Regional Operational Plan SF.2A.2015.08

Operational Plan: Cook Inlet Razor Clam Study, 2015

by

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and

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May 2015

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

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Weights and measures (metric)

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

Weights and measures (English)

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

Time and temperature

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

Physics and chemistry

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

General

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

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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May 2015

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This document should be cited as:
Kerkvliet, C. M., and M. D. Booz. 2015. Operational Plan: Cook Inlet Razor Clam Study, 2015. Alaska Department of Fish and Game, Regional Operational Plan ROP.SF.2A.2015.08, Homer.

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SIGNATURE PAGE

Project Title:	Cook Inlet Razor Clam Study
Project leader(s):	*Carol Kerkvliet and Michael Booz*
Division, Region, and Area	*Sport Fish, Region II, Homer*
Project Nomenclature:	*Management*
Period Covered	FY15/FY16
Field Dates:	April 5, 2015 to August 31, 2015
Plan Type:	Category II

Approval

Title	Name	Signature	Date
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ABSTRACT

Pacific razor clam (*Siliqua patula*) studies along eastern Cook Inlet will be conducted in 2015 to estimate abundance at Clam Gulch, Oil Pad Access, and Ninilchik beaches. Age and length composition will be estimated from 9 beaches. Since 2013, the razor clam sport and personal use fisheries have been progressively more restricted on Eastside beaches because of the combination of declining abundance, low recruitment, and high natural mortality.

Key words: razor clams, *Siliqua patula,* Cook Inlet, Eastside beaches, Clam Gulch, Oil Pad Access, Ninilchik abundance, age, length.

INTRODUCTION

Beaches along the east side of Cook Inlet (Figure 1) provide the largest sport fishery for the Pacific razor clam, *Siliqua patula* (Dixon), 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-b, 2007, 2009a-b, 2010a-b, 2011a-b, 2015). This fishery is confined primarily to an 81 km section of beach bounded by the Kasilof River to the north and the Anchor River to the south (Figure 1).

The Alaska Department of Fish and Game (ADF&G) began monitoring this clam population in 1965 following the 1964 earthquake, which caused subsidence of beaches in the Cook Inlet Area (Nelson *Unpublished*). Management-oriented razor clam studies have been focused on the heavily exploited Cook Inlet beaches that run from the Kasilof River south to the Anchor River, referred to as the "Eastside beaches" (Figure 1). These beaches consist of long stretches of sand intermixed with silt, coal, and gravel, typical razor clam habitat, and are often exposed to heavy wave action and precipitation.

Historically the following 4 data sets have been used to monitor the east side Cook Inlet razor clam fishery and stock.

AERIAL SURVEYS

Since 1966, low elevation aerial surveys have been flown from a fixed-wing plane during low tides to count clam diggers on the eastside beaches; however, only counts since 1970 are considered reliable (Nelson *Unpublished*). Digger distribution was assessed by counting the number of diggers within each of 6 management areas (Cohoe [CMA], Clam Gulch [CGMA], Oil Pad Access [OPMA], Ninilchik [NMA], Deep Creek [DCMA], and Whiskey Gulch [WGMA]; Figure 1, Table 1). The boundaries used to define the management areas have remained fairly consistent with only a few exceptions. Beginning in1989, surveyors began reporting digger count by beach subsections within these management areas. The term "beach" typically is used in reference to a beach subsection within a given management area. These subsections (beaches) are commonly referred to as the following beaches: Cohoe, Clam Gulch North, Clam Gulch South, Oil Pad Access North, Oil Pad Access South, Set Net Access, Ninilchik North, Ninilchik South, Ninilchik Bar, Deep Creek, and Whiskey Gulch (Table 1).

Historically, peak digger counts have occurred during June minus tides. The highest digger count (3,003) in a single aerial survey occurred in the CGMA in 1976 on a Sunday during a −5.7 ft tide. Annual digger counts were typically highest in the CGMA through 1984 and then shifted to the NMA. From 1985 to 2013, annual digger counts were highest in the NMA.

