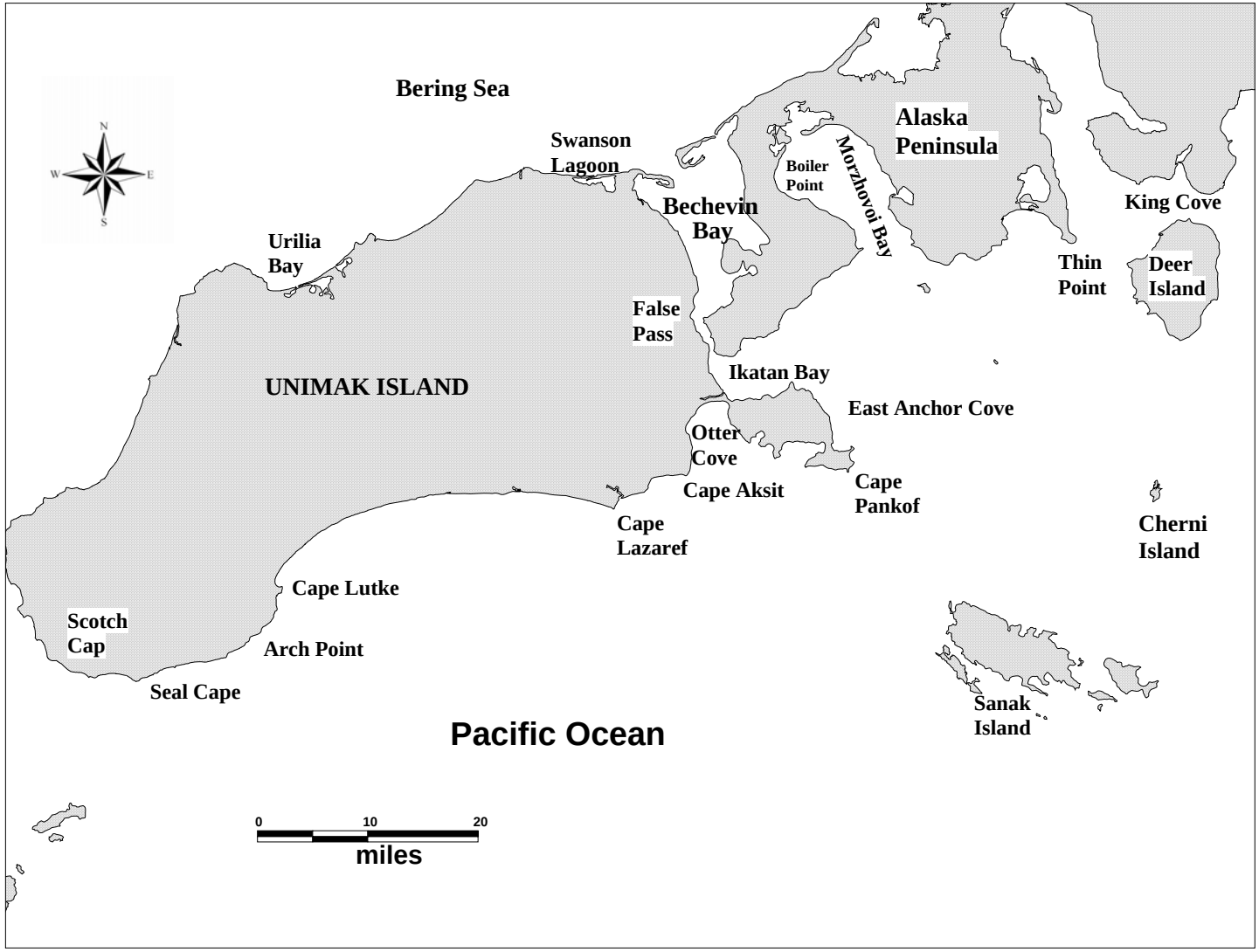

Figure 5.-Map of the Alaska Peninsula and Aleutian Islands from King Cove to Scotch Cap.

