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Harvest, Abundance, Age and Length Characteristics of Razor Clams from Eastern Cook Inlet Beaches, 1993-2003

by

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July 2010

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

Symbols and Abbreviations

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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
mid eye to fork	MEF
mid eye 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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TABLE OF CONTENTS

Page

LIST OF TABLES

Table **Page**

LIST OF FIGURES

Figure **Page**

LIST OF APPENDICES

ABSTRACT

Pacific razor clam *Siliqua patula* studies along eastern Cook Inlet were conducted from 1993 to 2003 to estimate clam digger distribution, clam harvest by beach, age and length composition of the harvest, and periodically, the abundance of clams at Ninilchik and Clam Gulch beaches. The percentage of the eastern Cook Inlet total average annual razor clam harvest taken from Ninilchik Beach was 53%, and 27% from Clam Gulch Beach. The percentage of the eastern Cook Inlet harvest from Ninilchik declined from 65.5% in 1993 to 39.6% in 2003, whereas the percentage from Clam Gulch increased from 21.0% to 34.2%. The abundance of harvestable-sized clams (≥80 mm) along a 5.8 km section of Ninilchik Beach, where diggers concentrate, was 964,109 (SE = 170,445) clams in 1998, 832,451 (SE = 116,180) in 2001, and 1,532,484 (SE = 335,507) in 2003. The estimated exploitation rates were 0.30 (SE = 0.055) in 1998, 0.26 (SE = 0.040) in 2001, and 0.14 (SE = 0.031) in 2003. The estimated abundance of harvestable-sized clams along a 6.1 km section of Clam Gulch, where diggers concentrate, was 4,052,949 (SE = 217,262) clams in 1999. The exploitation rate on this section of beach was approximately 5% (SE = 0.004). Clam age ranged from 1 to 14 years. Strong year classes from 1988 and 1994 were present in all areas sampled.

Keywords: Cook Inlet, razor clam, *Siliqua patula*, harvest, participation, abundance, exploitation, age, size-at-age

INTRODUCTION

Pacific razor clams *Siliqua patula* are found in exposed fine to medium grain sandy beaches along the west coast of North America from Pismo Beach, California, to the Bering Sea (Weymouth and McMillan 1931). On eastside Cook Inlet beaches razor clams are usually found between +4.6 and −4.3 ft tides (Szarzi 1991). Growth rates decrease with latitude while maximum size and age increase (Weymouth et al. 1925). Maximum age is generally 5 years on the southern end of their range, although the oldest clam aged in Alaska was 18 years (Nickerson 1975). Sexual maturity is related more to size than age and razor clams are mature at approximately 100 mm (between their fourth and sixth growing season in Alaska) (Nickerson 1975; Nelson *Unpublished*[1]). Spawning is triggered primarily by temperature (Nickerson 1975; Nelson *Unpublished*). Male and female sexes are separate. Females broadcast 6-10 million eggs into the water where they are fertilized randomly by sperm broadcast from males. Razor clams spawn primarily in July and August in Cook Inlet, but some may spawn earlier in the summer (Nelson *Unpublished*). Larvae drift from 6 weeks to 2 months or more as they metamorphose and then settle to the substrate as juveniles (Nelson *Unpublished*).

Beaches on the east side of Cook Inlet provide the largest sport fishery for Pacific razor clams in Alaska (Mills 1979, 1980, 1981a, b, 1982-1994; Howe et al. 1995, 1996, 2001a-d; Walker et al. 2003; Jennings et al. 2004, 2006a, 2006b). This fishery is confined primarily to 81 km (50 mi) of beach between the Kasilof and Anchor rivers (Figure 1). The Alaska Department of Fish and Game (department) began monitoring the clam population in 1965 after the 1964 earthquake caused subsidence of beaches in the Cook Inlet area.

Initial research to estimate clam harvest included creel surveys, digger distribution surveys, and length-at-age analyses at different beaches (Nelson *Unpublished*). Harvest and participation since 1977 have been estimated in the annual Statewide Harvest Survey (Mills 1979, 1980, 1981a, b, 1982-1994; Howe et al. 1995, 1996, 2001a-d; Walker et al. 2003; Jennings et al. 2004, 2006a, 2006b). Surveys are mailed to random households where at least one member obtained an Alaska sport fishing license.

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[1] Nelson, D. C. *Unpublished*. A review of Alaska's Kenai Peninsula east side beach recreational razor clam (*Siliqua patula,* Dixon) fishery, 1965-1980. Alaska Department of Fish and Game, Division of Sport Fish, Soldotna, Alaska.

The razor clam sport fishery developed rapidly beginning in 1972 (Figure 2), likely the result of improved road access to the fishery in the late 1960s. The fishery has been fairly stable since 1973 with an annual harvest between about 566,000 and 1,300,000 clams and digging effort ranging from about 22,700 to 47,000 digger-days. However, sport fish use and harvest patterns have changed substantially.

Growth rates increase incrementally from the northern to the southern beaches resulting in clams that are larger at age at Ninilchik than at Clam Gulch (Nelson *Unpublished*). Until the mid 1980s the predominant harvest came from Clam Gulch Beach. Beginning in 1986, a larger percentage of the harvest was taken at Ninilchik Beach as diggers shifted south to Ninilchik to take advantage of the larger clams found there (Athons 1992; Athons and Hasbrouck 1994).

The regulations allow diggers to take the first 60 clams dug per day. This has been the limit since 1962, except from 2000 to spring 2003 when the daily bag limit was lowered to 45 clams because of concerns by local residents that the 60 clam limit encouraged the waste of clams. The possession limit was lowered from three to two daily bag limits in 2000 and is currently 120 clams. Winter conditions such as ice build-up on beaches and cold temperatures, and low tides that occur at night preclude most clam digging from October through February. Razor clams may be harvested on any minus tide, but tides lower than −2.0 ft north of Ninilchik Beach and −3.0 ft on beaches from Ninilchik south are preferred by diggers. On the beaches north of Ninilchik suitable tides occur about 65 days annually while the southern beaches average about 35 days.

This report presents razor clam stock assessment information from 1993-2003 and includes estimates of clam harvest, age composition of harvested clams and clam abundance.

OBJECTIVES

The three project objectives were to estimate:

1. Digger distribution and the number of razor clams harvested at Cohoe, Clam Gulch, Oil Pad Access, Ninilchik, Happy Valley and Whiskey Gulch beaches;
2. The age and length composition and age-specific harvest of razor clams at Cohoe, Clam Gulch, Oil Pad Access and Ninilchik beaches;
3. Abundance of razor clams at Clam Gulch and Ninilchik beaches periodically.

The seasonal timing of post-larval settlement or juvenile razor clam recruitment was also determined at Clam Gulch and Ninilchik beaches from 2001 to 2003.

METHODS

The razor clam assessment program primarily estimates clam harvest, age composition of harvested clams, and abundance. Harvest for the entire study area, estimated from the Statewide Harvest Survey, was apportioned among beaches based on the distribution of clam diggers from aerial counts. The age and length composition of the harvest was estimated from samples collected among four of six study beaches. Finally, methods have been refined to estimate total abundance on two heavily dug clamming areas at Clam Gulch and Ninilchik beaches.

DIGGER DISTRIBUTION AND HARVEST BY BEACH

The eastside Cook Inlet beaches between the Anchor and Ninilchik rivers were divided into six study beaches based on beach morphology, razor clam population characteristics, and clam digger distribution. Aerial digger counts were made at these six study beaches: Cohoe, Clam Gulch, Oil Pad Access, Ninilchik, Happy Valley, and Whiskey Gulch (Figure 1). Cohoe Beach extends from Cape Kasilof south to where the southern extension of Cohoe Loop Road (Southern Extension) turns inland away from the bluff. Clam Gulch Beach extends from the southern boundary of Cohoe Beach to the Clam Gulch communications tower. Oil Pad Access Beach extends from the Clam Gulch communications tower to Set Net Access. Ninilchik Beach includes Set Net Access to Deep Creek. Happy Valley Beach includes Deep Creek to Happy Creek. Whiskey Gulch Beach includes Happy Creek to Anchor River. Set Net Access is a beach access road located approximately 13.7 km south of the Clam Gulch access road. The Clam Gulch communications tower is approximately 3.2 km south of the Clam Gulch access road.

Ninilchik Beach was further divided into three sub-beaches: Set Net Access to Lehman's, Lehman's to Deep Creek, and Ninilchik Bar. Clam Gulch was also further divided into three sub-beaches: Southern Extension to A-frame, A-frame to Bluff, and Bluff to Tower. Harvest estimates from sub-beaches between A-frame and the tower at Clam Gulch, and Leman's to Deep Creek at Ninilchik were applied to abundance estimates from those sub-beaches to estimate exploitation rates. Ninilchik Bar is located off the main beach between Deep Creek and the Ninilchik River and is only available to diggers on foot when the tide is less than −3.0 ft. Lehman's is the first group of set net cabins and is located approximately 5.2 km north of the Ninilchik River. A beach access road is also present at this location. The A-frame is a set net cabin located approximately 1.6 km north of Clam Gulch. Bluff refers to a section of non-vegetated bluff located approximately 0.4 km south of Clam Gulch. Southern Extension turns inland away from the bluff approximately 6.4 km north of Clam Gulch.

Aerial digger counts were stratified by tide height into two strata: −1.0 to −2.9 ft tides and −3.0 ft and lower. The number of days between flights was determined by dividing the total number of tides in both strata by the number of tides to be flown in those strata. The first flight was chosen randomly and subsequent surveys were chosen systematically April through mid-August when most harvesting occurred.

The aerial digger counts originated at Anchor River within 15 minutes of low water at Deep Creek/Ninilchik and proceeded north. All people associated with digging activity were included in the count, even those traveling along the beach on all-terrain vehicles. People in highway vehicles and those associated with commercial fishing activities were not included.

Digger counts were adjusted by a relative harvest success rate for each beach based on historical data (Szarzi 1991). Estimates were calculated separately for the two tidal stratums and then combined. Success rate of diggers varies by beach, so a crude adjustment for success rate was made to estimate harvest by beach. Success rates (I_b) of 0.5 (for Cohoe, Happy Valley, and Whiskey Gulch) or 1.0 (Clam Gulch, Set Net Access, and Ninilchik) were assigned to each beach based on historical information. Digger counts for each beach were multiplied by the harvest success rate to give adjusted digger counts:

$$d_{tbk} = I_b A_{tbk}\,; \tag{1}$$

where:

d_{tbk} = the adjusted digger count during flight k on beach b in tidal stratum t;

I_b = the harvest success rate for beach b; and

A_{tbk} = the number of diggers counted during flight k on beach b in tidal stratum t.

Harvest by beach was determined by apportioning the total harvest estimate from the Statewide Harvest Survey (Mills 1979, 1980, 1981a, b, 1982-1994; Howe et al. 1995, 1996, 2001a-d; Walker et al. 2003; Jennings et al. 2004, 2006a, 2006b) using adjusted digger counts per beach. The relative harvest on beach b during flight k of tidal stratum t was estimated as:

$$r_{tbk} = \frac{d_{tbk}}{d_{tk}}; \tag{2}$$

where:

d_{tk} = the total adjusted digger count during flight k in tidal stratum t;

$= \sum_{b=1}^{n} d_{tbk}$; and

n = the total number of beaches.

The average relative harvest on beach b in tidal stratum t ($\bar{r}_{tb}$) was estimated, incorporating the sample weights (w_{tk}) that adjust the proportions for different total numbers of diggers during different flights:

$$\bar{r}_{tb} = \frac{\sum_{k=1}^{c_t} w_{tk} r_{tbk}}{c_t}; \tag{3}$$

where:

w_{tk} = the sample weight of flight k in tidal stratum t,

$= \frac{d_{tk}}{\bar{d}_t}$;

$\bar{d}_t = \frac{\sum_{k=1}^{c_t} d_{tk}}{c_t}$; and,

c_t = the number of flights taken in tidal stratum t.

The number of diggers is probably related to the height of the minus tides. Because tide heights run in cycles and selection of flights was not random, numbers of diggers (sample weights) were probably cyclic. Therefore, a successive difference estimator (Wolter 1985) was used to estimate the variance of the average number of diggers ($\bar{r}_{tb}$):

$$\hat{V}\left[\bar{r}_{tb}\right] = \left\{1 - \frac{c_t}{m_t}\right\} \left\{ \frac{\sum_{k=2}^{c_t} \left(w_{tk} r_{tbk} - w_{tb(k-1)} r_{tb(k-1)}\right)^2}{2c_t^2 \left(c_t - 1\right)} \right\}; \quad (4)$$

where:

m_t = the number of tides in tidal stratum t.

The average relative harvest on beach b ($\bar{r}_b$) was then estimated by incorporating stratum weights (w_t) that adjust the proportions for different numbers of tides and different average numbers of diggers in each tidal stratum:

$$\bar{r}_b = \sum_{t=1}^{2} w_t \bar{r}_{tb} \; ; \quad (5)$$

where:

$\bar{w}_t$ = the weight for tidal stratum t,

$$= \frac{m_t \bar{d}_t}{\sum_{t=1}^{2} m_t \bar{d}_t}.$$

The estimated harvest for beach b ($\hat{H}_b$) is:

$$\hat{H}_b = \bar{r}_b \hat{H} \; ; \quad (6)$$

where $\hat{H}$ is the estimated harvest of razor clams between Anchor Point and Cape Kasilof from the Statewide Harvest Survey (e.g., Jennings et al. 2006b).

Its variance is estimated following Goodman (1960):

$$\hat{V}\left[\hat{H}_b\right] = \bar{r}_b^2 \hat{V}\left[\hat{H}\right] + \hat{H}^2 \hat{V}\left[\bar{r}_b\right] - \hat{V}\left[\hat{H}\right] \hat{V}\left[\bar{r}_b\right]; \quad (7)$$

where $\hat{V}\left[\hat{H}\right]$ is the variance of the Statewide Harvest Survey estimate, and

$$\hat{V}\left[\bar{r}_b\right] = \sum_{t=1}^{2} \hat{W}_t^2 \hat{V}\left[\bar{r}_{tb}\right].$$

AGE AND LENGTH COMPOSITION AND AGE SPECIFIC HARVEST BY BEACH

Age and length composition of the razor clam harvest has been estimated for Cohoe, Clam Gulch, Oil Pad Access, and Ninilchik beaches since 1977 (Nelson *Unpublished*). Szarzi (1991) recommended collecting 300 clams per beach to estimate age composition and mean length-at-age for the major age classes. Age and length composition of the harvest was estimated from clams hand dug at these four beaches. Sampling was designed to mimic an average clam digger

by collecting clams throughout the beach area, rather than sampling from a small specific area. All clams dug were retained, regardless of size or condition, in compliance with state regulation.

For age and length composition and specific harvest by beach, samples were taken from the southern end of Cohoe Beach (Figure 3). Clam Gulch samples were taken between 0.8 km north and 0.4 km south of the Clam Gulch access road. Oil Pad Access Beach was sampled with half of the specimens obtained from the northern end and the other half obtained from the southern end of the beach near Set Net Access. Half of the Ninilchik Beach samples were collected within 1.6 km north of the Ninilchik River and the other half was collected within 1.6 km south of the Ninilchik River. Additional clams were taken from Ninilchik Bar for baseline information and possible future studies.

To ensure the target sample size of 300 clams was available to estimate age, total length, and length-at-age, 350 clams were collected from each beach to compensate for breakage during processing. At the Ninilchik Bar, the target sample size was 175 clams. Clams dug at different locations on a beach were kept separate. Only one shell was required from each clam for measuring and aging. Total length was measured as closely as possible from clams that were broken and could not be aged. Clams were processed for aging by removing the body from the shell and bleaching the specimens to remove some of the periostracum (i.e., the shell's outermost layer). Shells were soaked in a 25% or 50% household bleach solution depending on shell size until most of the periostracum was removed, but the heavy annuli layers remained. Shells less than 80 mm TL were soaked in the 25% bleach solution to prevent over-bleaching. The bleach solution was then poured off, and the shells rinsed in water and dried for aging and measuring. Total length and length at each annulus was measured and input directly into an Excel spreadsheet using Mitutoyo Digimatic Calipers.

Shell aging followed the methods described by Nelson (*Unpublished)* and the recommendations of Coggins (1994). Agers aged a test set of previously aged clams until they achieved 60% agreement with the test set shell ages. Upon achieving the desired aging accuracy, aging of the current age sample commenced.

Age was determined independently for each shell in the sample at least twice. After determining age for the entire sample, the shells were rearranged and age determined a second time without knowledge of the previously assigned age. If both shell readings agreed, age composition was estimated using the assigned age. If two shell readings were different, those shells were aged again.

ABUNDANCE ESTIMATION

Razor clam abundance was estimated within a 5.8 km study area of Ninilchik Beach and a 6.1 km study area within Clam Gulch Beach where the most digging occurs (Figure 4). To estimate the number of clams at the Ninilchik and Clam Gulch study areas, each study area was stratified into 15.2 m (50 ft) strips parallel to the shoreline (Figure 5). Transects were established perpendicular to the shoreline across these strips, with one site sampled on a transect in each strip starting at the gravel edge located high up on the beach and extending out to the extreme low tide line. A site is a rectangular area 5.53 m long by 0.79 m wide. There were two to seven 0.5 m^2 circular plots sampled at each site. Abundance was estimated for each stratum independently with a two-stage sampling design. The primary units were sites and the secondary units were plots within a site.

Transect locations were randomly chosen within beach sections. The first site to be sampled along the transect was also chosen randomly within the first 15.2 m (50 ft) strip and sites were chosen systematically every 15.2 m thereafter along the transect as far as the tide allowed.

Sampling equipment used for the 0.5 m^2 plots consisted of a 4-cycle Honda pump with 30 m of cotton fire hose on the outlet (output) side and 7.6 m of stiff plastic hose on the inlet (intake) side (Figure 6). Samples were collected with a 2.5 hp pump from 1993 through 1999, and since 1999 have been collected with a 4.0 hp pump. The outlet hose has a metal tube or "wand" attached to direct water flow into the substrate enclosed by a 0.5 m^2 sampling ring. The sampling equipment and techniques used are described in greater detail by Szarzi (1991).

Samples were collected by repeatedly inserting the wand into the substrate inside the sample ring as far as the wand would penetrate. The substrate enclosed in the sample ring was emulsified such that all clams rose to the surface. Sampling continued for 3 minutes or until the entire area within the ring had been loosened and clams no longer surfaced. A hand-held net with 2 mm mesh was used to strain the loosened substrate to capture small clams. All clams collected were measured and released. The goal was to sample seven plots at each site before moving 15.2 m to the next site along a transect. If all the plots were not dug as the tide ebbed, the remaining plots at each beach site were sampled as the incoming tide flooded the beach. Distance from the gravel's edge along with the number of clams and the length of each clam from each plot was recorded.

The Ninilchik study area was divided into two areas: a 4.2 km area north of the Ninilchik River and a 1.6 km area south of the river. The northern area was further divided into five equal sections and the southern area into three equal sections. At Ninilchik Beach, 8 to 10 transects were sampled. At least one transect was sampled in each section and, if additional days were available for sampling, randomly selected northern sections were sampled with an additional transect.

Transects north of the Ninilchik River were located by measuring the distance from where the beach access road enters the beach at Lehman's Point south to the chosen random starting point for the transect using a vehicle odometer. Transects on the beach south of the Ninilchik River were located by driving south from the pilings, located at the high tide line approximately 182 m (597 ft) south of the Ninilchik River, to a random starting point.

Transects at Ninilchik were usually a minimum of 122 m (400 ft) and a maximum of 467 m (1,532 ft) in length. Number of plots sampled per site and transect length were dependent on the tidal range, the rate at which the tide fell, and the beach substrate. The transects north of the Ninilchik River commonly extended from 122 m to 320 m (400 ft to 1,050 ft) with 6 to 19 sites sampled. The transects sampled in sections north of the Ninilchik River in 1998, 2001 and 2003 extended from 107 m to 335 m (351 ft to 1,099 ft). The beach area north of the river has a steeper gradient than the area south of the river, and less beach area available for sampling. The three transects south of the Ninilchik River generally extended from 305 m to 456 m (1,001 ft to 1,496 ft) with 16 to 28 sites sampled. In 1998, 2001 and 2003, the transects sampled in the sections south of the river extended from 223 m to 426 m (732 ft to 1,398 ft). To allow comparison among years, abundance estimates for Ninilchik included only the first 183 m (600 ft) of sections north of the river and 396 m (1,299 ft) south of the river. The total beach area was 1,399,231 m^2 (15,061,197 ft^2).