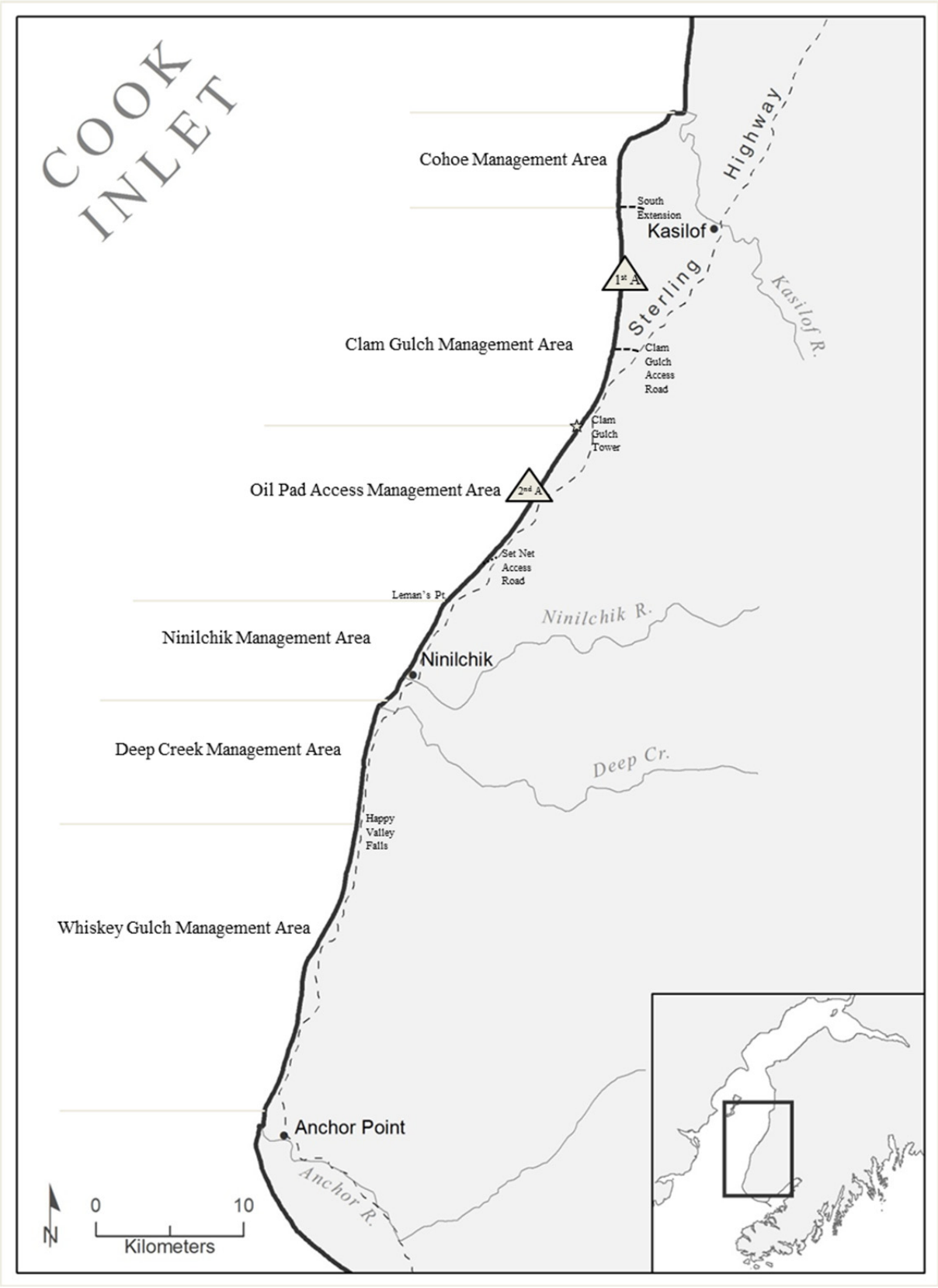

Figure 1.–Map of Kenai Peninsula showing Eastside beaches.

Table 1.–Razor clam management area between the Kasilof and Anchor rivers.