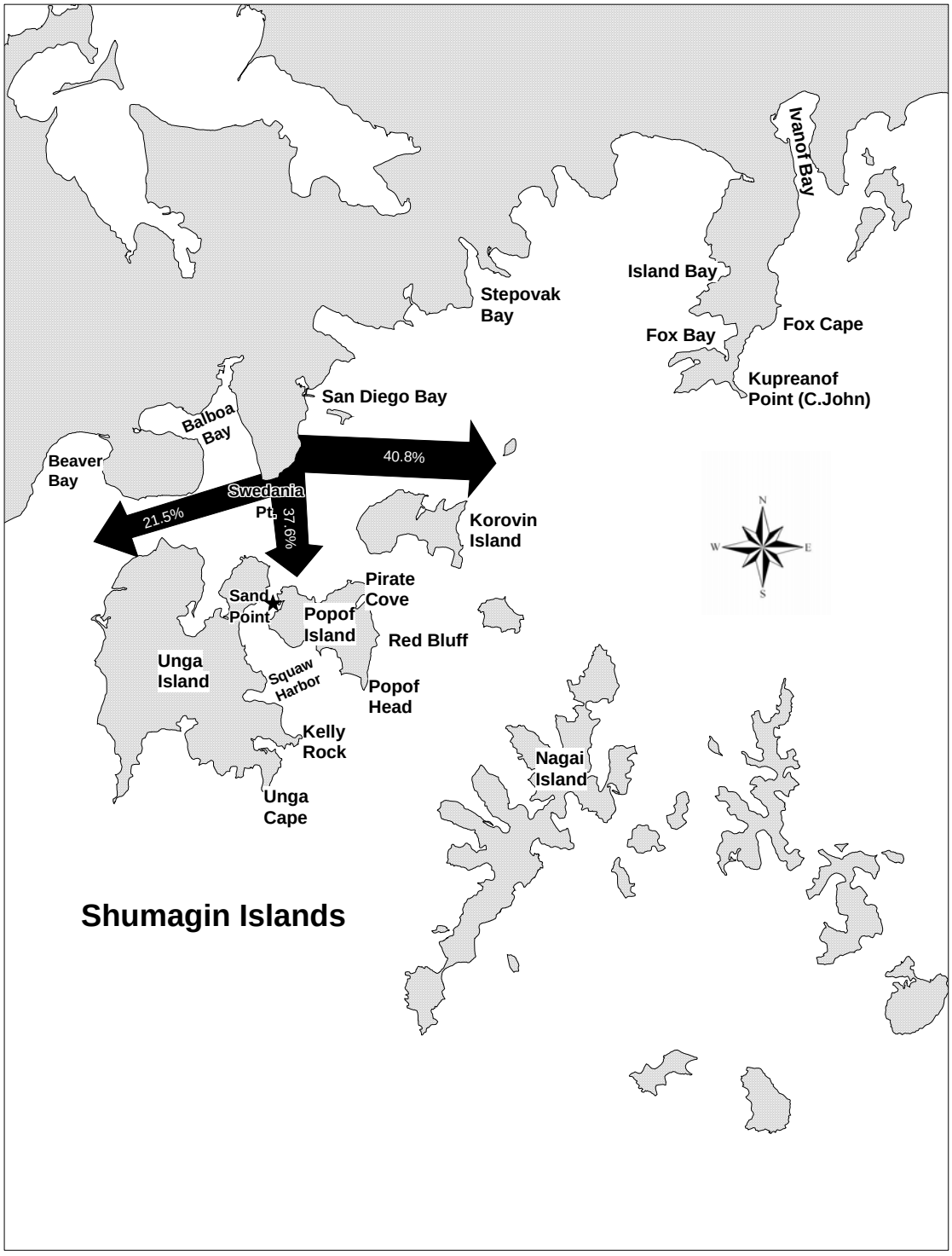

Figure 6.-Map of the Swedania Point – San Diego Bay tagging area depicting direction of sockeye salmon migration based on tag recoveries, June 1939.