The Clam Gulch study area extended from 3.2 km north of the Clam Gulch Beach access road to approximately 7.1 km south of the access road. The study area was divided into 12 equal sections, each approximately 858 m (2,815 ft) in length. At least one transect was sampled in each section and, if additional days were available for sampling, randomly selected southern sections were sampled with an additional transect. Transects at Clam Gulch were located by driving north or south a known distance from where the beach access road enters the beach to a chosen random starting point using a vehicle odometer. Only transects north of the communications tower to A-frame, in the comparable aerial survey sub-beaches, were used to estimate exploitation rates.

The beach at Clam Gulch access road and the area to the north has a slightly shallower gradient than the area south of the access road and less beach area available for sampling. Prior to 1993, Clam Gulch transects generally extended a maximum of 442 m (1,450 ft). Before 1993, transects north of the Clam Gulch access road extended from 305 m to 432 m (1,001 ft to 1,417 ft) with 20 to 28 sites sampled. The transects south of the Clam Gulch access road extended from 46 m to 260 m (151 ft to 853 ft) with 3 to 17 sites sampled. In 1999, transects in sections north of the access road extended from 274 m to 396 m (899 ft to 1,299 ft) and transects in sections south of the access road extended from 198 m to 396 m (650 ft to 1,299 ft). Abundance estimates for Clam Gulch included up to the first 320 m (1,050 ft) of every section. The total beach area used for abundance estimates was approximately 1,956,963 m^2 (21,064,574 ft^2).

The abundance of clams at the Ninilchik and Clam Gulch study areas was estimated using a two-stage design (Cochran 1977). The estimate was for clams ≥80 mm which are considered exploitable size (Szarzi 1991).

The number of clams ≥80 mm in each section was estimated as:

$$\hat{N}_b = S_b \hat{\bar{N}}_b , \tag{8}$$

where:

S_b = the number of possible sites in beach stratum *b*,

$\hat{\bar{N}}_b$ = estimated mean abundance of clams per site in beach stratum *b,*

$$\hat{\bar{N}}_b = \frac{\sum_{i=1}^{s_b} \hat{N}_{bi}}{s_b} , \tag{9}$$

s_b = the number of sites sampled in beach stratum *b,*

$\hat{N}_{bi}$ = the estimated abundance of clams in site *i,* beach stratum *b,*

$$\hat{N}_{bi} = P_{bi} \hat{\bar{N}}_{bi} \tag{10}$$

P_{bi} the number of possible plots at site *i* in beach stratum *b,*

$\hat{\bar{N}}_{bi}$ estimated mean abundance of clams per plot in site *i,* beach stratum *b,*

$$\hat{\bar{N}}_{bi} = \frac{\sum_{j=1}^{p_{bi}} \hat{N}_{bij}}{p_{bi}}, \tag{11}$$

$\hat{N}_{bij}$ = the abundance in plot *j*, site *i*, beach stratum *b*,

p_{bi} = the number of plots sampled at site *i* in beach stratum *b*,

with the variance of clam abundance estimated as:

$$Var\left[\hat{N}_b\right] = (1 - f_{1b}) S_b^2 \frac{s_{1b}^2}{s_b} + f_{1b}^{-1} P_{bi}^2 \sum_{i=1}^{s_b} \left[(1 - f_{2bi}) \frac{s_{2bi}^2}{p_{bi}} \right], \tag{12}$$

where:

$s_{1b}^2 = \dfrac{\sum_{i=1}^{s_b} \left(\hat{N}_{bi} - \hat{\bar{N}}_b \right)^2}{s_b - 1}$ the variance among sites,

$s_{2bi}^2 = \dfrac{\sum_{j=1}^{p_{hi}} \left(\hat{N}_{bij} - \hat{N}_{bi(j-1)} \right)^2}{p_{bi} - 1}$ the variance among plots within a site,

$f_{1b} = \dfrac{s_b}{S_b}$ the number of sites sampled on a transect relative to the total possible sites, and

$f_{2bi} = \dfrac{p_{bi}}{P_{bi}}$ the number of plots sampled in a site relative to the total possible plots.

The abundance of clams on the entire beach was the sum of the number of clams in each stratum:

$$\hat{N} = \sum_{b=1}^{B} \hat{N}_b \,. \tag{13}$$

The variance of clam abundance on the entire beach was estimated as:

$$V\left(\hat{N}\right) = \sum_{b=1}^{B} V\left(\hat{N}_b\right). \tag{14}$$

For each area where abundance was estimated annual exploitation rate was calculated as:

$$Exp\ Rate = \frac{\hat{H}}{\hat{N}_{\exp}}, \tag{15}$$

$$V\left[Exp\ Rate\right] = V\left[\hat{H} * \frac{1}{\hat{N}_{\exp}}\right] =$$

$$V\left[\hat{H}\left(\frac{1}{\hat{N}_{\exp}}\right)^2 + \left[\frac{1}{\hat{N}_{\exp}^4} V\left[\hat{N}_{\exp}\right]\right]\hat{H}^2 - V\left[\hat{H}\right]\left[\frac{1}{\hat{N}_{\exp}^4} V\left[\hat{N}_{\exp}\right]\right]\right]. \qquad (16)$$

Clam abundance at the seven northern sections of the 6.1 km Clam Gulch study area was used to estimate exploitation of all clams in each beach section because these sections encompass a portion of the beach where harvest was estimated from aerial surveys (Clam Gulch communications tower to Clam Gulch A-frame; Figure 1).

RECRUITMENT

The timing of juvenile razor clam recruitment was estimated with collectors at Clam Gulch and Ninilchik beaches during 2001 through 2003. Collectors consisted of Tuffy© nylon scouring pads. Two collectors were deployed May through September 2001 and May through October 2002 at three onshore sites at each of the two study areas. In May through August 2003, two strings of three collectors were deployed at two onshore sites at each study area. The onshore collectors at Clam Gulch were 1.8 km north of the Clam Gulch access road. The Ninilchik onshore collectors were approximately 0.4 km south of the Ninilchik River. The collectors or strings of collectors were affixed in replicate to two separate rock outcroppings or on lines anchored in the beach substrate near the −1.0 ft tide elevation. The same sites were used each year.

In 2002, additional collectors were deployed offshore beyond the ebb tide where they were submerged within 1 m of the water surface and periodically checked for juvenile clams. The offshore collectors were fished in association with setnet fishing operations: one at Ninilchik Beach 1.6 km north of the Ninilchik River and the second at Clam Gulch Beach approximately 1.6 km south of the access road. The offshore collectors were retrieved at the convenience of a setnetter and generally coincided with weekly setnet fishery openings.

In 2001, onshore collectors were deployed during each low tide series where they would be underwater for at least one 24-hour period, but not continuously underwater. A low tide series consisted of several consecutive days with tides <0.0 ft. In 2002, collectors were deployed so they were submerged continuously for one 24-hour period during a low tide series and an entire high tide series. The deployment and retrieval of collectors in September 2001 and October 2001 and 2002 occurred when staff was available preceding and following one high tide series during each month. In 2003, collectors were deployed only during each high tide series. Collector samples were frozen upon retrieval and kept frozen until removal and enumeration of razor clams and larvae could take place.

RESULTS

DIGGER EFFORT AND HARVEST BY BEACH

The highest clam digger count in a single aerial survey from 1993 through 2003 was 2,792 during a −5.8 ft tide on May 16, 1999 (Table 1). A count of 1,433 clam diggers at Ninilchik that same day was also the highest count on an individual beach. The lowest digger count of 45 occurred during a –1.5 ft tide on May 10, 1994.

The largest proportion of the total annual razor clam harvest was taken at Ninilchik Beach, peaking at 65.5% in 1995 (Table 2). From 1995 to 2003, the proportion of the total annual clam harvest at Ninilchik steadily declined to 39.6% of the annual total, whereas the proportion of harvest at Clam Gulch increased from 23.3% to approximately 34.2%. The proportion of the harvest at Oil Pad Access Beach generally increased from 11.8% in 1993 to 18.8% in 2003. The proportion of the harvest at Cohoe, Happy Valley, and Whiskey Gulch beaches was relatively stable throughout the study.

The largest razor clam harvest occurred in 1994 when approximately 1,269,131 clams were taken (Table 3). The largest harvest from an individual beach was 825,302 clams from Ninilchik in 1994. The lowest harvest from Ninilchik during 1993-2003 was about 226,434 clams in 2003. Most of the harvest from Ninilchik Beach was taken between Lehman's and Deep Creek (Table 4). The clam harvest from Clam Gulch during 1993-2003 ranged from 182,101 to 262,153. The harvest at Clam Gulch Beach came primarily between A-frame and the bluff (Table 4).

AGE AND LENGTH COMPOSITION OF THE HARVEST

The age of razor clams in hand-dug samples from eastside Cook Inlet beaches during 1993-2003 ranged from 1 to 13 years (Tables 5-8). The 1994 estimated harvests of 140,707 age-5 clams at Clam Gulch (Table 9) and 387,171 age-6 clams at Ninilchik (Table 10) were the largest harvests of individual razor clam age classes.

The growth rates of clams from Ninilchik, Set Net Access and Clam Gulch were significantly different (ANCOVA, $P < 0.001$) with the fastest growth rates at Ninilchik, and the slowest at Clam Gulch (Figure 7). Clams from Ninilchik south to Anchor River were vulnerable to fishing at a younger age than clams north of Ninilchik. Two-year-old clams were common in age samples from Ninilchik (Table 6), whereas clams at Clam Gulch were not common in age samples until they were 3 or 4 years old (Table 5). The length at last annulus measurements for clams of all ages from Ninilchik are larger than length at last annulus measurements for clams of the same age at all other locations (Table 11).

Spawning success of eastside Cook Inlet razor clams is variable and a strong year class typically enters the harvestable-size population every 3 to 6 years. A strong 1988 year class was first evident in hand-dug samples from 1993 as 5-year-old clams on Cohoe, Clam Gulch, Set Net/Oil Pad Access, and Ninilchik beaches (Tables 5-8 and Appendix B). A strong 1994 year class was first evident in the Ninilchik samples as 2-year-old clams in 1996 and as 3-year-old clams from other beaches in 1997. Other strong year classes were evident in samples from some beaches, but not all. A 2000 year class was predominant in Ninilchik samples as 2-year-olds in 2002 and as 3-year-old clams at Set Net Access and Oil Pad Access in 2003, but was not evident in samples from Clam Gulch. The prominence of an age class in samples a year before or after a strong year class can indicate that aging error occurred. Aging error may explain why the 1994

year class was predominant in samples from Clam Gulch in 1997 and 1999-2002, but not in 1998 when clams from the 1995 year class were predominant.

A test of the null hypothesis that age compositions of samples among sub-beaches were the same for a particular year was conducted from 1993 through 2003. The null hypothesis that age composition of clams from Ninilchik Bar was the same as the age composition from the Ninilchik mainland was rejected each year (Q_{CSMH} = 677.57, $P < 0.001$, df = 1). The age composition of clams from the two Ninilchik mainland sites north and south of the Ninilchik River was different in all years (Q_{CSMH} = 49.44, $P < 0.001$, df = 1). The null hypothesis that age composition of clams at Set Net Access and Oil Pad Access was similar was also rejected for all years (Q_{CSMH} = 242.92, $P < 0.001$, df = 1).

The null hypothesis that age composition of clams among Ninilchik (not including the Ninilchik Bar), Set Net/Oil Pad Access, Clam Gulch and Cohoe beaches were the same, was rejected for all years from 1993 through 2003 (χ^2 = 159.08, $P < 0.01$, df = 21).

RAZOR CLAM ABUNDANCE

Razor clam abundance was estimated for Clam Gulch in 1999 and for Ninilchik in 1998, 2001, and 2003. The abundance of exploitable-sized clams (≥80 mm) at Clam Gulch was 4,052,949 (SE = 217,262), the harvest was 185,144 (SE = 10,286), and the harvest rate was low at 4.6% (SE = 0.004). The harvest rate of exploitable-sized clams at Ninilchik declined from 29.8% in 1998 to 13.7% in 2003 (Table 12). The decline in harvest rate in 2001 and 2003 coincided with the appearance of another year class in the harvestable-sized population.

RECRUITMENT

The largest monthly capture of juvenile clams (15 at Clam Gulch and 87 at Ninilchik) in the collectors occurred in September 2001 (Figure 8). There were 35 juvenile clams found in the collectors at Clam Gulch in June 2002, but most were shells only. It is uncertain if the empty shells were clams that died in the collectors or if empty shells were deposited in the collectors by waves or tidal currents. Otherwise, fewer than 6 juvenile-sized clam shells, with or without their shell contents, were found in all collectors combined in any one month from July through October 2002. As a result, not enough juvenile clams were captured to determine the seasonal timing of recruitment.

DISCUSSION

The exploitation rate of razor clams along most of the 81 km of eastside Cook Inlet beaches is thought to be low based upon estimated clam production and harvest rates for Clam Gulch and Ninilchik compared to other beaches. High exploitation rates have been documented in some years on approximately 5.8 km of Ninilchik Beach. Overharvest is a concern at Ninilchik because harvest rates of exploitable-sized clams have periodically been above sustainable rates determined for more productive western Pacific Ocean beaches (Appendix A1). The Washington Department of Fish and Wildlife and their tribal co-managers found that harvest rates above 25.4% of the razor clam standing stock are not sustainable (D. L. Ayers, Washington Department of Fish and Wildlife, Monsanto, personal communication). The British Columbia Department of Fisheries and Oceans (DFO) and their tribal co-managers restrict British Columbia's only commercial razor clam fishery at North Beach to 12% of the exploitable biomass (DFO 2001). Exploitation of total clam abundance is approximately 20% or less on the

eastside Cook Inlet beaches (Appendix A1). The time series of abundance estimates from Ninilchik is limited (Table 12 and Appendix A1), but there is no overall trend to indicate that exploitation rates are negatively affecting recruitment at Ninilchik or exploitable abundance in the immediate vicinity.

Clam abundance estimates were lower and exploitation rates were higher for Clam Gulch than those by Szarzi (1991) because we determined abundance for a smaller area with boundaries corresponding more closely to where harvest was estimated. The harvest rate of exploitable-sized clams in 1988 of 11% at Clam Gulch approached British Columbia's guidelines but rates were well below that in 1989 and 1999 (Appendix A2).

There was generally a broad range of ages present with new year classes of clams recruiting into the population all along eastside Cook Inlet beaches, including Ninilchik (Tables 5-8). The average size of clams in samples at Ninilchik has declined since 1994 (Figure 9); most likely the result of strong new year classes recruiting to harvestable size in 1994, 1997 and 2003 (Table 6).

After 1990, there were generally fewer clams age-7 and older in annual samples from Clam Gulch (Table 5 and Appendix B1), and fewer clams age-8 and older from Ninilchik (Table 6 and Appendix B2). Older clams have been prevalent periodically in samples between Set Net Access and Oil Pad Access (Table 7 and Appendix B3) and at Cohoe Beach (Table 8 and Appendix B4); locations that receive a small proportion of the digger effort. Whether the smaller number of older clams in samples from Ninilchik since the early 1990s is the result of more harvest pressure is not known. The lower prevalence of older clams at Clam Gulch is not likely the result of higher harvest levels because harvests have been relatively stable there since the mid 1980s (Table 3 and Appendix D) and exploitation rates have been low.

Little is known about nearshore water circulation patterns that influence transport or settlement patterns of larval razor clams along eastside Cook Inlet beaches. A buoy deployed offshore from Ninilchik in June 2003 was tracked by satellite to study offshore surface currents. The drifting buoy oscillated north and south with the ebb and flow of the tides in Cook Inlet between the Kasilof River and Bluff Point throughout the summer until a different current pattern took it south of Bluff Point (S. Pegau, Alaska Department of Fish and Game, Homer, personal communication). If surface circulation patterns nearshore are similar to offshore surface patterns, the impact of localized depletion of a beach on future recruitment to that beach or the surrounding population is most likely mitigated by large scale dispersal of larvae along eastside Cook Inlet beaches.

In some years, strong year classes recruited to all of the study beaches. The overall synchrony of reproductive success suggests that the eastside Cook Inlet razor clam population is influenced by large scale factors. The apparent asynchronous spawning success among study beaches apparent in some years may be the result of local factors favoring survival in combination with sampling protocol that limits the area that clams are dug to estimate age composition.

From 1986 through 1995, clam diggers shifted south from Clam Gulch to Ninilchik to take advantage of the larger clams found there (Table 2 and Appendix C). Ninilchik sustained the highest harvests of any beach in the history of the fishery in 1994 (Appendix D1). (Estimated harvest by beach found in Appendix D1 and the corresponding harvest by age class at Ninilchik and Clam Gulch for 1990 and 1991 found in Appendices D2 and D3 are corrected from Athons (1992) and Athons and Hasbrouck (1994). The declining average size of clams at Ninilchik after 1995 is probably the impetus for diggers shifting their efforts back to Clam Gulch, where

abundant clams of an intermediate size are found. The natural tendency of clam diggers to shift to other areas and maximize the amount of clam biomass they harvest is relieving the pressure on the Ninilchik area when biomass is relatively low.

The razor clam bag and possession limits were established based more on social principles of how many razor clams were "enough" for a harvester to take in a single day rather than biological principles. However, indications are that the stock is healthy and the fishery is sustainable. Exploitation rates are low on most beaches because effort is concentrated in small areas around beach access points. When clam populations or clam size decreases, diggers shift to other beaches. Clams in a wide range of ages and sizes are available on all beaches. If small clams predominate at a beach it is because a strong new year class is successfully recruiting into the population.

Changing future environmental conditions that result in lower clam productivity could challenge managers to sustain the fishery. Predictive models that forecast clam abundance are limited by many unknowns. The direct influence of physical environmental factors such as temperature, salinity changes, storms, currents and tides on clam abundance is not understood. Important life history information about larval clams, clam natural mortality rates, prey species and dynamics are unknown. There is even uncertainty about digger selectivity, relative digger success by beach and incidental fishing mortality. Additionally, although the number of abundance estimates and sample sizes of aged clams and the number of annual flights have increased since predictive models were last used to forecast future clam abundance (Athons and Hasbrouck 1994), age error continues to limit managers in modeling future clam abundance.

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TABLES

Table 1.–Razor clam digger counts by date and tide (ft) on eastside Cook Inlet beaches, 1993-2003.

BEACH 1993	Date:	5/07	5/21	6/04	6/07	6/19	6/22	6/24	7/06	7/18	7/19	7/20	7/31	8/02
	Tide:	-4.9	-1.9	-4.2	-2.9	-2.2	-3.6	-1.9	-2.4	-2.1	-3.3	-4.0	-1.3	-2.1
Cohoe														
C. Kasilof to S. Ext. of Cohoe Loop Rd.		9	0	9	0	12	2	0	0	0	5	8	0	2
Clam Gulch														
S. Ext. of Cohoe Loop Rd. to Tower		328	73	200	79	165	169	49	96	109	199	297	66	65
A. S. Ext. to A-frame		31	0	18	0	31	6	4	0	0	9	19	0	0
B. A-frame to Bluff		217	52	91	59	75	101	39	88	73	140	205	65	40
C. Bluff to Tower		80	21	91	20	59	62	6	8	36	50	73	1	25
Oil Pad Access														
Clam Gulch Tower to Set Net Access		204	17	129	22	64	106	19	43	77	128	173	26	44
Ninilchik														
Set Net Access to Deep Creek		773	70	842	150	267	756	97	161	330	656	982	118	284
A. Set Net Access to Lehman's		25	0	30	0	3	12	3	2	10	31	37	4	6
B. Lehman's to Deep Creek		498	67	642	149	244	597	94	158	313	515	765	106	264
C. Ninilchik Bar		250	3	170	1	20	147	0	1	7	110	180	8	14
Happy Valley														
Deep Creek to Happy Creek		117	5	142	25	33	93	7	29	43	83	166	2	13
Whiskey Gulch														
Happy Creek to Anchor River		29	0	25	0	2	11	0	12	5	9	20	0	8
Total Diggers		1,460	165	1,347	276	543	1,137	172	341	564	1,080	1,646	212	416

-continued-

Table 1.–Page 2 of 11.