Razor clam management areas				Management area (beach) subsections			
		Latitude				Latitude	
Management area	Description	North	South	Beach (common name) [a]	Description	North	South
Cohoe (CMA)	Kasilof River to south extension of Cohoe Loop Road	60.38645	60.29778	Cohoe	Kasilof River to south extention of Cohoe Loop Road	60.38645	60.29778
Clam Gulch (CGMA)	First A-frame to Clam Gulch Tower	60.29778	60.21700	South Extension	South extension of Cohoe Loop Road to first A-frame	60.29778	60.26165
				Clam Gulch North	First A-frame to Clam Gulch Access Road	60.26165	60.24008
				Clam Gulch South	Clam Gulch Access Road to Clam Gulch Tower	60.24008	60.21700
Oil Pad Access (OPMA)	Clam Gulch Tower to Setnet Access	60.21700	60.09438	Oil Pad Access North	Clam Gulch Tower to second A-frame	60.21700	60.18367
				Oil Pad Access South	Second A-frame to Setnet Access Road	60.18367	60.14033
				Setnet Access [b]	Setnet Access Road to Leman's Point	60.14033	60.09438
Ninilchick (NMA)		60.09438	60.03923	Ninilchik North	Leman's Point to Ninilchik River	60.09438	60.05413
				Ninilchik South	Ninilchik River to Deep Creek	60.05413	60.03923
				Ninilchik Bar	Offshore bar from Ninilchik South Beach, dug on extreme low tides	60.04732	60.24008
Deep Creek (DCMA)	Deep Creek to Happy Creek Falls	60.03923	59.93387	Deep Creek	Same as management area	60.03923	59.93387
Whiskey Gulch (WGMA)	Happy Creek Falls to Anchor River	59.93387	59.79118	Whiskey Gulch	Same as management area	59.93387	59.79118

[a] Reference to the beach using the common name is used to describe the subsection of a given management area.

[b] Historically, Setnet Access Beach was placed in the NMA.

EFFORT AND HARVEST

The annual Statewide Harvest Survey (SWHS) is used to estimate total sport razor clam harvest and effort for all Cook Inlet Eastside beaches (Table 2). Aerial survey data is used to apportion the total effort and harvest to specific beach sections.

In addition to using aerial counts of diggers to apportion harvest and effort between the management areas, differences in digger success between management areas is also used in apportioning harvest. In 2009, a 1-day digger success survey was conducted to determine relative harvest success for each management area, which was then used to apportion harvest and effort in 2010 and 2011. In 2013 and 2014, 1-day digger success surveys were again conducted and used to apportion harvest and effort for those years.

Table 2.–Harvest and effort in the recreational razor clam fishery from Cook Inlet Eastside beaches between the Anchor and Kasilof rivers based on a creel survey from 1969 to 1976 and the SWHS (1977–2013).

	Harvest [a]		Days fished [a]		
Year	Estimate	SE	Estimate	SE	Clams per digger
1969	195,800	–	12,200	–	16
1970	314,650	–	11,370	–	28
1971	187,760	–	6,800	–	28
1972	437,530	–	15,400	–	28
1973	682,600	–	23,770	–	29
1974	872,450	–	27,410	–	32
1975	896,080	–	24,260	–	37
1976	939,000	–	29,320	–	32
1977	871,247	–	25,393	–	34
1978	896,667	–	29,750	–	30
1979	966,677	–	30,323	–	32
1980	771,603	–	31,494	–	25
1981	829,436	–	31,298	–	27
1982	963,994	–	31,954	–	30
1983	978,720	–	31,470	–	31
1984	1,044,307	–	30,013	–	35
1985	1,070,265	–	32,652	–	33
1986	1,124,728	–	33,486	–	34
1987	979,020	–	25,427	–	39
1988	1,171,308	–	30,998	–	38
1989	832,155	–	22,693	–	37
1990	950,974	73,001	29,427	–	32
1991	1,166,787	68,194	31,899	–	37
1992	1,156,034	–	44,537	–	26
1993	947,437	–	40,324	–	23
1994	1,270,541	–	48,508	–	26

-continued-

Table 2.–part 2 of 2.