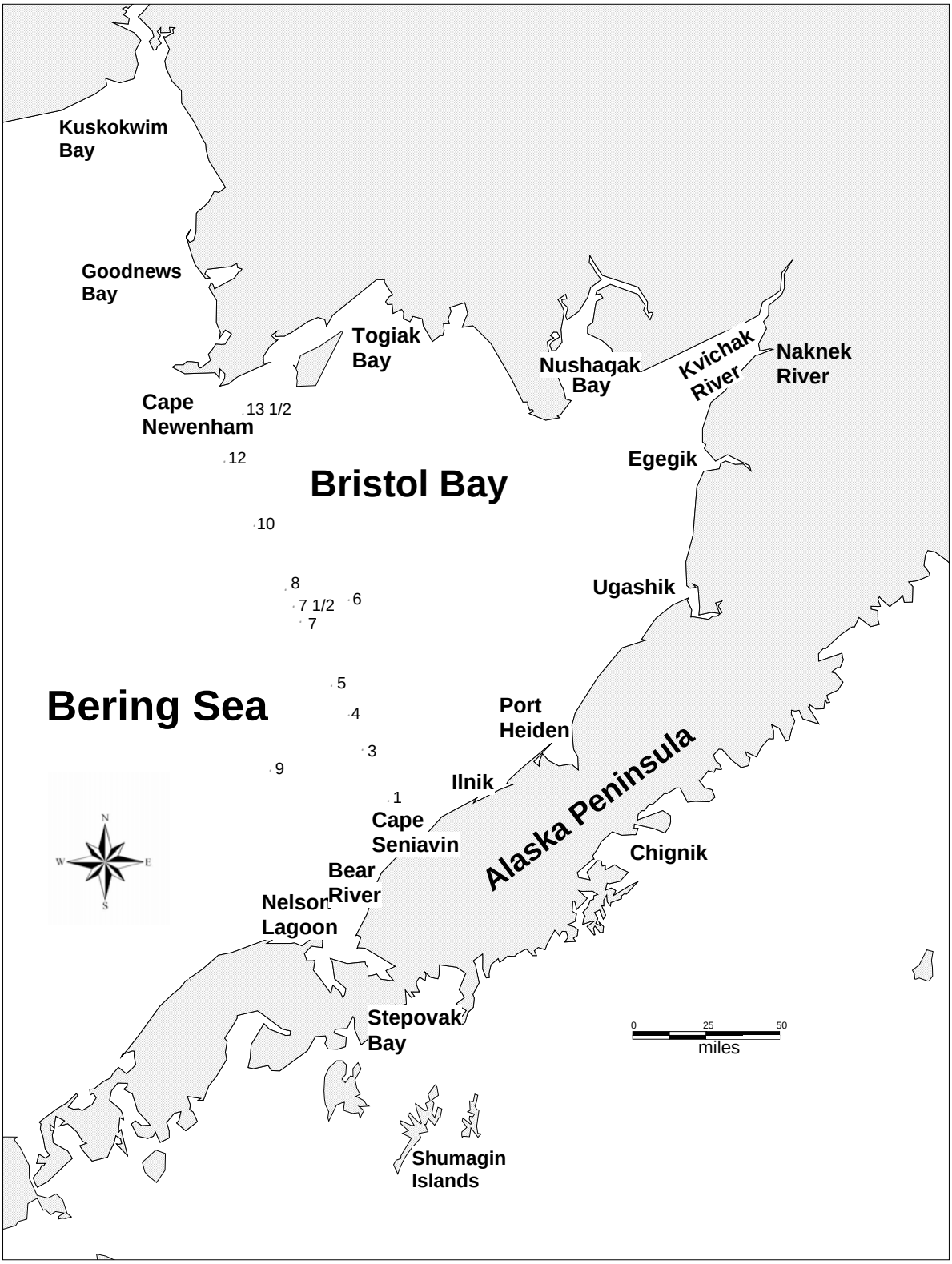

Figure 7.-Map of Cape Seniavin to Cape Newenham tagging stations, 1939.