BEACH 1994	Date:	4/26	5/10	5/23	5/27	6/11	6/23	7/08	7/10	7/12	7/20	7/22	8/07	8/10
	Tide:	-5.5	-1.5	-3.2	-5.1	-2.1	-5.0	-1.7	-2.6	-1.9	-1.9	-3.8	-2.2	-1.8
Cohoe														
C. Kasilof to S. Ext. of Cohoe Lp. Rd.		3	0	0	6	14	5	0	2	8	0	10	0	0
Clam Gulch														
S. Ext. of Cohoe Lp. Rd. to Tower		145	5	108	228	151	231	123	96	106	72	246	114	37
A. S. Ext. to A-frame		16	0	2	26	7	8	0	4	5	0	6	14	1
B. A-frame to Bluff		92	0	49	78	119	175	75	59	27	50	115	72	29
C. Bluff to Tower		37	5	57	124	25	48	48	33	74	22	125	28	7
Oil Pad Access														
Clam Gulch Tower to Set Net Access		129	7	58	125	57	149	36	73	36	15	78	72	4
Ninilchik														
Set Net Access to Deep Creek		755	33	284	856	269	1,037	267	382	188	221	834	275	52
A. Set Net Access to Lehman's		17	0	12	24	6	44	4	22	6	10	26	9	1
B. Lehman's to Deep Creek		548	29	259	700	263	834	260	350	173	205	707	253	51
C. Ninilchik Bar		190	4	13	132	0	159	3	10	9	6	101	13	0
Happy Valley														
Deep Creek to Happy Creek		120	0	31	162	28	117	23	46	17	12	78	15	14
Whiskey Gulch														
Happy Creek to Anchor River		21	0	10	33	15	45	2	13	10	0	13	3	0
Total Diggers		1,173	45	491	1,410	534	1,584	451	612	365	320	1,259	479	107

-continued-

Table 1.–Page 3 of 11.

BEACH 1995	Date:	4/30	5/16	5/19	5/30	6/12	6/15	6/17	6/27	7/10	7/12	7/13	7/28	8/09
	Tide:	-2.1	-5.6	-2.4	-1.9	-4.6	-5.5	-2.7	-1.3	-2.5	-5.1	-5.4	-1.6	-3.1
Cohoe														
C. Kasilof to S. Ext. of Cohoe Lp. Rd.		0	6	0	0	5	2	2	0	0	5	9	0	0
Clam Gulch														
S. Ext. of Cohoe Lp. Rd. to Tower		130	207	46	28	144	115	198	80	131	284	330	144	77
A. S. Ext. to A-frame		6	10	1	0	9	2	29	0	3	12	12	11	6
B. A-frame to Bluff		86	123	35	8	50	51	119	78	68	127	240	90	31
C. Bluff to Tower		38	74	10	20	85	62	50	2	60	145	78	43	40
Oil Pad Access														
Clam Gulch Tower to Set Net Access		56	141	18	28	97	112	72	10	74	152	172	53	48
Ninilchik														
Set Net Access to Deep Creek		72	998	43	97	829	869	320	150	353	1,313	1,237	125	237
A. Set Net Access to Lehman's		2	19	1	0	19	40	5	5	2	25	36	9	9
B. Lehman's to Deep Creek		67	744	39	97	653	688	308	143	333	1,053	961	110	221
C. Ninilchik Bar		3	235	3	0	157	141	7	2	18	235	240	6	7
Happy Valley														
Deep Creek to Happy Creek		7	149	3	13	62	86	26	5	20	62	195	25	5
Whiskey Gulch														
Happy Creek to Anchor River		0	42	0	2	16	27	8	2	7	22	25	0	1
Total Diggers		265	1,543	110	168	1,153	1,211	626	247	585	1,838	1,968	347	368

-continued-

Table 1.–Page 4 of 11.

BEACH 1996	Date:	5/03	5/06	5/16	6/02	6/05	6/06	6/15	6/17	6/29	7/03	7/15	7/18	7/31
	Tide:	-3.0	-3.8	-2.8	-4.8	-4.0	-2.6	-2.2	-2.2	-2.3	-5.3	-1.5	-1.1	-5.2
Cohoe														
C. Kasilof to S. Ext. of Cohoe Lp. Rd.		2	7	7	20	1	4	0	0	13	16	1	0	13
Clam Gulch														
S. Ext. of Cohoe Lp. Rd. to Tower		117	125	52	243	75	72	114	101	91	268	128	41	341
A. S. Ext. to A-frame		4	10	2	17	11	5	17	2	12	26	2	4	18
B. A-frame to Bluff		80	87	37	87	40	39	58	68	46	160	88	22	229
C. Bluff to Tower		33	28	13	139	24	28	39	31	33	82	38	15	94
Oil Pad Access														
Clam Gulch Tower to Set Net Access		79	56	36	198	56	18	75	33	121	145	95	19	93
Ninilchik														
Set Net Access to Deep Creek		207	290	98	990	285	103	167	139	304	848	153	60	836
A. Set Net Access to Lehman's		4	2	5	50	8	0	2	5	1	24	6	0	13
B. Lehman's to Deep Creek		179	242	90	753	229	103	161	134	287	585	136	60	560
C. Ninilchik Bar		24	46	3	187	48	0	4	0	16	239	11	0	263
Happy Valley														
Deep Creek to Happy Creek		28	40	11	182	34	5	3	7	20	176	18	0	105
Whiskey Gulch														
Happy Creek to Anchor River		6	11	0	73	12	0	4	2	14	43	0	0	15
Total Diggers		439	529	204	1,706	463	202	363	282	563	1,496	395	120	1,403

-continued-

Table 1.–Page 5 of 11.

BEACH 1997	Date:	507	521	523	524	605	619	623	624	702	703	706	820
	Tide:	-4.5	-1.4	-3	-3.1	-3.9	-1.5	-3.9	-3.2	-1.7	-2.3	-2.4	-3.9
Cohoe													
C. Kasilof to S. Ext. of Cohoe Lp. Rd.		9	2	11	30	7	2	9	2	0	6	2	2
Clam Gulch													
S. Ext. of Cohoe Lp. Rd. to Tower		179	30	162	522	160	71	182	132	54	123	112	101
A. S. Ext. to A-frame		2	1	6	25	20	0	5	11	0	8	7	7
B. A-frame to Bluff		88	15	78	278	96	43	102	88	39	69	70	47
C. Bluff to Tower		89	14	78	219	44	28	75	33	15	46	35	47
Oil Pad Access													
Clam Gulch Tower to Set Net Access		140	13	115	339	136	25	88	68	23	0	37	59
Ninilchik													
Set Net Access to Deep Creek		637	37	300	981	601	117	470	248	102	217	99	317
A. Set Net Access to Lehman's		16	0	5	65	12	0	20	14	2	5	5	22
B. Lehman's to Deep Creek		498	35	252	789	530	117	382	209	100	212	92	240
C. Ninilchik Bar		123	2	43	127	59	0	68	25	0	0	2	55
Happy Valley													
Deep Creek to Happy Creek		67	0	37	55	47	4	37	5	9	33	5	12
Whiskey Gulch													
Happy Creek to Anchor River		13	5	22	56	10	0	16	16	1	5	4	15
Total Diggers		1,045	87	647	1,983	961	219	802	471	189	384	259	506

-continued-

Table 1.–Page 6 of 11.

BEACH 1998	Date:	430	512	525	527	528	610	621	622	625	626	708	724
	Tide:	-2.6	-1.6	-4.9	-4.2	-4.3	-2	-1.7	-3.2	-4.4	-3.7	-1	-3.3
Cohoe													
C. Kasilof to S. Ext. of Cohoe Lp. Rd.		0	0	51	8	7	6	4	15	25	9	0	29
Clam Gulch													
S. Ext. of Cohoe Lp. Rd. to Tower		18	37	415	253	146	132	60	180	251	215	69	200
A. S. Ext. to A-frame		0	7	65	13	16	1	0	44	42	5	4	20
B. A-frame to Bluff		9	13		55	65	81	33	61	78	135	30	135
C. Bluff to Tower		9	17	350	185	65	50	27	75	131	75	35	45
Oil Pad Access													
Clam Gulch Tower to Set Net Access		8	12	318	146	64	44	23	93	183	107	44	190
Ninilchik													
Set Net Access to Deep Creek		23	15	970	541	211	162	75	385	629	320	97	
A. Set Net Access to Lehman's		9	3	51	52	8	0	2	14	28	17	0	20
B. Lehman's to Deep Creek		14	12	781	453	191	162	73	370	547	290	97	320
C. Ninilchik Bar		0	0	138	36	12	0	0	1	54	13	0	30
Happy Valley													
Deep Creek to Happy Creek		2	5	110	49	17	12	4	33	56	44	0	42
Whiskey Gulch													
Happy Creek to Anchor River		3	3	73	22	17	5	0	6	22	5	0	21
Total Diggers		54	72	1,937	1,019	462	361	166	712	1,166	700	210	482

-continued-

Table 1.–Page 7 of 11.

BEACH 1999	Date	4/17	5/13	5/16	5/19	5/31	6/14	6/18	7/01	7/12	7/13	7/29	8/09	8/10	8/13
	Tide:	-4.8	-1.5	-5.8	-3.5	-1.8	-5.9	-1.9	-1.8	-4.6	-5.2	-2.1	-2.4	-3.5	-3.3
Cohoe															
C. Kasilof to S. Ext. of Cohoe Lp. Rd.		19	0	84	0	13	34	11	0	13	55	10	1	6	15
Clam Gulch															
S. Ext. of Cohoe Lp. Rd. to Tower		167	33	575	72	130	390	111	81	399	360	149	67	126	158
A. S. Ext. to A-frame		9	0	95	5	5	45	1	8	29	35	4	0	16	10
B. A-frame to Bluff		61	1	180	20	55	160	75	3	265	110	90	33	20	68
C. Bluff to Tower		97	32	300	47	70	185	35	70	105	215	55	34	90	80
Oil Pad Access															
Clam Gulch Tower to Set Net Access		26	53	355	25	44	198	21	60	183	135	80	46	79	79
Ninilchik															
Set Net Access to Deep Creek		432	11	1,433	81	204	1,134	95	31	592	1,020	195	75	238	235
A. Set Net Access to Lehman's		5	0	85	8	5	60	4	0	14	45	7	5	9	28
B. Lehman's to Deep Creek		386	11	1,160	44	199	975	91	31	505	800	188	70	226	199
C. Ninilchik Bar		41	0	188	29	0	99	0	0	73	175	0	0	3	8
Happy Valley															
Deep Creek to Happy Creek		43	0	280	28	16	164	0	3	94	154	4	11	46	36
Whiskey Gulch															
Happy Creek to Anchor River		6	2	65	0	27	28	0	0	22	17	0	0	10	4
Total Diggers		693	99	2,792	206	434	1,948	238	175	1,303	1,741	438	200	505	527

-continued-

Table 1.–Page 8 of 11.

BEACH 2000	Date	5/03	5/07	5/09	5/19	6/03	6/06	6/07	6/18	7/05	7/18	7/28	7/30	8/03
	Tide:	-4.7	-4	-1.1	-2.4	-5.5	-3.7	-2.1	-1.8	-3.9	-1.5	-1.1	-5.2	-3.3
Cohoe														
C. Kasilof to S. Ext. of Cohoe Lp. Rd.		48	76	8	0	81	25	13	0	0	16	1	78	14
Clam Gulch														
S. Ext. of Cohoe Lp. Rd. to Tower		719	449	18	97	276	79	65	114	102	95	77	320	100
A. S. Ext. to A-frame		336	227	7	65	96	5	10	63	28	65	29	105	30
B. A-frame to Bluff		222	125	7	29	133	70	55	49	63	30	48	183	70
C. Bluff to Tower		161	97	4	3	47	4	0	2	11	0	0	32	0
Oil Pad Access														
Clam Gulch Tower to Set Net Access		268	43	0	23	186	49	29	47	44	72	35	161	69
Ninilchik														
Set Net Access to Deep Creek		825	425	4	70	671	196	81	126	324	141	155	739	128
A. Set Net Access to Lehman's		75	27	0	1	20	18	7	10	14	0	5	22	4
B. Lehman's to Deep Creek		685	387	4	69	562	177	74	116	308	141	100	651	124
C. Ninilchik Bar		65	11	0	0	89	1	0	0	2	0	50	66	0
Happy Valley														
Deep Creek to Happy Creek		251	137	7	4	244	18	0	0	24	22	0	75	39
Whiskey Gulch														
Happy Creek to Anchor River		39	26	0	1	37	3	6	5	21	0	0	40	23
Total Diggers		2,150	1,156	37	195	1,495	370	194	292	515	346	268	1,413	373

-continued-

Table 1.–Page 9 of 11.

BEACH 2001	Date	5/08	5/11	5/24	5/28	6/05	6/09	6/21	6/24	7/03	7/06	7/24	8/01
	Tide:	-3.8	-1	-3.8	-1.1	-3	-1.2	-3.8	-4.2	-1.3	-1.7	-3.3	-0.9
Cohoe													
C. Kasilof to S. Ext. of Cohoe Lp. Rd.		8	2	27	6	9	30	0	8	13	20	29	0
Clam Gulch													
S. Ext. of Cohoe Lp. Rd. to Tower		94	27	248	144	86	162	367	85	92	153	162	28
A. S. Ext. to A-frame		4	6	18	13	0	20	80	6	7	18	11	11
B. A-frame to Bluff		55	11	95	92	20	110	113	34	53	36	49	7
C. Bluff to Tower		35	10	135	39	66	32	174	45	32	99	102	10
Oil Pad Access													
Clam Gulch Tower to Set Net Access		64	22	66	20	97	58	77	86	55	83	118	27
Ninilchik													
Set Net Access to Deep Creek		148	15	402	81	196	98	274	143	99	151	194	23
A. Set Net Access to Lehman's		15	0	58	31	15	3	6	8	6	17	4	0
B. Lehman's to Deep Creek		126	15	338	50	181	95	268	126	93	134	187	21
C. Ninilchik Bar		7	0	6	0	0	0	0	9	0	0	3	2
Happy Valley													
Deep Creek to Happy Creek		28	3	73	14	28	34	63	24	13	12	43	7
Whiskey Gulch													
Happy Creek to Anchor River		13	0	15	0	3	5	28	10	7	19	21	0
Total Diggers		355	69	831	265	419	387	809	356	279	438	567	85

-continued-

Table 1.–Page 10 of 11.

BEACH 2002	Date	4/26	4/30	5/15	5/25	6/09	6/12	6/22	6/25	7/10	7/13	7/15	7/24	8/07	8/10
	Tide:	-3.5	-3.1	-1.8	-4.8	-0.9	-2.9	-2.1	-3.8	-2.8	-3.6	-1	-2.6	-1.6	-4
Cohoe															
C. Kasilof to S. Ext. of Cohoe Lp. Rd.		19	5	2	65	1	6	13	25	0	48	9	21	0	88
Clam Gulch															
S. Ext. of Cohoe Lp. Rd. to Tower		58	32	28	425	45	167	162	241	157	245	81	117	50	371
A. S. Ext. to A-frame		4	0	1	70	0	20	2	27	2	32	5	2	0	50
B. A-frame to Bluff		29	10	11	155	10	91	60	79	100	123	30	75	18	86
C. Bluff to Tower		25	22	16	200	35	56	100	135	55	90	46	40	32	235
Oil Pad Access															
Clam Gulch Tower to Set Net Access		31	13	15	310	13	59	52	130	86	267	74	65	18	218
Ninilchik															
Set Net Access to Deep Creek		100	41	30	1,145	70	206	198	498	308	194	80	45	68	496
A. Set Net Access to Lehman's		0	2	0	85	0	5	6	21	0	13	0	0	0	17
B. Lehman's to Deep Creek		98	39	30	1,040	70	201	185	465	303	382	80	45	68	450
C. Ninilchik Bar		2	0	0	20	0	0	7	12	5	7	0	0	0	29
Happy Valley															
Deep Creek to Happy Creek		22	1	0	185	15	15	9	92	57	27	0	14	6	86
Whiskey Gulch															
Happy Creek to Anchor River		3	0	2	125	10	17	5	50	22	20	1	0	4	50
Total Diggers		233	92	77	2,255	154	470	439	1,036	630	801	245	262	146	1,309

-continued-

Table 1.–Page 11 of 11.

BEACH 2003	Date	4/17	4/19	5/02	5/16	5/19	5/30	6/16	6/18	7/02	7/12	7/15	7/31	8/13
	Tide:	-4.5	-4.6	-1.6	-5.4	-3.7	-1.3	-5.2	-2.1	-2	-3.3	-4	-2.5	-2.9
Cohoe														
C. Kasilof to S. Ext. of Cohoe Lp. Rd.		9	56	0	16	15	2	74	0	4	19	24	2	2
Clam Gulch														
S. Ext. of Cohoe Lp. Rd. to Tower		85	377	18	269	68	41	524	107	109	334	340	135	106
A. S. Ext. to A-frame		0	31	3	29	5	0	64	4	7	12	2	5	8
B. A-frame to Bluff		40	180	11	90	18	17	185	56	64	85	116	42	30
C. Bluff to Tower		45	166	4	150	45	24	275	47	38	237	222	88	68
Oil Pad Access														
Clam Gulch Tower to Set Net Access		56	316	9	168	33	4	219	47	56	138	216	73	56
Ninilchik														
Set Net Access to Deep Creek		165	503	13	516	144	50	582	75	96	398	295	137	100
A. Set Net Access to Lehman's		7	33	1	15	1	1	20	0	11	14	2	0	0
B. Lehman's to Deep Creek		150	448	10	475	142	49	525	75	85	379	265	137	100
C. Ninilchik Bar		8	22	2	26	1	0	37	0	0	5	28	0	0
Happy Valley														
Deep Creek to Happy Creek		40	87	3	135	43	5	225	14	5	94	44	11	12
Whiskey Gulch														
Happy Creek to Anchor River		13	65	5	31	10	8	73	7	11	22	24	6	2
Total Diggers		368	1,404	48	1,135	313	110	1,697	250	281	1,005	943	364	278

Table 2.-Percentage of razor clam harvest by beach from eastside Cook Inlet, adjusted for relative success rate, 1993-2003.

Year	No. of surveys	Beach: Cohoe	Clam Gulch	Oil Pad	Ninilchik	Happy Valley	Whiskey Gulch
1993	13	0.3	21.0	11.8	61.9	4.3	0.7
1994	13	0.3	19.8	10.0	65.0	4.0	1.0
1995	13	0.1	19.9	10.5	65.5	3.2	0.7
1996	13	0.6	23.3	13.6	57.5	3.9	1.1
1997	12	0.6	26.5	13.6	56.1	2.2	1.1
1998	12	1.0	28.3	16.6	50.6	2.4	1.1
1999	14	1.2	27.1	13.4	53.5	4.0	0.9
2000	13	2.2	31.1	12.8	47.8	4.9	1.2
2001	13	1.8	37.1	16.8	39.4	3.6	1.3
2002	14	2.0	28.0	17.5	47.3	3.4	2.0
2003	13	1.3	34.2	18.8	39.6	4.3	1.7
Mean	13.0	1.0	26.9	14.1	53.1	3.6	1.2

Note: Harvest percentage weighted by tidal height.

Table 3.–Estimated number of razor clams harvested from eastside Cook Inlet beaches, 1993-2003.