Year	Harvest [a] Estimate	Harvest [a] SE	Days fished [a] Estimate	Days fished [a] SE	Clams per digger
1995	1,158,007	–	42,083	–	28
1996	812,946	61,231	29,911	2,259	27
1997	829,841	59,856	28,343	1,935	29
1998	643,612	51,479	26,636	1,982	24
1999	750,447	64,508	36,324	3,877	21
2000	842,270	68,310	37,755	2,816	22
2001	628,771	53,674	32,221	3,204	20
2002	759,246	70,756	34,021	3,614	22
2003	566,847	56,846	25,153	2,350	23
2004	507,624	46,273	29,308	3,233	17
2005	427,016	26,315	32,835	2,945	13
2006	438,482	31,223	24,474	2,875	18
2007	349,180	25,271	25,098	2,563	14
2008	534,431	41,605	27,480	2,837	19
2009	491,994	39,399	26,913	2,330	18
2010	325,440	26,729	19,261	1,534	17
2011	403,639	30,877	22,964	2,345	18
2012	259,736	19,268	21,680	2,038	12
2013	174,305	15,380	23,875	2,534	7
Average					
1969–2003	843,136	–	29,275	–	29
2004–2013	391,185	–	25,389	–	15

[a] From 1966 to 1968, a creel survey was conducted on a time-available basis at Clam Gulch and seasonal harvest totals were simply the sum of the harvest on the days sampled, considered a minimum, and not comparable to subsequent estimates (Nelson *Unpublished*). From 1969 to 1977, the Clam Gulch survey was modified and harvest estimates made for surveyed and nonsurveyed days were calculated by multiplying the estimated mean number of razor clams per digger by the estimated number of diggers. During these years, 1–3 surveys were flown annually. The results of the surveys were averaged to calculate the percentage of diggers on the remaining Eastside beaches to estimate harvest and effort between the Anchor and Kasilof rivers. However, aerial surveys in 1969 were not considered reliable (Nelson *Unpublished*).

AGE AND LENGTH COMPOSITION

Since 1969, razor clams have been collected annually to assess the age and length composition of the harvest. Razor clams were hand dug by ADF&G staff, mimicking a typical clam digger that retains all clams regardless of size or condition and uses only a shovel, clam gun, or hands, in compliance with state regulations.

Historically, the annual harvest has comprised 8–12 age classes (broods) of razor clams on all beaches. The most prevalent age class has differed between beaches but over most beaches has averaged 4 to 6 years old. The growth rate is greater in the southern beaches, resulting in clams that are larger at age at Ninilchik than at Clam Gulch (Nelson *Unpublished*; Szarzi et al.

2010). Historically, the NMA has had a higher prevalence of larger size clams (≥120 mm), likely due to this faster growth rate. Roughly every 10 years, a greater than average prevalence of larger sized clams has been observed on the CGMA beaches. Since 2003, the average age and length of the razor clam harvest on all beaches has shifted to younger and smaller razor clams. The average number of broods and predominate age class have both declined. Additionally, the average length and percentage of large sized clams in the harvest have decreased on all beaches. These age and size trends occurring on all beaches suggests that the decrease has occurred regardless of harvest rates and likely reflects the stock's inability to reach historical age and size because of an increase in natural mortality.

DENSITY AND ABUNDANCE

In the late 1980s, razor clam abundance information became necessary for the management of the fishery following increases in annual harvest and shifts in effort between beaches. Surveys were used to estimate both density and abundance of razor clams greater than or equal to 80 mm(exploitable size, which also represents the size of mature razor clams).

The periodic surveys conducted through 2008 were primarily conducted from May through August (concurrently with the fishery) on beaches within the CGMA and NMA with some surveys in the OPAMA on days when the predicted low tide was −2.0 ft or less (Athons 1992; Athons and Hasbrouck 1994; Szarzi 1991; Szarzi and Hansen 2009; Szarzi et al. 2010). Beginning 2011, surveys were conducted in April and May before most of the harvest occurred. Since 2011, razor clam abundance has been estimated annually at the Ninilchik South Beach (Table 1). Abundance was also estimated in 2011 at the Ninilchik North Beach and in 2014 at the Clam Gulch North and South beaches (Tables 3–4).