Year	Beach: Cohoe	Clam Gulch	Oil Pad	Ninilchik	Happy Valley	Whiskey Gulch	Total Harvest	Participation (digger-days)
1993	2,497	198,993	111,823	585,751	40,877	6,508	946,450	39,927
1994	3,611	250,634	126,788	825,302	50,292	12,505	1,269,131	47,112
1995	1,602	227,924	120,438	752,350	37,051	8,508	1,147,872	41,837
1996	4,453	189,186	110,776	467,529	31,863	9,138	812,946	29,885
1997	4,658	219,530	113,210	465,680	17,932	8,831	829,841	28,343
1998	6,344	182,101	106,749	325,811	15,341	7,266	643,612	26,636
1999	9,177	203,127	100,368	401,960	29,827	6,425	750,883	36,292
2000	18,475	262,153	107,460	402,427	41,542	10,214	842,270	37,755
2001	11,364	231,888	105,152	246,299	22,716	8,308	625,727	31,915
2002	14,861	212,126	132,620	358,290	25,402	14,763	758,062	33,966
2003	7,525	192,567	104,277	226,434	24,736	10,104	565,643	25,120
Mean	7,688	215,475	112,696	459,803	30,689	8,793	941,642	35,623

Note: Harvest and digger-days of participation determined by Statewide Harvest Survey. Harvest by beach is apportioned from aerial surveys and assumes a success rate of 0.5 on Whiskey Gulch, Happy Valley and Cohoe beaches.

Table 4.–Relative percentage of the number of razor clams harvested and estimated harvest by beach or sub-beach from eastside Cook Inlet, 1993-2003.

Beach/sub-beach	Relative percent (P_b)	SE (P_b)	Relative success	Harvest (H)	SE (H)
1993					
Cohoe	0.00	0.000	0.5	2,497	208
S. Ext. of Cohoe Loop Rd to A-frame	0.01	0.001	1.0	12,543	1,027
A-frame to Bluff	0.14	0.005	1.0	130,218	7,560
Bluff to Tower	0.06	0.001	1.0	56,232	2,816
Oil Pad Access	0.12	0.002	1.0	111,823	5,484
Set Net Access to Lehman's	0.02	0.001	1.0	17,680	1,219
Lehman's to Deep Creek	0.49	0.008	1.0	467,471	22,008
Ninilchik Bar	0.11	0.002	1.0	100,600	5,039
Happy Valley	0.04	0.001	0.5	40,877	2,134
Whiskey Gulch	0.01	0.000	0.5	6,508	423
TOTAL	1.00	0.02		946,449	47,916
1994					
Cohoe	0.00	0.000	0.5	3,611	438
S. Ext. of Cohoe Loop Rd to A-frame	0.01	0.001	1.0	13,453	1,633
A-frame to Bluff	0.11	0.005	1.0	141,598	8,763
Bluff to Tower	0.08	0.006	1.0	95,583	8,066
Oil Pad Access	0.10	0.003	1.0	126,788	6,072
Set Net Access to Lehman's	0.02	0.001	1.0	27,384	1,642
Lehman's to Deep Creek	0.55	0.004	1.0	700,324	28,050
Ninilchik Bar	0.08	0.005	1.0	97,594	7,020
Happy Valley	0.04	0.002	0.5	50,292	3,224
Whiskey Gulch	0.01	0.001	0.5	12,505	862
TOTAL	1.00	0.03		1,269,132	65,770
1995					
Cohoe	0.00	0.000	0.5	1,602	118
S. Ext. of Cohoe Loop Rd to A-frame	0.01	0.001	1.0	12,293	1,308
A-frame to Bluff	0.12	0.006	1.0	132,934	9,222
Bluff to Tower	0.07	0.003	1.0	82,697	5,350
Oil Pad Access	0.10	0.002	1.0	120,438	6,288
Set Net Access to Lehman's	0.02	0.001	1.0	19,321	1,635
Lehman's to Deep Creek	0.54	0.005	1.0	617,486	30,359
Ninilchik Bar	0.10	0.001	1.0	115,543	5,812
Happy Valley	0.03	0.002	0.5	37,051	2,990
Whiskey Gulch	0.01	0.000	0.5	8,508	583
TOTAL	1.00	0.02		1,147,873	63,664

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Table 4.–Page 2 of 4.

Beach/sub-beach	Relative percent (P_b)	SE (P_b)	Relative success	Harvest (H)	SE (H)
1996					
Cohoe	0.01	0.000	0.5	4,453	387
S. Ext. of Cohoe Loop Rd to A-frame	0.02	0.001	1.0	13,910	986
A-frame to Bluff	0.14	0.008	1.0	111,521	8,047
Bluff to Tower	0.08	0.002	1.0	63,756	3,445
Oil Pad Access	0.14	0.004	1.0	110,776	5,895
Set Net Access to Lehman's	0.02	0.002	1.0	12,321	1,365
Lehman's to Deep Creek	0.46	0.005	1.0	371,241	17,446
Ninilchik Bar	0.10	0.003	1.0	83,967	4,727
Happy Valley	0.04	0.002	0.5	31,863	2,074
Whiskey Gulch	0.01	0.001	0.5	9,138	787
TOTAL	1.00	0.03		812,946	45,159
1997					
Cohoe	0.01	0.000	0.5	4,658	337
S. Ext. of Cohoe Loop Rd to A-frame	0.01	0.001	1.0	10,698	838
A-frame to Bluff	0.15	0.003	1.0	123,577	5,910
Bluff to Tower	0.10	0.003	1.0	85,255	4,393
Oil Pad Access	0.14	0.005	1.0	113,210	6,333
Set Net Access to Lehman's	0.02	0.002	1.0	17,670	1,517
Lehman's to Deep Creek	0.48	0.007	1.0	397,499	18,210
Ninilchik Bar	0.06	0.001	1.0	50,511	2,522
Happy Valley	0.02	0.001	0.5	17,932	1,358
Whiskey Gulch	0.01	0.001	0.5	8,831	658
TOTAL	1.00	0.02		829,841	42,076
1998					
Cohoe	0.01	0.001	0.5	6,344	465
S. Ext. of Cohoe Loop Rd to A-frame	0.03	0.003	1.0	17,664	2,421
A-frame to Bluff	0.13	0.004	1.0	82,939	4,816
Bluff to Tower	0.13	0.004	1.0	81,499	5,041
Oil Pad Access	0.17	0.003	1.0	106,749	5,732
Set Net Access to Lehman's	0.03	0.002	1.0	16,885	1,448
Lehman's to Deep Creek	0.45	0.010	1.0	287,423	15,845
Ninilchik Bar	0.03	0.002	1.0	21,503	1,654
Happy Valley	0.02	0.001	0.5	15,341	908
Whiskey Gulch	0.01	0.001	0.5	7,266	569
TOTAL	1.00	0.03		643,613	38,899

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Table 4.–Page 3 of 4.

Beach/sub-beach	Relative percent (P_b)	SE (P_b)	Relative success	Harvest (H)	SE (H)
1999					
Cohoe	0.01	0.001	0.5	9,177	667
S. Ext. of Cohoe Loop Rd to A-frame	0.02	0.001	1.0	17,983	1,370
A-frame to Bluff	0.11	0.007	1.0	82,909	6,837
Bluff to Tower	0.14	0.008	1.0	102,235	7,685
Oil Pad Access	0.13	0.009	1.0	100,368	8,313
Set Net Access to Lehman's	0.03	0.002	1.0	18,930	1,544
Lehman's to Deep Creek	0.46	0.015	1.0	341,838	20,827
Ninilchik Bar	0.05	0.004	1.0	41,192	3,678
Happy Valley	0.04	0.002	0.5	29,827	1,935
Whiskey Gulch	0.01	0.001	0.5	6,425	598
TOTAL	1.00	0.05		750,884	53,454
2000					
Cohoe	0.02	0.002	0.5	18,475	1,830
S. Ext. of Cohoe Loop Rd to A-frame	0.04	0.002	1.0	36,411	2,732
A-frame to Bluff	0.13	0.003	1.0	113,542	6,253
Bluff to Tower	0.13	0.007	1.0	112,200	7,882
Oil Pad Access	0.13	0.005	1.0	107,460	6,944
Set Net Access to Lehman's	0.02	0.001	1.0	20,870	1,351
Lehman's to Deep Creek	0.42	0.006	1.0	351,967	18,480
Ninilchik Bar	0.04	0.004	1.0	29,590	3,324
Happy Valley	0.05	0.002	0.5	41,542	2,488
Whiskey Gulch	0.01	0.000	0.5	10,214	633
TOTAL	1.00	0.03		842,271	51,919
2001					
Cohoe	0.02	0.001	0.5	11,364	1,017
S. Ext. of Cohoe Loop Rd to A-frame	0.04	0.005	1.0	26,120	3,278
A-frame to Bluff	0.16	0.008	1.0	99,304	7,503
Bluff to Tower	0.17	0.007	1.0	106,464	7,078
Oil Pad Access	0.17	0.011	1.0	105,152	8,783
Set Net Access to Lehman's	0.04	0.005	1.0	23,265	3,421
Lehman's to Deep Creek	0.35	0.006	1.0	219,972	12,371
Ninilchik Bar	0.00	0.001	1.0	3,062	612
Happy Valley	0.04	0.001	0.5	22,716	1,390
Whiskey Gulch	0.01	0.001	0.5	8,308	705
TOTAL	1.00	0.05		625,727	46,158

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Table 4.–Page 4 of 4.

Beach/sub-beach	Relative percent (P_b)	SE (P_b)	Relative success	Harvest (H)	SE (H)
2002					
Cohoe	0.02	0.001	0.5	14,861	1,276
S. Ext. of Cohoe Loop Rd to A-frame	0.03	0.003	1.0	21,215	2,361
A-frame to Bluff	0.11	0.005	1.0	86,447	6,191
Bluff to Tower	0.14	0.013	1.0	104,464	11,395
Oil Pad Access	0.17	0.007	1.0	132,620	9,355
Set Net Access to Lehman's	0.02	0.002	1.0	14,663	1,479
Lehman's to Deep Creek	0.44	0.006	1.0	335,537	20,605
Ninilchik Bar	0.01	0.001	1.0	8,090	944
Happy Valley	0.03	0.003	0.5	25,402	2,964
Whiskey Gulch	0.02	0.002	0.5	14,763	1,988
TOTAL	1.00	0.04		758,062	58,557
2003					
Cohoe	0.013	0.0007	0.5	7,525	613
S. Ext. of Cohoe Loop Rd to A-frame	0.022	0.0017	1.0	12,577	1,241
A-frame to Bluff	0.129	0.0043	1.0	73,177	5,207
Bluff to Tower	0.189	0.0035	1.0	106,813	7,013
Oil Pad Access	0.184	0.0052	1.0	104,277	7,188
Set Net Access to Lehman's	0.013	0.0013	1.0	7,559	877
Lehman's to Deep Creek	0.372	0.0095	1.0	210,385	14,293
Ninilchik Bar	0.015	0.0013	1.0	8,491	900
Happy Valley	0.044	0.0016	0.5	24,736	1,810
Whiskey Gulch	0.018	0.0007	0.5	10,104	758
TOTAL	1.000	0.030		565,643	39,900

Table 5.–Percentage of razor clams sampled at Clam Gulch Beach by age class, 1993-2003.

Year	Age class												Number sampled
	1	2	3	4	5	6	7	8	9	10	11	12	
1993		1.0	0.8	0.8	53.8	9.4	2.9	6.0	12.1	10.8	2.1	0.3	381
1994		4.7	1.2	8.3	52.8	13.7	3.8	4.5	5.2	4.7	0.7	0.5	424
1995			6.7	1.0	24.4	32.7	7.3	9.5	11.7	5.1	1.3	0.3	315
1996		3.2	2.3	22.2	17.8	23.7	15.5	8.8	4.4	1.8	0.3		342
1997		0.8	22.0	12.6	19.8	19.5	17.0	4.1	3.3	0.8			364
1998		3.3	7.9	47.5	6.6	12.5	11.5	5.9	4.6	0.3			305
1999			3.0	58.7	18.3	12.7	3.3	3.7	0.3				300
2000		0.6	0.3	3.8	14.6	23.1	14.9	18.0	12.0	8.9	3.2	0.6	316
2001			0.7	4.4	5.4	15.2	31.3	16.8	13.5	8.8	3.7	0.3	297
2002			0.7	6.5	5.5	11.0	15.8	34.7	11.3	8.6	5.8		291
2003			1.0	10.6	16.3	17.3	15.6	24.9	9.0	4.0	1.0	0.3	301

Table 6.–Percentage of razor clams sampled at Ninilchik Beach by age class, 1993-2003.

Year	Age class													Number sampled
	1	2	3	4	5	6	7	8	9	10	11	12	13	
1993		1.0	13.3	5.5	47.8	24.6	3.1	1.0	1.4	1.0	1.0	0.3		293
1994		0.3	2.7	17.6	12.2	55.1	8.4	0.8	1.6	0.8	0.3	0.3		370
1995		1.6	6.2	15.8	26.4	41.0	5.6	0.6	1.6	0.9	0.0	0.3		322
1996		40.2	5.6	8.5	19.9	21.7	2.1	1.5	0.3	0.3	0.0			341
1997		0.3	40.5	16.0	10.8	10.8	13.7	4.6	1.6	1.3	0.3			306
1998		5.6	8.9	57.2	5.6	8.6	7.2	5.9	1.0	0.0				304
1999		24.8	13.9	6.6	41.1	4.3	3.0	5.0	1.3	0.0				302
2000		5.0	58.8	9.4	4.4	15.4	3.8	0.9	0.9	0.6	0.3	0.3		318
2001		5.3	8.3	38.0	22.0	5.3	15.0	2.7	1.7	0.3	0.7	0.3	0.3	300
2002	11.0	36.7	12.3	3.9	25.6	3.6	1.6	2.6	1.0	0.6	0.3	0.3	0.3	308
2003		56.6	18.4	8.9	4.3	5.3	2.6	2.3	1.0	0.3	0.3			304

Table 7.–Percentage of razor clams sampled at Oil Pad Access and Set Net Access combined by age class, 1993-2003.

Year	Age class												Number sampled
	1	2	3	4	5	6	7	8	9	10	11	12	
1993		0.2	13.5	3.9	51.3	11.4	3.4	7.1	4.3	3.6	1.1	0.2	466
1994		0.2	1.5	5.4	63.8	15.1	3.2	4.3	4.7	1.3	0.6		536
1995		1.6	8.7	3.7	35.4	37.3	5.8	4.5	1.9	0.8	0.3		378
1996		4.8	3.5	18.0	27.3	31.5	9.0	3.5	1.6	0.6			311
1997		0.3	62.1	5.5	21.0	4.7	4.7	0.9	0.9				343
1998		0.7	3.9	78.1	9.8	4.9	1.6	0.7	0.3				306
1999		0.7	9.9	62.7	13.9	9.2	3.3	0.3					303
2000		0.3	8.1	6.6	12.1	45.2	17.9	6.3	2.6	0.9	0.0		347
2001	0.6	4.9	4.5	7.8	12.3	16.9	42.5	7.8	1.6	0.6	0.3		308
2002	3.9	9.8	8.1	8.8	14.7	15.6	18.6	16.3	3.6	0.7			307
2003		12.4	25.8	15.7	6.5	15.0	8.8	9.2	5.6	1.0			306

Table 8.–Percentage of razor clams sampled at Cohoe Beach by age class, 1993-2003.

Year	Age class												Number sampled
	1	2	3	4	5	6	7	8	9	10	11	12	
1993			19.0	6.3	50.0	18.3	2.1	0.7	2.8	0.7			142
1994		0.5	1.4	30.6	59.7	7.9							216
1995		0.6	17.8	9.2	33.9	29.3	4.6	2.3	2.3				174
1996			0.6	59.4	25.5	10.9	3.6						165
1997			31.7	9.0	31.7	20.0	4.8	2.8					145
1998		24.2	5.9	46.4	7.2	7.8	5.2	3.3					153
1999			7.2	51.0	13.7	11.1	6.5	6.5	2.6	1.3			153
2000		9.9	2.5	8.7	16.1	29.8	20.5	7.5	4.3	0.6	0.0	0.0	161
2001		0.0	7.9	2.6	16.6	6.0	52.3	9.3	3.3	2.0	0.0	0.0	151
2002		0.0	0.0	6.9	9.4	5.0	19.5	12.6	34.0	7.5	4.4	0.6	159
2003		0.7	13.8	24.1	11.7	9.0	15.2	16.6	5.5	2.8	0.7	0.0	145

Table 9.–Estimated number of razor clams harvested by age class from Clam Gulch Beach, 1993-2003.

Year	Age class								Total
	4	5	6	7	8	9	10	11+	
1993	1,596	109,074	19,154	5,853	12,238	24,475	21,815	4,789	198,993
1994	21,985	140,707	36,433	10,050	11,935	13,819	12,563	3,141	250,634
1995	2,326	59,694	79,851	17,831	23,258	28,684	12,404	3,876	227,924
1996	44,514	35,729	47,443	31,043	17,571	8,786	3,514	586	189,186
1997	35,937	56,250	55,468	48,437	11,719	9,375	2,344		219,530
1998	97,434	13,439	25,534	23,519	12,095	9,407	672		182,101
1999	122,853	38,392	26,525	6,980	7,678	698			203,127
2000	10,051	38,527	61,141	39,365	47,740	31,827	23,451	10,051	262,153
2001	10,219	12,577	35,373	73,104	39,303	31,442	20,438	9,433	231,888
2002	13,946	11,744	23,488	33,764	74,134	24,222	18,350	12,478	212,126
2003	20,678	31,664	33,602	30,371	48,465	17,447	7,754	2,585	192,567

Table 10.-Estimated number of razor clams harvested by age class from Ninilchik Beach, 1993-2003.

Year	Age class									Total
	3	4	5	6	7	8	9	10	11+	
1993	62,867	25,792	225,676	116,062	14,508	4,836	6,448	4,836	6,448	467,471
1994	18,979	123,363	85,405	387,171	58,835	5,694	11,387	5,694	3,796	700,324
1995	38,958	99,343	165,572	257,124	35,062	3,896	9,740	5,844	1,948	617,486
1996	34,576	52,774	123,747	134,666	12,739	9,099	1,820	1,820		371,241
1997	161,606	63,860	43,008	43,008	54,738	18,246	6,516	5,213	1,303	397,499
1998	27,040	174,256	17,025	26,038	22,032	18,027	3,004			287,423
1999	63,248	30,118	186,731	19,577	13,553	22,588	6,024			341,838
2000	217,940	34,964	16,316	57,107	13,985	3,496	3,496	2,331	2,331	351,967
2001	19,364	88,299	51,120	12,393	34,855	6,196	3,873	775	3,098	219,972
2002	79,195	25,009	164,642	22,925	10,420	16,673	6,252	4,168	6,252	335,537
2003	89,254	43,033	20,720	25,501	12,751	11,157	4,781	1,594	1,594	210,385

Table 11.–Average length at last annuli formation of clams by age class from eastside Cook Inlet beaches, 1993-2003.

	Cohoe	Age class													
		1	2	3	4	5	6	7	8	9	10	11	12	13	Total
1993	Number measured			27	9	71	26	3	1	4	1				142
	Average length			59.26	88.22	99.89	111.50	120.00	122.00	119.00	127.00				
	SE (length)			3.61	8.56	6.06	4.68	4.58		4.24					
1994	Number measured		1	3	66	129	17								216
	Average length		26.00	51.67	74.23	98.91	110.76								
	SE (length)			2.31	4.54	6.81	5.49								
1995	Number measured		1	31	16	59	51	8	4	4					174
	Average length		25.00	56.29	74.25	89.54	103.24	106.00	111.50	121.50					
	SE (length)			3.82	4.37	7.50	6.80	5.88	10.34	3.51					
1996	Number measured			1	98	42	18	6							165
	Average length			52.00	84.99	98.21	106.28	111.33							
	SE (length)				4.65	4.61	5.10	6.44							
1997	Number measured			46	13	46	29	7	4						145
	Average length			67.80	93.38	100.89	109.90	115.00	117.00						
	SE (length)			4.74	5.66	4.63	6.39	8.81	2.16						
1998	Number measured		37	9	71	11	12	8	5						153
	Average length		44.92	73.78	90.34	104.00	108.58	115.38	114.60						
	SE (length)		4.02	5.45	5.61	5.12	5.55	5.60	5.45						
1999	Number measured			11	78	21	17	10	10	4	2				153
	Average length			76.27	88.71	103.14	107.18	107.30	114.20	117.50	127.50				
	SE (length)			5.20	5.11	6.22	4.13	4.57	4.09	7.55	6.36				
2000	Number measured		9	9	19	33	41	28	13	6	1				159
	Average length		48.01	57.81	82.11	93.01	99.84	107.27	109.23	112.67	119.77				
	SE (length)		10.64	11.33	7.99	8.06	6.75	5.48	7.71	6.51					
2001	Number measured			12	4	25	9	79	14	5	3				151
	Average length			74.12	86.73	96.97	103.52	106.49	114.14	118.37	115.84				
	SE (length)			6.25	12.16	5.46	5.63	7.24	6.12	7.06	4.91				
2002	Number measured				2	7	31	20	53	14	7	1			135
	Average length				85.02	102.58	106.40	114.37	113.72	117.80	117.09	104.90			
	SE (length)				15.52	7.15	5.90	5.66	5.39	9.75	6.45				
2003	Number measured		1	20	35	17	13	22	24	8	4	1			145
	Average length		47.95	62.43	86.23	100.22	105.88	109.04	111.49	116.93	122.57	116.48			
	SE (length)			6.67	7.75	4.87	4.94	3.96	5.08	6.75	2.86				

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Table 11.–Page 2 of 9.

	Clam Gulch	Age class													
		1	2	3	4	5	6	7	8	9	10	11	12	13	Total
1993	Number measured		4	3	3	205	36	11	23	46	41	8	1		381
	Average length		58.00	70.33	90.00	99.55	109.64	121.64	121.17	122.72	124.59	129.88	132.00		
	SE (length)		3.37	1.15	2.00	4.99	5.84	5.45	4.84	5.25	5.24	6.10			
1994	Number measured		20	5	35	224	58	16	19	22	20	3	2		424
	Average length		25.95	54.60	72.51	97.19	104.62	112.88	117.05	117.18	122.70	121.67	126.50		
	SE (length)		3.47	3.58	5.35	5.61	5.96	6.67	5.85	3.50	4.07	5.03	9.19		
1995	Number measured			21	3	77	103	23	30	37	16	4	1		315
	Average length			49.10	77.67	96.45	111.27	119.57	122.37	124.54	127.38	131.00	137.00		
	SE (length)			5.49	3.79	9.45	5.97	5.97	4.57	4.77	4.88	7.26			
1996	Number measured		11	8	76	61	81	53	30	15	6	1			342
	Average length		27.55	66.38	83.84	102.21	110.88	117.26	123.63	127.00	126.00	140.00			
	SE (length)		3.24	8.19	6.93	5.73	5.74	5.71	4.97	5.79	5.22				
1997	Number measured		3	80	46	72	71	62	15	12	3				364
	Average length		28.67	65.51	96.30	100.33	109.86	117.63	127.20	128.75	130.00				
	SE (length)		2.89	6.22	5.29	6.05	5.93	6.32	6.92	4.85	1.00				
1998	Number measured		10	24	145	20	38	35	18	14	1				305
	Average length		46.50	74.83	90.44	105.75	114.26	117.60	124.39	127.79	123.00				
	SE (length)		6.84	6.41	7.83	5.33	5.56	6.35	7.93	7.52					
1999	Number measured			9	176	55	38	10	11	1					300
	Average length			71.56	89.06	99.69	108.74	109.90	117.36	118.00					
	SE (length)			4.00	5.71	5.93	4.57	5.72	7.16						
2000	Number measured		2	1	12	29	84	52	58	43	24	10	3		318
	Average length		40.49	59.91	85.92	91.02	100.55	110.60	115.74	116.72	121.05	122.24	129.47		
	SE (length)		9.28		10.07	9.92	7.14	9.17	6.51	7.95	7.40	7.20	4.83		
2001	Number measured			2	13	16	45	93	50	40	26	11			296
	Average length			71.21	91.51	92.73	103.98	108.66	114.35	117.89	120.37	122.02			
	SE (length)			17.08	3.68	5.38	8.62	6.03	6.48	4.53	4.84	4.06			
2002	Number measured			2	19	16	32	46	101	32	25	17	1	291	291
	Average length			83.83	91.80	104.46	108.77	110.88	115.30	120.47	121.85	120.44	127.85		
	SE (length)			0.49	5.04	6.28	7.17	5.90	6.76	7.45	6.78	6.23			
2003	Number measured			3	32	49	52	47	75	27	12	3	1		301
	Average length			64.37	88.24	101.10	106.50	112.18	113.93	116.90	119.89	122.14	138.19		
	SE (length)			9.40	6.77	7.39	7.90	6.82	5.10	6.15	5.77	3.64			

-continued-

Table 11.–Page 3 of 9.

	Set Net Access	Age class													
		1	2	3	4	5	6	7	8	9	10	11	12	13	Total
1993	Number measured			28	9	124	22	3	4	5	2				197
	Average length			88.39	109.22	116.03	123.55	128.67	133.75	140.20	134.00				
	SE (length)			6.19	6.22	4.96	5.70	2.52	8.81	4.15	5.66				
1994	Number measured			7	9	128	34	9	12	10	2				211
	Average length			84.86	102.11	118.97	126.03	128.22	133.42	135.90	138.00				
	SE (length)			5.34	4.26	5.22	5.41	5.63	7.42	8.91	5.66				
1995	Number measured		4	19	4	50	74	13	9	3	1	1			178
	Average length		61.25	84.53	101.50	114.34	122.46	131.00	132.78	130.67	135.00	149.00			
	SE (length)		6.85	3.89	5.26	7.10	5.91	4.64	5.72	11.24					
1996	Number measured		15	11	32	40	35	15	5	3	1				157
	Average length		47.73	79.27	104.25	118.60	124.31	133.40	133.20	138.33	127.00				
	SE (length)		3.83	12.81	5.18	7.93	6.29	5.57	1.92	2.31					
1997	Number measured		1	141	4	13	1	1							161
	Average length		58.00	90.32	106.25	113.85	122.00	133.00							
	SE (length)			4.70	4.86	3.26									
1998	Number measured			4	131	10	7	1	1						154
	Average length			88.25	106.47	119.40	125.57	131.00	137.00						
	SE (length)			4.50	5.14	4.20	3.41								
1999	Number measured		2	21	109	10	6	2							150
	Average length		40.50	89.19	109.11	115.80	124.67	128.50							
	SE (length)		3.54	7.95	4.65	6.73	4.41	0.71							
2000	Number measured			10	16	23	96	11	5	2					163
	Average length			91.83	104.44	113.02	117.67	122.31	125.91	127.56					
	SE (length)			5.84	7.48	6.62	5.28	6.07	2.50	1.91					
2001	Number measured	2	15	10	19	17	27	47	15	3	2				157
	Average length	14.59	55.83	93.21	108.04	115.41	116.82	125.81	128.51	129.36	134.70				
	SE (length)	0.30	3.00	11.79	5.73	6.15	8.15	6.66	4.01	2.94	1.71				
2002	Number measured	11	28	18	21	30	29	13	6	1					157
	Average length	14.70	72.11	96.29	109.11	119.52	119.44	122.63	129.98	112.22					
	SE (length)	9.40	5.71	6.57	4.75	5.39	6.59	5.31	6.06						
2003	Number measured		31	60	29	7	14	6	2	3	2				154
	Average length		56.21	85.79	101.37	114.12	121.32	126.57	125.22	127.32	124.11				
	SE (length)		10.83	14.49	7.19	4.49	5.95	7.58	3.09	1.78	2.82				

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Table 11.–Page 4 of 9.

	Oil Pad Access	Age class													
		1	2	3	4	5	6	7	8	9	10	11	12	13	Total
1993	Number measured			36	8	116	31	13	28	16	15	5			268
	Average length			69.97	91.88	107.41	117.35	123.92	128.46	131.44	138.87	138.00			
	SE (length)			4.99	5.59	5.69	7.03	5.69	5.39	5.23	6.66	6.67			
1994	Number measured		1	1	20	214	47	8	11	15	5	3			325
	Average length		30.00	75.00	85.55	109.27	118.36	120.38	130.18	129.40	132.20	141.00			
	SE (length)				6.75	5.70	6.20	5.48	5.12	5.33	5.22	6.56			
1995	Number measured		2	14	10	84	67	9	8	4	2				200
	Average length		39.50	72.86	99.80	108.31	117.03	120.22	125.38	132.25	134.50				
	SE (length)		0.71	3.63	5.29	8.23	5.82	8.36	8.99	9.39	2.12				
1996	Number measured				24	45	63	13	6	2	1				154
	Average length				91.92	111.87	115.95	125.69	126.00	133.00	131.00				
	SE (length)				13.73	8.02	7.32	6.99	6.13	0.00					
1997	Number measured			72	15	59	15	15	3	3					182
	Average length			75.82	97.53	109.25	121.20	125.13	126.00	137.33					
	SE (length)			7.09	6.65	5.72	7.55	4.17	6.08	4.73					
1998	Number measured		2	8	108	20	8	4	1	1					152
	Average length		54.50	82.88	97.34	114.05	120.88	120.25	126.00	141.00					
	SE (length)		0.71	2.36	6.35	4.74	4.45	3.77							
1999	Number measured			9	81	32	22	8	1						153
	Average length			83.11	98.89	110.06	119.82	125.75	137.00						
	SE (length)			7.72	4.90	5.90	3.89	3.85							
2000	Number measured		1	15	9	19	57	49	22	9	2	1			184
	Average length		56.30	76.33	92.70	103.55	108.20	114.17	118.67	123.71	131.28	130.77			
	SE (length)			5.11	9.39	6.27	6.20	5.42	4.79	5.16	0.31				
2001	Number measured			4	5	21	25	84	9	2		1			151
	Average length			78.71	92.58	100.48	106.15	111.13	115.89	118.11		136.23			
	SE (length)			2.57	5.73	6.05	7.00	5.69	6.77	6.32					
2002	Number measured	1	2	7	6	15	19	44	44	10	2				150
	Average length	8.20	67.19	89.77	107.05	111.74	118.73	121.52	124.37	126.56	131.88				
	SE (length)		0.04	7.06	3.30	7.83	9.37	6.00	6.62	3.88	1.43				
2003	Number measured		7	19	19	13	32	21	26	14	1				152
	Average length		50.96	76.38	93.11	104.86	112.58	116.94	116.21	116.80	119.77				
	SE (length)		8.73	9.63	6.71	10.38	7.31	6.82	7.42	6.89					

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Table 11.–Page 5 of 9.

	Set Net and Oil Pad access (combined)	Age class 1	2	3	4	5	6	7	8	9	10	11	12	13	Total
1993	Number measured			64	17	240	53	16	32	21	17	5	1		466
	Average length			78.03	101.06	111.87	119.92	124.81	129.13	133.52	138.29	138.00	155.00		
	SE (length)			10.73	10.62	6.84	7.15	5.52	5.99	6.21	6.59	6.67			
1994	Number measured		1	8	29	342	81	17	23	25	7	3			536
	Average length		30.00	83.63	90.69	112.90	121.58	124.53	131.87	132.00	133.86	141.00			
	SE (length)			6.05	9.84	7.25	6.98	6.73	6.49	7.54	5.61	6.56			
1995	Number measured		6	33	14	134	141	22	17	7	3	1			378
	Average length		54.00	79.58	100.29	110.56	119.88	126.59	129.29	131.57	134.67	149.00			
	SE (length)		12.43	6.94	5.14	8.33	6.45	8.27	8.14	9.32	1.53				
1996	Number measured		15	11	56	85	98	28	11	5	2				311
	Average length		47.73	79.27	98.96	115.04	118.94	129.82	129.27	136.20	129.00				
	SE (length)		3.83	12.81	11.49	8.62	8.02	7.29	5.87	3.35	2.83				
1997	Number measured		1	213	19	72	16	16	3	3					343
	Average length		58.00	85.42	99.37	110.08	121.25	125.63	126.00	137.33					
	SE (length)			8.87	7.19	5.63	7.30	4.49	6.08	4.73					
1998	Number measured		2	12	239	30	15	5	2	1					306
	Average length		54.50	84.67	102.34	115.83	123.07	122.40	131.50	141.00					
	SE (length)		0.71	4.01	7.30	5.17	4.56	5.81	7.78						
1999	Number measured		2	30	190	42	28	10	1						303
	Average length		40.50	87.37	104.75	111.43	120.86	126.30	137.00						
	SE (length)		3.54	8.25	6.94	6.51	4.41	3.59							
2000	Number measured		1	25	25	42	153	60	27	11	2	1			347
	Average length		56.30	82.79	100.17	108.65	114.19	115.73	120.06	124.56	131.28	130.77			
	SE (length)			9.44	9.87	7.97	7.24	6.38	5.27	4.83	0.31				
2001	Number measured	2	15	14	24	38	52	131	24	5	2	1			308
	Average length	14.59	55.83	89.07	104.82	107.16	111.69	116.40	123.78	124.86	134.70	136.23			
	SE (length)	0.30	3.00	12.00	8.52	9.63	9.27	9.29	8.04	7.23	1.71				
2002	Number measured	12	30	25	27	45	48	57	50	11	2				307
	Average length	14.16	71.78	94.47	108.65	116.93	119.16	121.77	125.04	125.26	131.88				
	SE (length)	9.16	5.65	7.21	4.49	7.24	7.72	5.82	6.75	5.68	1.43				
2003	Number measured		38	79	48	20	46	27	28	17	3				306
	Average length		55.24	83.53	98.10	108.10	115.24	119.08	116.85	118.66	122.66				
	SE (length)		10.57	14.02	8.04	9.74	7.97	7.97	7.55	7.48	3.20				

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Table 11.–Page 6 of 9.

Ninilchik Bar		Age class														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
1993	Number measured			10	2	98	89	1	3	11	2	2	7			225
	Average length			91.50	116.00	128.69	133.07	144.00	151.67	147.82	158.50	156.00	155.86			
	SE (length)			7.50	4.24	4.73	6.64		3.06	3.92	3.54	2.83	3.93			
1994	Number measured				12	5	56	13	3	7	8	9	6			119
	Average length				110.33	128.80	134.00	139.46	151.00	150.43	156.13	156.00	159.67			
	SE (length)				6.36	3.19	6.01	5.44	5.57	10.29	3.27	4.58	6.74			
1995	Number measured			1	1	24	78	28	5	2	2	4	1			146
	Average length			76.00	98.00	127.63	135.22	140.57	149.20	148.50	161.50	155.50	167.00			
	SE (length)					7.48	5.70	6.03	3.56	0.71	6.36	6.61				
1996	Number measured		6	2	4	15	80	30	16	8	7	2	2			172
	Average length		45.83	70.50	100.50	130.73	136.41	141.37	144.00	148.75	152.57	160.00	166.00			
	SE (length)		6.79	20.51	4.80	9.39	6.34	5.92	3.90	5.23	6.21	1.41	12.73			
1997	Number measured			12	5	9	43	50	20	7	3	2				151
	Average length			80.17	110.00	133.44	137.00	142.22	143.95	149.71	162.33	161.50				
	SE (length)			5.89	12.33	6.84	5.68	4.29	4.21	4.15	8.02	4.95				
1998	Number measured			3	47	13	66	21	3	1	1					155
	Average length			81.00	97.64	122.85	137.18	144.57	147.00	156.00	158.00					
	SE (length)			7.00	5.97	8.05	7.17	6.23	5.00							
1999	Number measured		6	5	8	61	18	37	13	5	3					156
	Average length		34.50	70.00	104.38	115.85	133.39	140.95	146.38	150.20	149.00					
	SE (length)		5.09	4.85	6.09	7.49	8.07	7.34	5.28	6.69	8.72					
2000	Number measured		3	45	3	5	39	28	26	7	3					159
	Average length		35.62	73.56	93.96	112.40	123.62	138.72	139.95	147.05	151.69					
	SE (length)		4.81	9.14	3.34	3.35	6.00	6.21	7.91	10.88	6.38					
2001	Number measured		1	21	92	5		29	3	8	5	5	6	3		178
	Average length		60.25	88.42	103.77	110.85		129.82	142.71	138.11	151.81	145.03	154.28	150.16		
	SE (length)			7.20	5.29	3.39		7.08	5.44	12.93	6.06	4.16	6.40	9.17		
2002	Number measured		17	21	10	68	4	9	22	2	5	1		1		160
	Average length		50.15	83.33	106.97	117.03	125.30	132.62	134.53	142.70	145.37	139.45		153.35		
	SE (length)		6.01	7.73	5.90	4.62	8.95	9.72	6.38	1.86	9.32					
2003	Number measured		41	15	15	9	46	1	1	19	1	1	2	1	1	153
	Average length		46.74	75.81	99.60	113.60	125.50	122.93	140.94	139.44	139.18	147.56	143.14	153.65	143.86	
	SE (length)		6.77	20.22	9.74	10.93	7.34			7.43			3.23			

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Table 11.–Page 7 of 9.

Ninilchik (southern area)		Age class													
		1	2	3	4	5	6	7	8	9	10	11	12	13	Total
1993	Number measured	Not available (southern and northern area samples were mistakenly combined)													
	Average length														
	SE (length)														
1994	Number measured		1	8	35	27	70	8		1	1				151
	Average length		45.00	86.25	110.77	128.07	135.83	141.50		142.00	152.00				
	SE (length)			10.54	7.08	8.67	6.78	6.19							
1995	Number measured		4	19	25	39	52	14	2	1	2				158
	Average length		44.75	85.11	108.72	128.54	137.00	138.36	140.50	160.00	146.50				
	SE (length)		12.97	7.65	6.05	7.31	7.71	6.46	3.54		0.71				
1996	Number measured		125	10	8	9	14	4		1					171
	Average length		60.97	91.10	106.38	117.11	128.71	134.25		138.00					
	SE (length)		7.78	5.32	4.00	7.72	9.05	9.43							
1997	Number measured			69	10	18	27	23	3		1				151
	Average length			86.58	98.40	119.11	132.52	142.48	148.67		143.00				
	SE (length)			6.27	7.20	5.71	7.16	6.62	6.66						
1998	Number measured		4	11	81	10	8	13	13	3					143
	Average length		49.00	84.64	108.30	121.90	130.63	137.69	142.00	140.33					
	SE (length)		3.74	5.43	5.89	6.57	10.34	6.41	8.85	7.77					
1999	Number measured		9	17	15	90	8	4	4	3					150
	Average length		46.67	78.94	103.73	118.19	127.63	135.00	144.75	146.00					
	SE (length)		6.76	5.06	8.53	5.58	3.50	1.41	5.25	7.21					
2000	Number measured		11	92	25	8	23	4	1	1	2	1	1		169
	Average length		53.73	83.97	100.70	113.66	125.34	126.56	132.16	133.39	151.92	147.28	162.78		
	SE (length)		8.15	6.62	5.92	6.95	6.64	7.46			2.04				
2001	Number measured		12	22	50	29	9	23	1	2		1		1	150
	Average length		58.18	80.23	110.57	118.51	126.04	133.91	136.27	143.51		151.06		157.00	
	SE (length)		15.44	11.77	7.58	8.86	8.40	4.88		5.42					
2002	Number measured	16	92	16	4	23	1	1	4	1	1	1	1	1	162
	Average length	12.08	63.59	94.64	108.25	118.35	128.58	126.93	134.18	115.91	144.82	149.70	154.50	142.09	
	SE (length)	8.09	5.70	6.53	5.05	6.35			4.34						
2003	Number measured		86	27	16	10	9	1	1	1		1			152
	Average length		57.30	91.47	104.11	108.91	128.31	141.61	136.65	137.15		146.92			
	SE (length)		7.95	8.89	8.01	10.59	9.09								

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Table 11.–Page 8 of 9.

	Ninilchik (northern area)	Age class													
		1	2	3	4	5	6	7	8	9	10	11	12	13	Total
1993	Number measured	Not available (northern area and southern area samples were mistakenly combined)													
	Average length														
	SE (length)														
1994	Number measured			2	30	18	134	23	3	5	2	1	1		219
	Average length			89.00	109.63	130.83	134.90	140.43	147.00	149.60	144.00	153.00	143.00		
	SE (length)			1.41	5.53	6.06	6.29	7.94	5.57	5.41	2.83				
1995	Number measured		1	1	26	46	80	4		4	1		1		164
	Average length		46.00	87.00	111.15	131.39	135.21	138.50		147.75	156.00		151.00		
	SE (length)				6.31	6.43	4.92	4.20		9.54					
1996	Number measured		12	9	21	59	60	3	5		1				170
	Average length		60.17	77.78	108.19	126.05	131.82	139.33	143.80		161.00				
	SE (length)		6.53	8.23	5.12	6.54	6.15	1.15	4.09						
1997	Number measured		1	55	39	15	6	19	11	5	3	1			155
	Average length		39.00	86.45	95.54	112.07	125.67	132.58	138.55	139.60	150.00	153.00			
	SE (length)			3.92	5.11	7.64	8.24	7.66	6.28	6.99	2.65				
1998	Number measured		13	16	93	7	18	9	5						161
	Average length		51.08	85.44	104.88	116.29	130.78	141.00	142.00						
	SE (length)		8.26	4.49	5.32	6.45	8.87	6.52	6.16						
1999	Number measured		66	25	5	34	5	5	11	1					152
	Average length		47.67	85.68	108.20	117.76	127.40	139.20	147.00	144.00					
	SE (length)		5.05	5.38	2.05	4.45	4.62	13.10	5.51						
2000	Number measured		6	89	7	6	23	12	2	1					146
	Average length		52.89	87.42	102.76	118.01	125.41	125.40	135.23	137.31					
	SE (length)		8.42	5.48	6.03	5.22	4.73	7.22	0.21						
2001	Number measured		4	3	64	37	7	22	7	3	1	1	1		150
	Average length		67.78	94.80	110.44	111.66	124.28	129.42	129.62	146.18	149.38	133.27	148.83		
	SE (length)		5.76	4.70	5.92	19.85	8.12	5.58	4.47	7.53					
2002	Number measured	18	21	22	8	56	10	4	4	2	1				146
	Average length	9.65	64.37	93.61	109.58	121.60	128.57	130.24	132.83	125.72	145.09				
	SE (length)	2.57	8.96	9.94	7.87	5.30	7.12	6.45	3.85	3.63					
2003	Number measured		86	29	11	3	6	8	6	2	1				152
	Average length		58.31	68.31	98.96	110.52	124.83	130.21	136.35	143.60	144.79				
	SE (length)		8.50	7.12	6.63	9.28	5.82	4.51	2.99	0.49					

-continued-

Table 11.–Page 9 of 9.

	Ninilchik (northern and southern areas)	Age class													
		1	2	3	4	5	6	7	8	9	10	11	12	13	Total
1993	Number measured		3	39	16	137	74	7	4	4	3	3	1		291
	Average length		53.33	95.64	115.25	127.72	132.19	136.86	144.75	145.75	143.67	143.67	147.00		
	SE (length)		6.43	7.81	9.55	5.69	5.90	4.74	6.60	4.99	2.31	4.04			
1994	Number measured		1	10	65	45	204	31	3	6	3	1	1		370
	Average length		45.00	86.80	110.25	129.18	135.22	140.71	147.00	148.33	146.67	153.00	143.00		
	SE (length)			9.38	6.39	7.78	6.46	7.44	5.57	5.75	5.03				
1995	Number measured		5	20	51	85	132	18	2	5	3		1		322
	Average length		45.00	85.20	109.96	130.08	135.92	138.39	140.50	150.20	149.67		151.00		
	SE (length)		11.25	7.46	6.24	6.96	6.21	5.92	3.54	9.91	5.51				
1996	Number measured		137	19	29	68	74	7	5	1	1				341
	Average length		60.90	84.79	107.69	124.87	131.23	136.43	143.80	138.00	161.00				
	SE (length)		7.66	9.54	4.84	7.31	6.83	7.23	4.09						
1997	Number measured		1	124	49	33	33	42	14	5	4	1			306
	Average length		39.00	86.52	96.12	115.91	131.27	138.00	140.71	139.60	148.25	153.00			
	SE (length)			5.34	5.64	7.45	7.71	8.61	7.47	6.99	4.11				
1998	Number measured		17	27	174	17	26	22	18	3					304
	Average length		50.59	85.11	106.47	119.59	130.73	139.05	142.00	140.33					
	SE (length)		7.39	4.81	5.83	6.93	9.13	6.51	8.01	7.77					
1999	Number measured		75	42	20	124	13	9	15	4					302
	Average length		47.55	82.95	104.85	118.07	127.54	137.33	146.40	145.50					
	SE (length)		5.24	6.17	7.65	5.28	3.78	9.57	5.36	5.97					
2000	Number measured		17	181	32	14	46	16	3	2	2	1	1		315
	Average length		53.43	85.67	101.15	115.53	125.38	125.69	134.20	135.35	151.92	147.28	162.78		
	SE (length)		7.99	6.31	5.91	6.44	5.70	7.05	1.78	2.77	2.04				
2001	Number measured		16	25	114	66	16	45	8	5	1	2	1	1	300
	Average length		60.58	81.97	110.49	114.67	125.27	131.71	130.45	145.11	149.38	142.17	148.83	157.00	
	SE (length)		14.14	12.10	6.67	16.24	8.05	5.65	4.76	6.15		12.58			
2002	Number measured	34	113	38	12	79	11	5	8	3	2	1	1	1	308
	Average length	10.79	63.74	94.04	109.14	120.66	128.57	129.58	133.50	122.45	144.96	149.70	154.50	142.09	
	SE (length)	5.89	6.39	8.58	6.84	5.78	6.75	5.77	3.86	6.21	0.19				
2003	Number measured		172	56	27	13	15	9	7	3	1	1			304
	Average length		57.81	79.48	102.01	109.28	126.92	131.47	136.39	141.45	144.79	146.92			
	SE (length)		8.22	14.12	7.78	9.94	7.90	5.68	2.74	3.74					

Table 12.-Estimated number of razor clams harvested (H); number of total and exploitable-size (≥80 mm) clams (N); and exploitation rate (Exp) with standard errors at Ninilchik Beach from Lehman's to Deep Creek.

	Year	H	SE (H)	N	SE (N)	Exp	SE (Exp)
Total	1998	287,423	15,845	1,517,748	128,088	0.189	0.019
	2001	219,972	12,371	1,442,316	148,842	0.153	0.018
	2003	210,385	14,293	4,387,196	648,139	0.048	0.008
Exploitable-size[a]	1998	287,423	15,845	964,109	170,445	0.298	0.055
	2001	219,972	12,371	832,451	116,180	0.264	0.040
	2003	210,385	14,293	1,532,484	335,507	0.137	0.031

[a] Statewide Harvest Survey data does not distinguish clam size and assumes that all clams harvested are exploitable size.

FIGURES

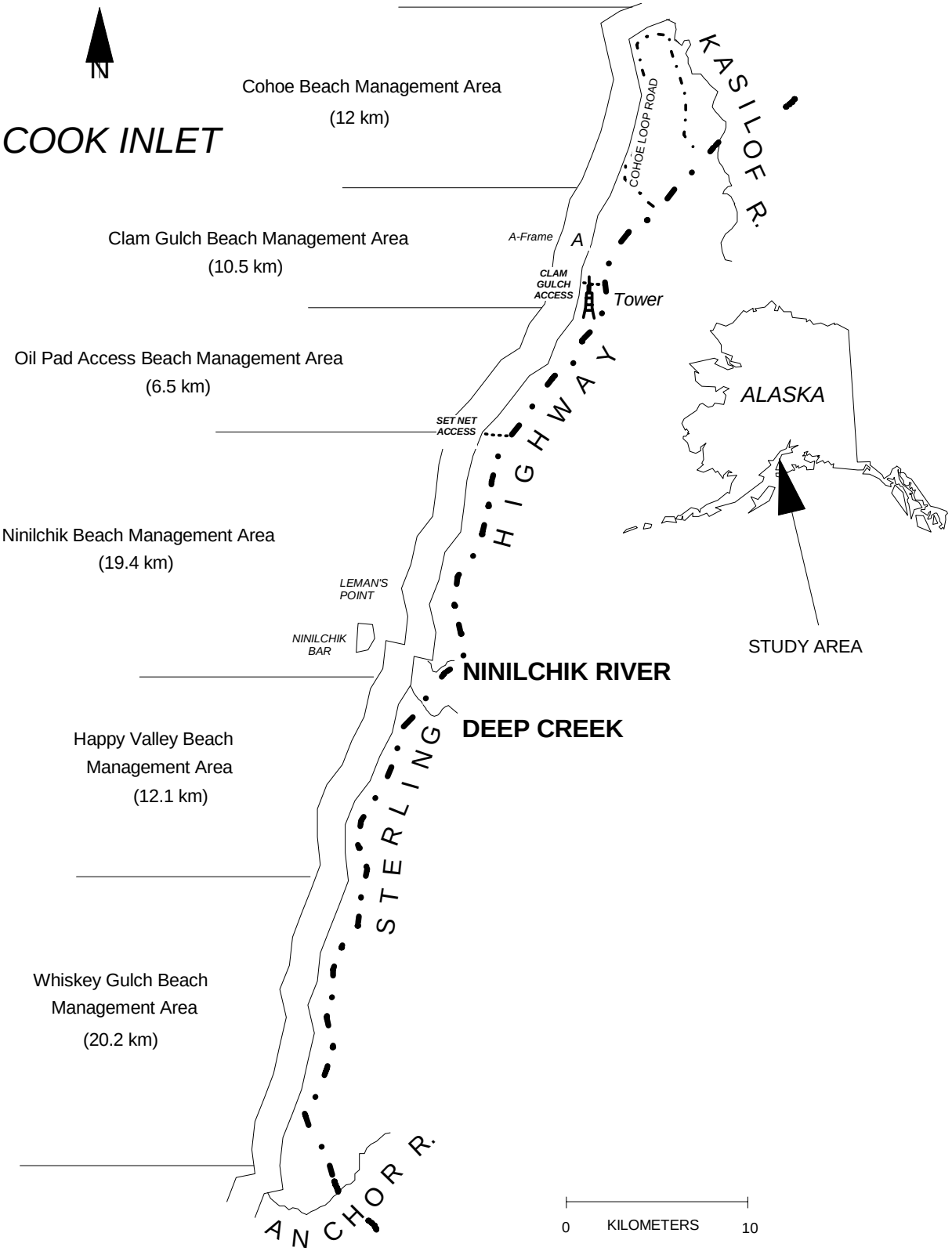

Figure 1.-Kenai Peninsula showing eastside Cook Inlet beaches.

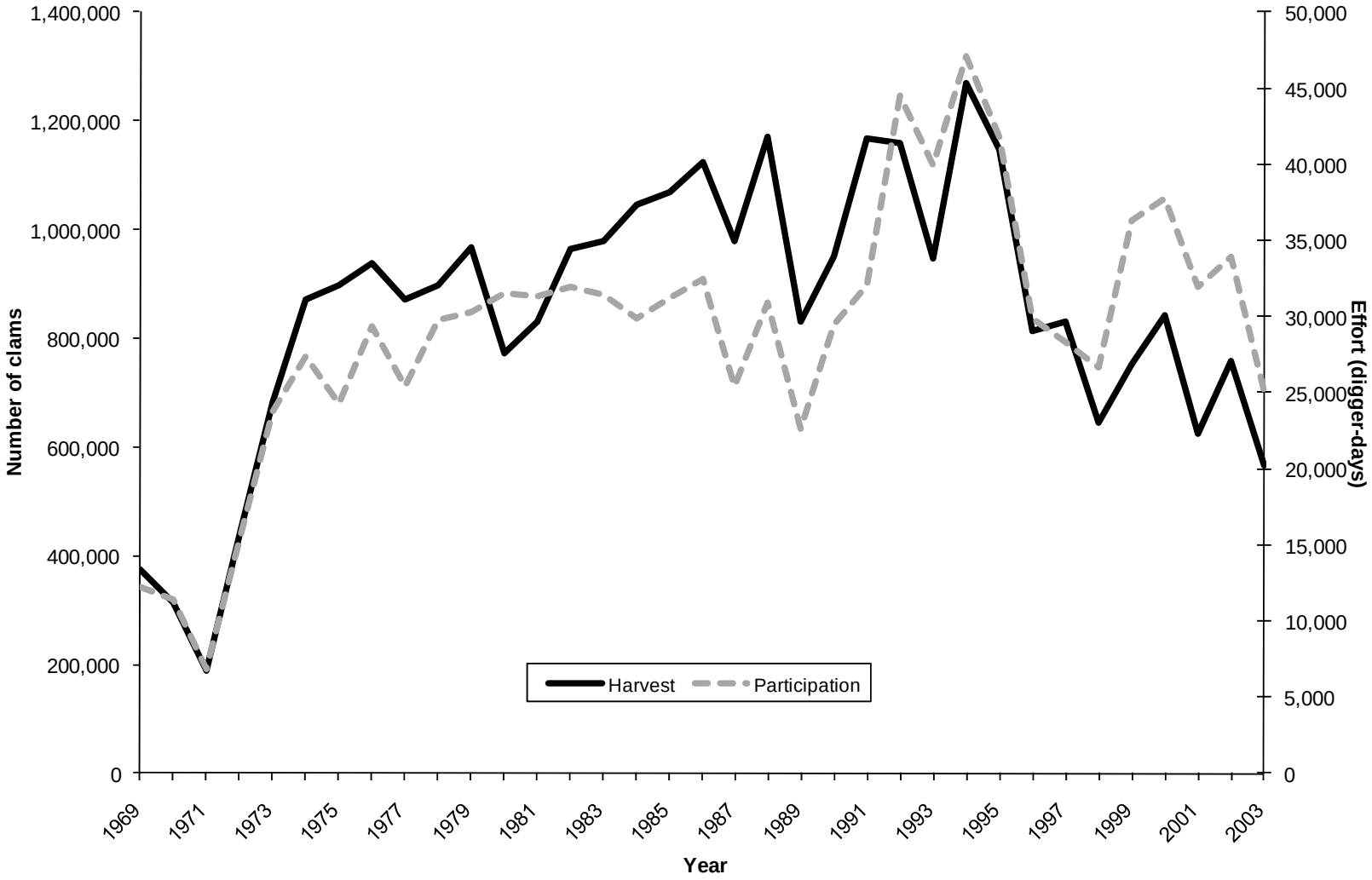

Figure 2.-Harvest and participation in the recreational razor clam fishery on eastside Cook Inlet beaches, 1969-2003.

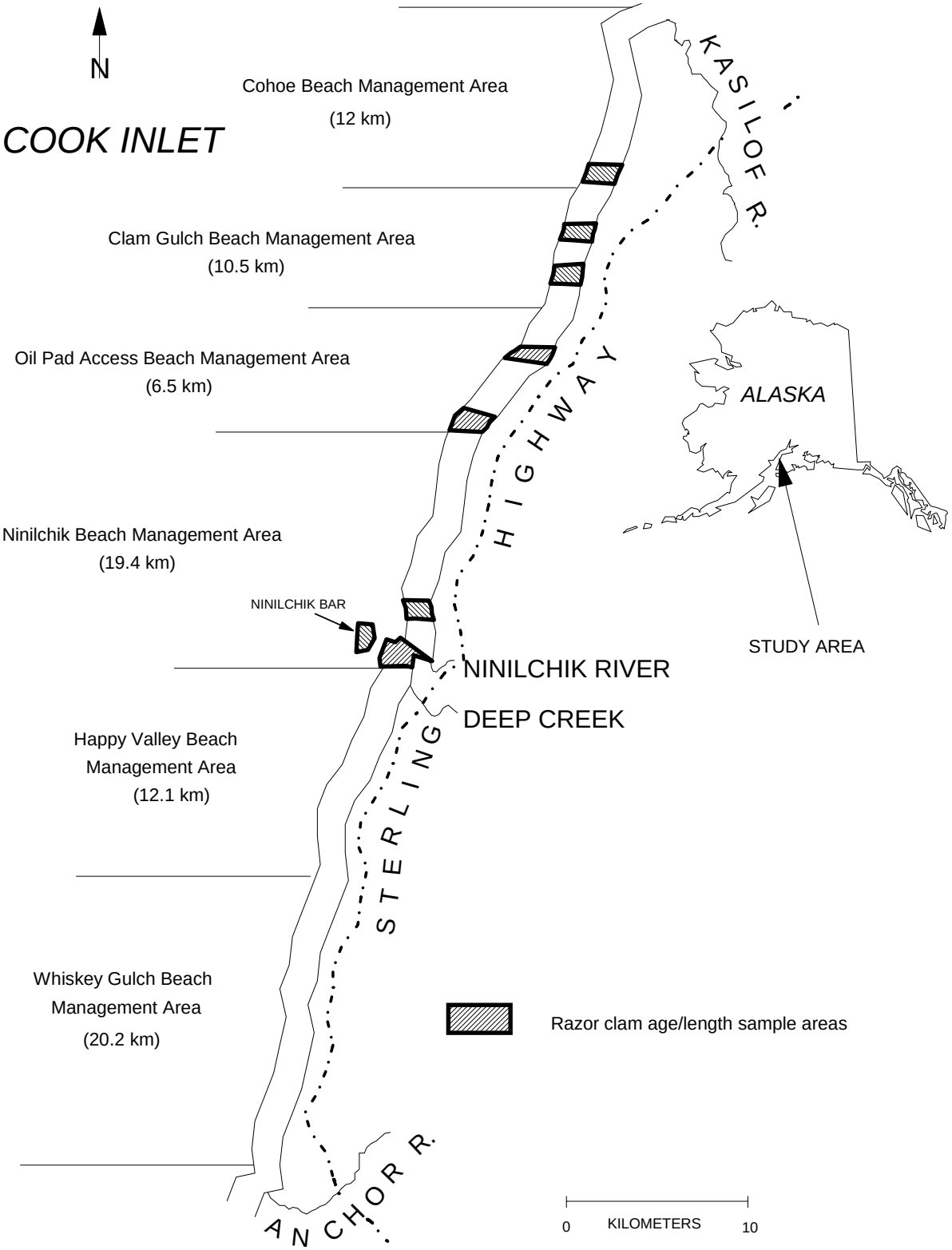

Figure 3.-Eastside Cook Inlet sample locations used to estimate razor clam harvest, length, and age composition.

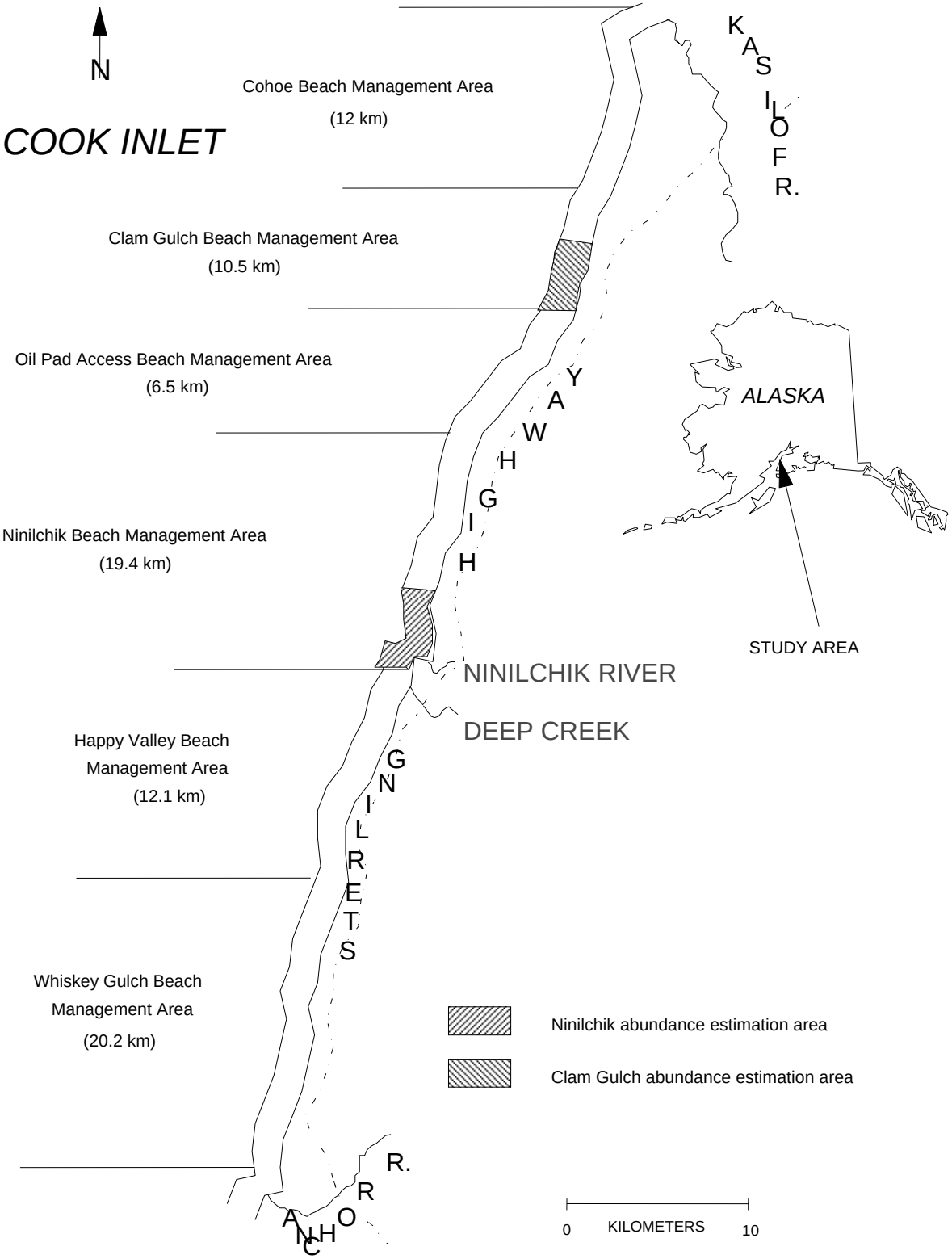

Figure 4.-Ninilchik and Clam Gulch beach sample locations used to estimate razor clam abundance.

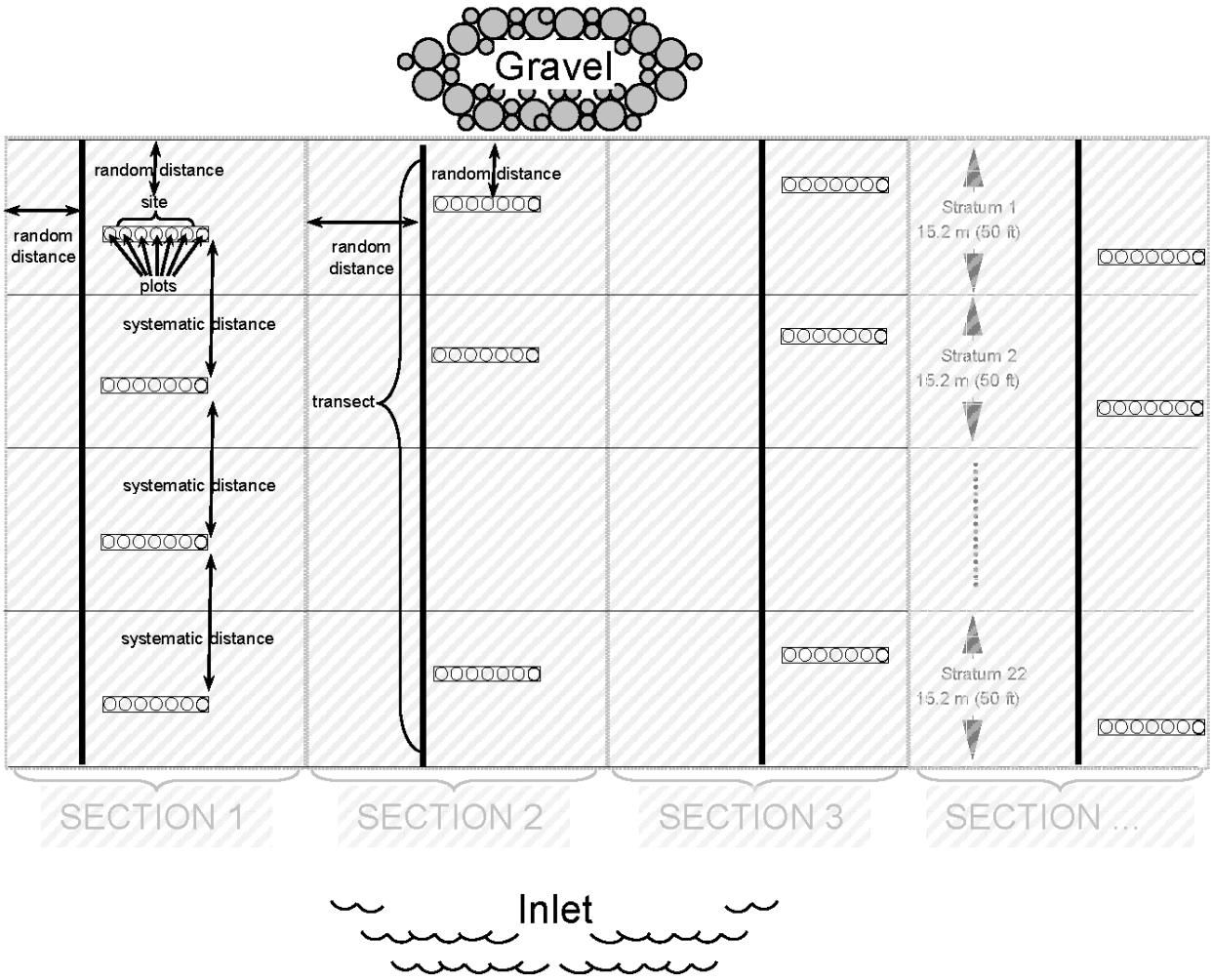

Figure 5.-Sampling layout used for razor clam abundance estimates.

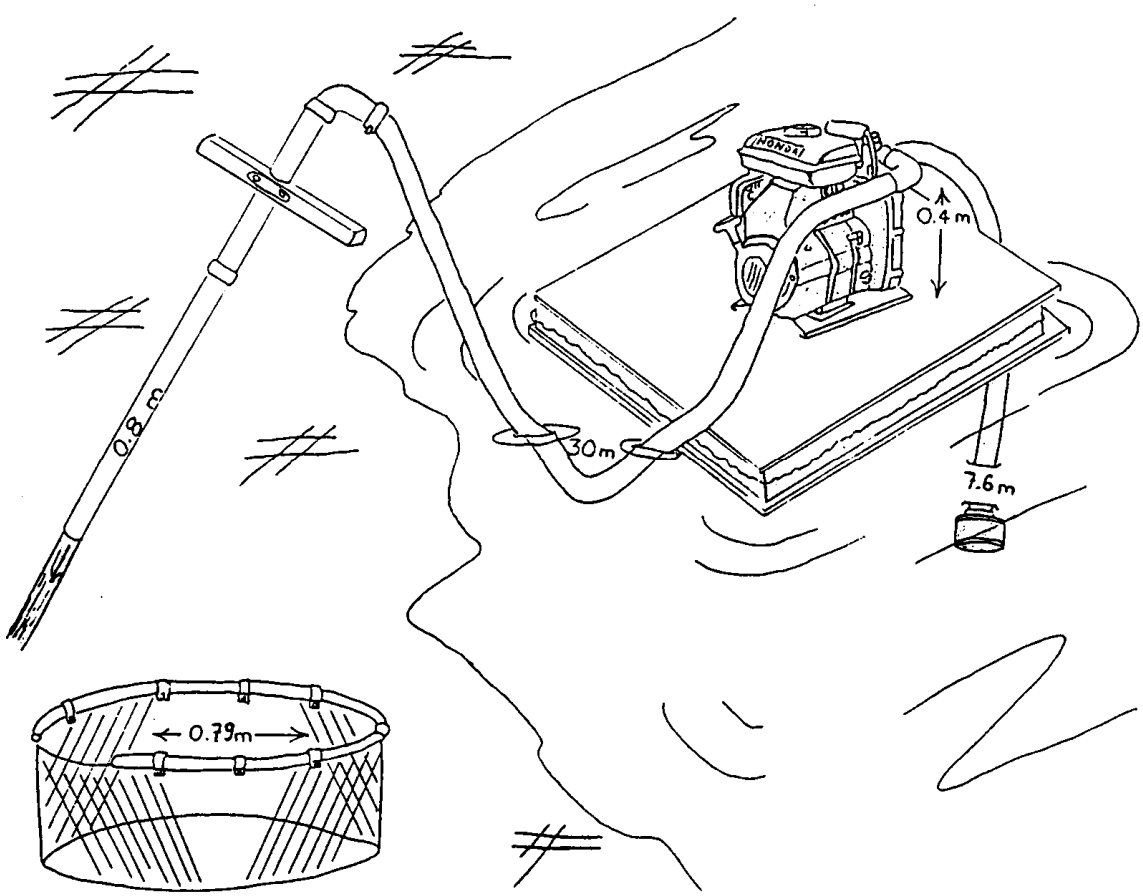

Figure 6.-Sampling ring and pumping apparatus used to collect razor clams for density estimates.

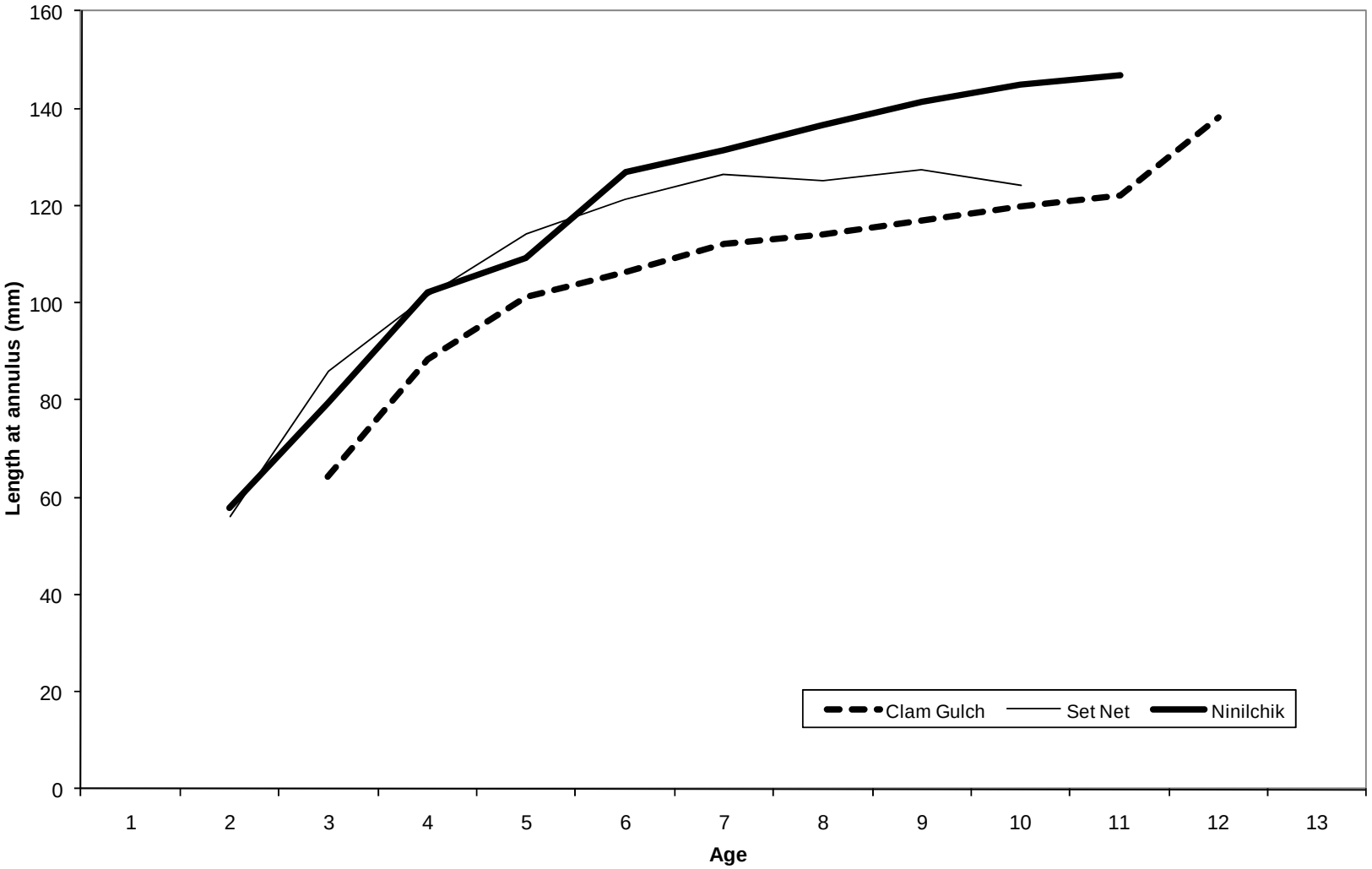

Figure 7.-Razor clam length at last annulus formation on three eastside Cook Inlet beaches, 2003.

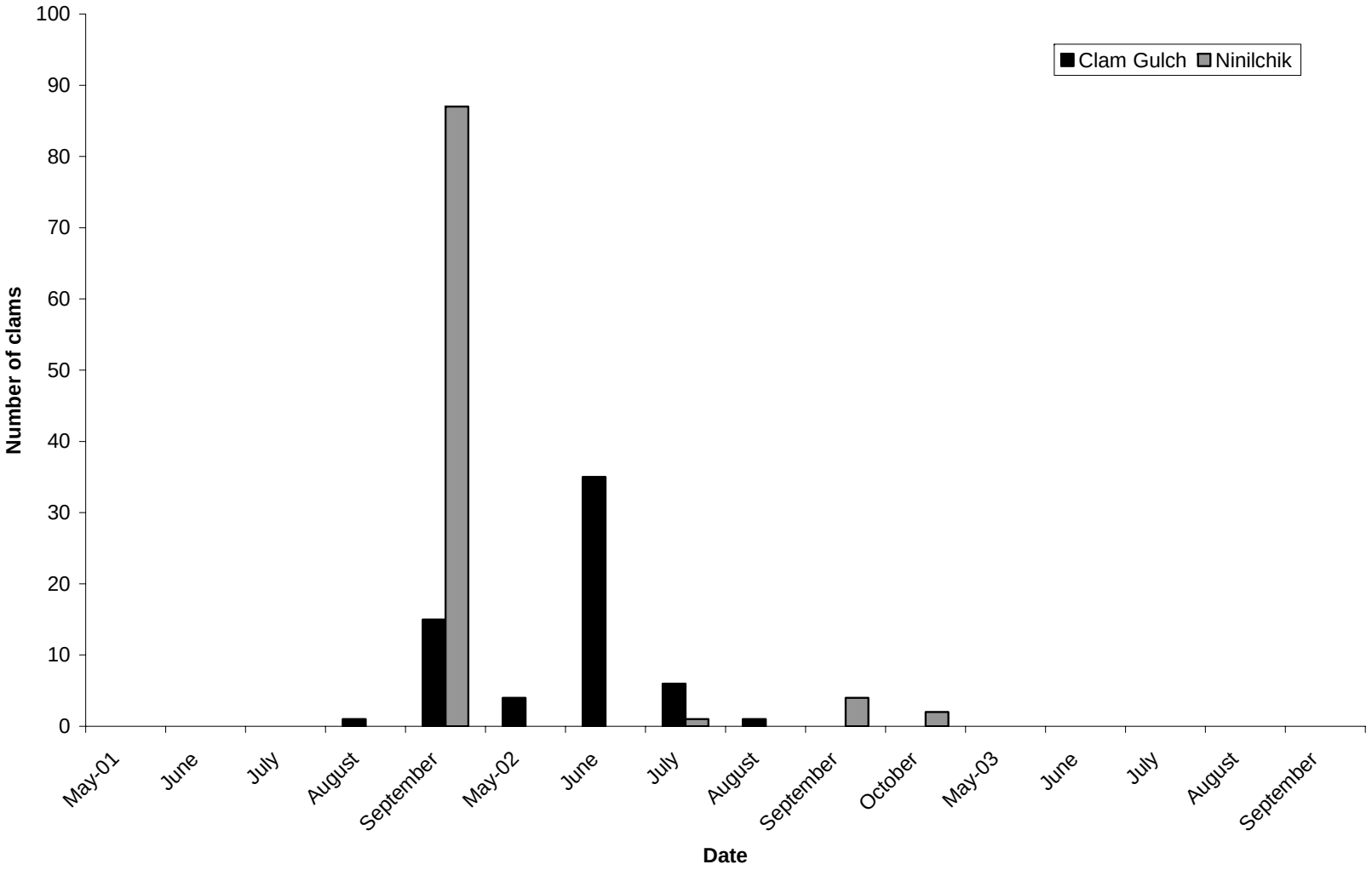

Figure 8.-Number of juvenile razor clams found in collectors placed at Clam Gulch and Ninilchik beaches, 2001-2003.

Figure 9.-Average lengths of razor clams from four eastside Cook Inlet beaches, 1991-2003.

APPENDIX A. HARVEST ESTIMATES

Appendix A1.–Estimated number of razor clams harvested (H); number of total and exploitable-size (≥80 mm) clams (N); and exploitation rate (Exp) with standard errors at Ninilchik Beach from Lehman's to Deep Creek.

	Year	H	SE (H)	N	SE (N)	Exp	SE (Exp)
Total	1989[a]	334,389	18,139	1,922,958	291,507	0.174	0.028
	1990	321,354	26,342	2,497,119	415,512	0.129	0.024
	1991	354,583	20,952	2,284,160	363,719	0.155	0.026
	1992	563,709	24,690	3,751,812	997,854	0.150	0.040
	1998	287,423	15,845	1,517,748	128,088	0.189	0.019
	2001	219,972	12,371	1,442,316	148,842	0.153	0.018
	2003	210,385	14,293	4,387,196	648,139	0.048	0.008
Exploitable-size	1989[a]	334,389	18,139	559,252	113,278	0.598	0.125
	1990	321,354	26,342	741,462	202,179	0.433	0.123
	1991	354,583	20,952	2,128,979	355,182	0.167	0.029
	1992	563,709	24,690	3,645,057	1,002,100	0.155	0.043
	1998	287,423	15,845	964,109	170,445	0.298	0.055
	2001	219,972	12,371	832,451	116,180	0.264	0.040
	2003	210,385	14,293	1,532,484	335,507	0.137	0.031

Note: Abundance and exploitation rate estimates with standard errors for 1989-1992 are corrected from publications printed prior to 2009.

[a] Harvest was estimated as the product of the proportion of average total beach harvest that occurred in 1990-1999 in a smaller Ninilchik Beach study area and the average harvest of the entire beach in 1990-1999. Variance is estimated as the product of the square of the harvest estimate and the average squared coefficient of variation (CV).

Appendix A2.-Estimated number of razor clams harvested (H); number of total and exploitable-size (≥80 mm) clams (N); and exploitation rate (Exp) with standard errors at Clam Gulch Beach from A-frame to the communications tower.

Beach	Year	H	SE (H)	N	SE (N)	Exp	SE (Exp)
Total	1988[a]	286,375	14,646	7,240,569	999,223	0.040	0.006
	1989[a]	224,173	11,465	8,093,750	540,227	0.028	0.002
	1999	185,144	10,286	9,191,769	587,435	0.020	0.002
Exploitable-size	1988[a]	286,375	14,646	2,463,695	607,132	0.116	0.029
	1989[a]	224,173	11,465	4,773,362	371,752	0.047	0.004
	1999	185,144	10,286	4,052,949	217,262	0.046	0.004

Note: Abundance and exploitation rate estimates with standard errors for 1988 and 1989 are corrected from previous publications that contained estimates for a larger beach area.

[a] Harvest estimated as the product of the proportion of average total beach harvest that occurred in 1990-1999 in a smaller Clam Gulch Beach study area and the average harvest of the entire beach in 1990-1999. Variance estimated as the product of the square of the harvest estimate and the average squared coefficient of variation (CV).

APPENDIX B. HISTORIC AGE COMPOSITION

Appendix B1.-Percentage of razor clams sampled at Clam Gulch Beach by age class, 1969-2003.

	Age class														Number
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	sampled
1969		2.4	5.8	13.6	5.4	36.5	36.3								742
1970			4.1	17.1	15.9	30.5	32.4								655
1971			0.9	28.8	17.6	29.0	20.2	3.5							688
1972				8.4	45.9	19.8	11.5	14.4							715
1973			1.5	2.4	8.6	52.4	23.3	9.2	2.6						824
1974			0.2	1.5	2.3	12.3	43.5	28.3	10.0	1.9					480
1975			0.4	0.6	4.2	5.0	18.6	42.9	19.2	9.1					504
1976				0.4	1.0	7.4	5.9	9.8	14.1	19.9	41.5				744
1977			1.1	3.0	2.0	4.5	5.9	8.8	28.9	45.8					433
1978				1.4	6.1	6.9	8.0	9.6	28.1	39.9					492
1979			0.2	1.5	5.3	5.3	9.5	11.2	30.0	30.0	6.2	0.8			546
1980		0.3	12.4	0.9	5.7	3.4	11.8	12.6	14.9	29.9	7.2	0.9			348
1981			0.4	30.9	14.3	8.5	10.0	7.7	5.8	17.4	4.2	0.8			260
1982		1.5	1.0	23.0	25.5	14.2	10.8	5.9	7.8	8.8	1.0	0.5			204
1983			4.3	5.1	16.3	36.8	17.9	6.8	2.6	7.6	1.7	0.9			116
1984		1.3	2.8	8.7	14.6	10.0	42.6	9.3	6.0	4.0		0.7			150
1985			3.1	7.7	9.2	6.2	30.8	16.9	6.2	12.3	4.6	1.5		1.5	65
1986			4.2	3.2	41.5	8.5	9.6	29.8	2.1	1.1					94
1987			19.3	3.7	18.3	38.6	12.8	6.4	0.9						109
1988				11.6	18.2	42.1	14.9	9.9	3.3						122
1989			2.7	10.7	2.7	24.1	21.4	18.8	11.6	8.0					112
1990	7.7	1.9	5.2	3.2	7.1	5.2	18.1	36.8	11.6	3.2					155
1991			5.3	7.3	5.6	7.6	10.6	32.3	22.1	9.2					303
1992			0.6	29.8	10.2	9.1	4.4	12.3	14.3	17.3	1.5	0.6			342
1993		1.0	0.8	0.8	53.8	9.4	2.9	6.0	12.1	10.8	2.1	0.3			381
1994		4.7	1.2	8.3	52.8	13.7	3.8	4.5	5.2	4.7	0.7	0.5			424
1995			6.7	1.0	24.4	32.7	7.3	9.5	11.7	5.1	1.3	0.3			315
1996		3.2	2.3	22.2	17.8	23.7	15.5	8.8	4.4	1.8	0.3				342
1997		0.8	22.0	12.6	19.8	19.5	17.0	4.1	3.3	0.8					364
1998		3.3	7.9	47.5	6.6	12.5	11.5	5.9	4.6	0.3					305
1999			3.0	58.7	18.3	12.7	3.3	3.7	0.3						300
2000		0.6	0.3	3.8	14.6	23.1	14.9	18.0	12.0	8.9	3.2	0.6			316
2001			0.7	4.4	5.4	15.2	31.3	16.8	13.5	8.8	3.7	0.3			297
2002			0.7	6.5	5.5	11.0	15.8	34.7	11.3	8.6	5.8				291
2003			1.0	10.6	16.3	17.3	15.6	24.9	9.0	4.0	1.0	0.3			301

Appendix B2.-Percentage of razor clams sampled at Ninilchik Beach by age class, 1974 and 1977–2003.

	Age class													Number
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	sampled
1974			1.3	1.3	1.3	43.0	21.5	22.2	9.4					149
1977					6.4	3.2	1.6	24.2	32.3	11.3	21.0			62
1978						12.5			37.5	12.5	25.0	12.5		8
1979														
1980			90.0	7.5	2.5									80
1981														
1982			7.5	5.0	3.1	79.5	1.2			2.5		1.2		161
1983		7.9	21.2	46.3	4.0	4.0	16.6							151
1984		1.4	63.0	27.4	6.8	1.4								73
1985		0.0	5.9	69.4	11.8	4.7	3.5	2.4	2.4					85
1986		0.0	3.4	3.4	48.9	34.1	3.4	5.7		1.1				88
1987			9.9	6.6	2.2	57.1	18.7	4.4	1.1	0.0				91
1988														
1989	3.3	4.7	0.7	7.3	16.0	6.0	1.3	21.3	24.0	9.3	4.0	1.3	0.7	150
1990		10.0	27.3	9.1	0.9	0.9	12.7	19.1	8.2	8.2	3.6			110
1991		1.7	81.7	12.5				2.5		0.8	0.8			120
1992		2.1	0.8	73.2	9.2	1.3	1.3	3.8	2.9	4.2	0.8	0.4		239
1993		1.0	13.3	5.5	47.8	24.6	3.1	1.0	1.4	1.0	1.0	0.3		293
1994		0.3	2.7	17.6	12.2	55.1	8.4	0.8	1.6	0.8	0.3	0.3		370
1995		1.6	6.2	15.8	26.4	41.0	5.6	0.6	1.6	0.9	0.0	0.3		322
1996		40.2	5.6	8.5	19.9	21.7	2.1	1.5	0.3	0.3	0.0			341
1997		0.3	40.5	16.0	10.8	10.8	13.7	4.6	1.6	1.3	0.3			306
1998		5.6	8.9	57.2	5.6	8.6	7.2	5.9	1.0	0.0				304
1999		24.8	13.9	6.6	41.1	4.3	3.0	5.0	1.3	0.0				302
2000		5.0	58.8	9.4	4.4	15.4	3.8	0.9	0.9	0.6	0.3	0.3		318
2001		5.3	8.3	38.0	22.0	5.3	15.0	2.7	1.7	0.3	0.7	0.3	0.3	300
2002	11.0	36.7	12.3	3.9	25.6	3.6	1.6	2.6	1.0	0.6	0.3	0.3	0.3	308
2003		56.6	18.4	8.9	4.3	5.3	2.6	2.3	1.0	0.3	0.3			304

Appendix B3.-Percentage of razor clams sampled at Oil Pad Access and Set Net Access combined by age class, 1985-2003.

Year	Age class												Number
	1	2	3	4	5	6	7	8	9	10	11	12	sampled
1985			22.9	11.8	24.8	20.3	11.1	7.8	1.3				153
1986	1.9	6.3	16.9	23.1	26.3	12.5	6.3	4.4	2.5				160
1987			4.8	23.5	29.5	27.7	10.2	4.2					166
1988													
1989	1.8	10.0	32.7	1.8	12.7	1.8	27.3	10.0	1.8				220
1990		11.4	10.2	11.4	3.1	10.6	10.6	26.8	12.6	3.1			254
1991		0.4	9.7	21.5	14.7	4.3	9.3	19.0	11.8	6.1	2.5	0.7	279
1992		0.3	1.4	45.1	14.4	6.3	2.6	14.4	10.6	4.3	0.6		348
1993		0.2	13.5	3.9	51.3	11.4	3.4	7.1	4.3	3.6	1.1	0.2	466
1994		0.2	1.5	5.4	63.8	15.1	3.2	4.3	4.7	1.3	0.6		536
1995		1.6	8.7	3.7	35.4	37.3	5.8	4.5	1.9	0.8	0.3		378
1996		4.8	3.5	18.0	27.3	31.5	9.0	3.5	1.6	0.6			311
1997		0.3	62.1	5.5	21.0	4.7	4.7	0.9	0.9				343
1998		0.7	3.9	78.1	9.8	4.9	1.6	0.7	0.3				306
1999		0.7	9.9	62.7	13.9	9.2	3.3	0.3					303
2000		0.3	8.1	6.6	12.1	45.2	17.9	6.3	2.6	0.9	0.0		347
2001	0.6	4.9	4.5	7.8	12.3	16.9	42.5	7.8	1.6	0.6	0.3		308
2002	3.9	9.8	8.1	8.8	14.7	15.6	18.6	16.3	3.6	0.7			307
2003		12.4	25.8	15.7	6.5	15.0	8.8	9.2	5.6	1.0			306

Appendix B4.-Percentage of razor clams sampled at Cohoe Beach by age class, 1985-1987 and 1989-2003.

	Age class												Number
Year	1	2	3	4	5	6	7	8	9	10	11	12	sampled
1985			15.0	32.0	36.0	7.0	8.0	2.0					100
1986			0.0	68.4	16.3	9.2		5.1	1.0				98
1987			10.1		69.7	14.1	3.0	3.0					99
1988													
1989			23.3	6.8	8.7	13.6	22.3	22.3	2.9				103
1990		8.5	5.4	69.8	2.3	1.6	9.3	0.8	0.8	0.8	0.8		129
1991		0.9	37.4	44.3	5.2	1.7	3.5	2.6	3.5	0.9			115
1992		0.7	4.4	70.8	19.7	1.5	2.2	0.7					137
1993			19.0	6.3	50.0	18.3	2.1	0.7	2.8	0.7			142
1994		0.5	1.4	30.6	59.7	7.9							216
1995		0.6	17.8	9.2	33.9	29.3	4.6	2.3	2.3				174
1996			0.6	59.4	25.5	10.9	3.6						165
1997			31.7	9.0	31.7	20.0	4.8	2.8					145
1998		24.2	5.9	46.4	7.2	7.8	5.2	3.3					153
1999			7.2	51.0	13.7	11.1	6.5	6.5	2.6	1.3			153
2000		9.9	2.5	8.7	16.1	29.8	20.5	7.5	4.3	0.6	0.0	0.0	161
2001		0.0	7.9	2.6	16.6	6.0	52.3	9.3	3.3	2.0	0.0	0.0	151
2002		0.0	0.0	6.9	9.4	5.0	19.5	12.6	34.0	7.5	4.4	0.6	159
2003		0.7	13.8	24.1	11.7	9.0	15.2	16.6	5.5	2.8	0.7	0.0	145

APPENDIX C. HISTORIC RAZOR CLAM HARVEST BY BEACH

Appendix C1.-Percentage of razor clam harvest by beach from eastside Cook Inlet, adjusted for relative success rate, 1977-2003.

Year	No. of surveys	Beach					
		Cohoe	Clam Gulch	Oil Pad	Ninilchik	Happy Valley	Whiskey Gulch
1977	3	2.2	70.6	11.2	11.4	3.1	1.5
1978	9	1.8	74.7	10.4	6.9	4.3	1.9
1979	8	2.5	77.1	7.3	7.5	4.8	0.8
1980	8	2.0	67.5	8.2	11.7	8.3	2.3
1981	9	1.7	60.9	12.8	11.1	10.2	3.4
1982	6	1.2	49.6	10.9	13.7	18.4	6.2
1983	6	1.7	48.5	12.8	15.7	15.0	6.3
1984	6	0.9	45.7	19.5	20.2	10.0	3.7
1985	5	0.9	35.1	17.5	31.1	12.7	2.7
1986	4	1.0	25.3	21.4	35.5	13.3	3.5
1987	3	0.2	21.6	13.1	51.9	9.5	3.7
1988	3	0.8	26.1	4.9	53.3	11.2	3.7
1989	11	0.2	28.8	12.1	50.4	5.7	2.8
1990	12	0.3	30.5	14.8	46.4	6.0	2.0
1991	10	0.6	28.0	13.6	50.2	6.2	1.5
1992	13	0.3	21.6	10.4	61.9	5.0	0.8
1993	13	0.3	21.0	11.8	61.9	4.3	0.7
1994	13	0.3	19.8	10.0	65.0	4.0	1.0
1995	13	0.1	19.9	10.5	65.5	3.2	0.7
1996	13	0.6	23.3	13.6	57.5	3.9	1.1
1997	12	0.6	26.5	13.6	56.1	2.2	1.1
1998	12	1.0	28.3	16.6	50.6	2.4	1.1
1999	14	1.2	27.1	13.4	53.5	4.0	0.9
2000	13	2.2	31.1	12.8	47.8	4.9	1.2
2001	13	1.8	37.1	16.8	39.4	3.6	1.3
2002	14	2.0	28.0	17.5	47.3	3.4	2.0
2003	13	1.3	34.2	18.8	39.6	4.3	1.7
Mean	9.6	1.1	37.3	13.2	39.4	6.8	2.2

Note: Harvest percentage weighted by tidal height beginning in 1990.

APPENDIX D. HISTORIC RAZOR CLAM HARVEST BY BEACH AND AGE

Appendix D1.-Estimated number of razor clams harvested from eastside Cook Inlet beaches, 1977-2003.

Year	Beach						Total harvest	Participation (digger-days)
	Cohoe	Clam Gulch	Oil Pad	Ninilchik	Happy Valley	Whiskey Gulch		
1977	19,072	614,943	97,684	99,545	26,979	13,025	871,247	25,393
1978	15,977	670,079	92,959	61,973	38,733	16,946	896,667	29,750
1979	24,023	745,767	71,025	72,070	45,958	7,834	966,677	30,323
1980	15,206	520,484	63,431	90,368	64,300	17,813	771,603	31,494
1981	13,864	504,833	106,130	91,788	84,617	28,206	829,436	31,298
1982	11,519	477,753	105,494	132,170	177,035	60,022	963,994	31,954
1983	16,854	474,312	125,199	154,091	146,868	61,396	978,720	31,470
1984	9,575	477,568	203,475	210,657	104,730	38,301	1,044,307	29,880
1985	9,312	374,943	187,472	332,731	135,327	28,555	1,068,340	31,195
1986	11,261	284,825	241,108	398,755	149,699	39,081	1,124,728	32,507
1987	1,664	211,890	128,687	508,092	92,632	36,055	979,020	25,427
1988	8,807	306,207	56,906	624,607	131,425	43,357	1,171,308	30,905
1989	1,809	239,697	100,401	419,696	47,487	23,065	832,155	22,658
1990	3,081	289,581	140,579	441,589	56,992	19,154	950,974	29,427
1991	6,792	326,429	158,135	586,115	72,433	16,883	1,166,787	31,899
1992	3,887	249,724	120,247	716,193	58,193	9,520	1,157,765	44,527
1993	2,497	198,993	111,823	585,751	40,877	6,508	946,450	39,927
1994	3,611	250,634	126,788	825,302	50,292	12,505	1,269,131	47,112
1995	1,602	227,924	120,438	752,350	37,051	8,508	1,147,872	41,837
1996	4,453	189,186	110,776	467,529	31,863	9,138	812,946	29,885
1997	4,658	219,530	113,210	465,680	17,932	8,831	829,841	28,343
1998	6,344	182,101	106,749	325,811	15,341	7,266	643,612	26,636
1999	9,177	203,127	100,368	401,960	29,827	6,425	750,883	36,292
2000	18,475	262,153	107,460	402,427	41,542	10,214	842,270	37,755
2001	11,364	231,888	105,152	246,299	22,716	8,308	625,727	31,915
2002	14,861	212,126	132,620	358,290	25,402	14,763	758,062	33,966
2003	7,525	192,567	104,277	226,434	24,736	10,104	565,643	25,120
Mean	9,529	338,491	119,948	370,306	65,592	23,271	973,799	31,993

Note: Harvest and digger-days of participation determined by Statewide Harvest Study. Harvest by beach is apportioned from aerial surveys and assumes a success rate of 0.5 on Whiskey Gulch, Happy Valley and Cohoe beaches.

Appendix D2.-Estimated number of razor clams harvested by age class from Clam Gulch Beach, 1977-2003.

Year	Age class								Total
	4	5	6	7	8	9	10	11+	
1977	18,653	12,436	27,980	36,685	54,717	179,695	284,777		614,943
1978	9,381	40,875	46,235	53,606	64,328	188,292	267,362		670,079
1979	11,209	39,605	39,605	70,990	83,693	224,178	224,178	52,308	745,767
1980	5,366	33,984	20,271	70,352	75,121	88,834	178,264	48,292	520,484
1981	156,620	72,481	43,083	50,686	39,028	29,398	88,194	25,343	504,833
1982	112,701	124,951	69,580	52,920	28,910	38,220	43,120	7,350	477,753
1983	25,277	80,787	182,390	88,717	33,702	12,886	37,667	12,886	474,312
1984	43,325	72,706	49,799	212,142	46,313	29,879	19,919	3,486	477,568
1985	29,794	35,598	23,990	119,177	65,393	23,990	47,593	29,407	374,943
1986	9,514	123,385	25,272	28,542	88,599	6,244	3,270		284,825
1987	9,715	48,049	101,350	33,608	16,804	2,363			211,890
1988	35,520	55,730	128,913	45,625	30,314	10,105			306,207
1989	26,359	6,651	59,370	52,719	46,313	28,576	19,708		239,697
1990	10,969	24,132	17,550	61,426	125,046	39,488	10,969		289,581
1991	25,022	19,336	26,160	36,396	111,464	76,205	31,847		326,429
1992	74,917	25,707	22,769	11,017	30,848	35,990	43,334	5,141	249,724
1993	1,596	109,074	19,154	5,853	12,238	24,475	21,815	4,789	198,993
1994	21,985	140,707	36,433	10,050	11,935	13,819	12,563	3,141	250,634
1995	2,326	59,694	79,851	17,831	23,258	28,684	12,404	3,876	227,924
1996	44,514	35,729	47,443	31,043	17,571	8,786	3,514	586	189,186
1997	35,937	56,250	55,468	48,437	11,719	9,375	2,344		219,530
1998	97,434	13,439	25,534	23,519	12,095	9,407	672		182,101
1999	122,853	38,392	26,525	6,980	7,678	698			203,127
2000	10,051	38,527	61,141	39,365	47,740	31,827	23,451	10,051	262,153
2001	10,219	12,577	35,373	73,104	39,303	31,442	20,438	9,433	231,888
2002	13,946	11,744	23,488	33,764	74,134	24,222	18,350	12,478	212,126
2003	20,678	31,664	33,602	30,371	48,465	17,447	7,754	2,585	192,567

Appendix D3.-Estimated number of razor clams harvested by age class from Ninilchik Beach, 1977-2003.

Year	Age class									Total
	3	4	5	6	7	8	9	10	11+	
1990	97,380	32,460	3,246	3,246	45,444	68,166	29,214	29,214	12,984	321,354
1991	294,484	45,074				9,015		3,005	3,005	354,583
1992	4,818	421,577	52,998	7,227	7,227	21,681	16,863	24,090	7,227	563,709
1993	62,867	25,792	225,676	116,062	14,508	4,836	6,448	4,836	6,448	467,471
1994	18,979	123,363	85,405	387,171	58,835	5,694	11,387	5,694	3,796	700,324
1995	38,958	99,343	165,572	257,124	35,062	3,896	9,740	5,844	1,948	617,486
1996	34,576	52,774	123,747	134,666	12,739	9,099	1,820	1,820		371,241
1997	161,606	63,860	43,008	43,008	54,738	18,246	6,516	5,213	1,303	397,499
1998	27,040	174,256	17,025	26,038	22,032	18,027	3,004			287,423
1999	63,248	30,118	186,731	19,577	13,553	22,588	6,024			341,838
2000	217,940	34,964	16,316	57,107	13,985	3,496	3,496	2,331	2,331	351,967
2001	19,364	88,299	51,120	12,393	34,855	6,196	3,873	775	3,098	219,972
2002	79,195	25,009	164,642	22,925	10,420	16,673	6,252	4,168	6,252	335,537
2003	89,254	43,033	20,720	25,501	12,751	11,157	4,781	1,594	1,594	210,385