The estimated abundance of mature sized razor clams was about 82% below the 1991–2012 average at the Ninilchik South Beach and 89% below the 1989–2008 average at Clam Gulch beaches. Additionally, the abundance estimate of juvenile sized razor clams was about 36% below the average at Ninilchik South Beach and 86% below average abundance at Clam Gulch beaches. In 2014, both juvenile and mature sized razor clam densities were low at both the Ninilchik South and Clam Gulch beaches. Razor clam recruitment to the beaches and fishery are assessed with the abundance data by age. Historically, recruitment to the beaches has been highly variable between beach and year. Razor clam recruitment to the fishery on Clam Gulch beaches tends to occur annually while at Ninilchik, large recruitments occur every 2 to 4 years (Kerkvliet et al. *In prep*.[1]). In the NMA, the last large recruitment to the beach was observed in 2009 as age-1 from brood year (BY) 2007.

[1] Kerkvliet, C. M., Booz, M., Blackmon, T., and P. A. Hansen, M. D. Booz, and B. Harris. *In Prep*. Harvest, abundance, age and length characteristics of razor clams form eastern Cook Inlet beaches, 2009-2014. Fisheries Data Series, Anchorage.

Table 3.–Expected estimates, variances, and precision of harvest of razor clams by age at Clam Gulch, 2014.

	Clam Gulch								
	North			South			Combined		
Year	Abundance	Harvest	Exp. (%) [a]	Abundance	Harvest	Exp. (%) [a]	Abundance	Harvest	Exp. (%) [a]
1989	1,645,048	6,295	0.4	2,616,217	171,328	6.5	4,261,265	177,623	4.2
1990	1,798,280	183,137	10.2	1,074,908	97,721	9.1	2,873,188	280,859	9.8
1991	–	–	–	–	–	–	–	–	–
1992	–	–	–	–	–	–	–	–	–
1998	–	–	–	–	–	–	–	–	–
1999	4,036,610	84,663	2.1	6,139,901	103,561	1.7	10,176,511	188,224	1.8
2001	–	–	–	–	–	–	–	–	–
2003	–	–	–	–	–	–	–	–	–
2005	–	–	–	–	–	–	–	–	–
2008	651,872	44,098	6.8	600,037	22,144	3.7	1,251,909	66,241	5.3
2011	–	–	–	–	–	–	–	–	–
2012	–	–	–	–	–	–	–	–	–
2013	–	–	–	–	–	–	–	–	–
2014	327,815	–	–	174,188	–	–	502,003	–	–
Average 1989–2012	2,032,953	79,548	5.0	2,607,766	98,689	5.0	4,640,718	178,237	5.3

[a] Exploitation rates (%) from 1989 to 2008 reflect maximum rates because abundance sampling was primarily conducted from May through August (concurrently with the fishery) when most of the harvest occurred.

Table 4.–Expected estimates, variances, and precision of harvest of razor clams by age at Ninilchik, 2014.

	Ninilchik								
	North			South			Combined		
Year	Abundance	Harvest	Exp. (%) [a]	Abundance	Harvest	Exp. (%) [a]	Abundance	Harvest	Exp. (%) [a]
1989	421,675	–	–	–	–	–	–	324,469	–
1990	573,810	–	–	–	–	–	573,810	321,745	56.1
1991	1,821,120	–	–	251,601	–	–	2,072,721	335,518	16.2
1992	3,336,073	–	–	237,755	–	–	3,573,828	562,810	15.7
1998	597,993	–	–	308,129	–	–	906,122	287,581	31.7
1999	–	–	–	–	–	–	–	–	–
2001	540,652	122,427	22.6	275,475	93,930	34.1	816,127	216,356	26.5
2003	1,249,055	136,578	10.9	241,475	73,864	30.6	1,490,530	210,441	14.1
2005	857,322	141,313	16.5	440,851	78,800	17.9	1,298,173	215,378	16.6
2008	–	–	–	–	–	–	–	–	–
2011	1,212,311	198,585	16.4	1,621,765	98,475	6.1	2,834,076	297,060	10.5
2012	–	–	–	624,992	59,846	9.6	–	–	–
2013	–	–	–	65,688	37,573	57.2	–	–	–
2014	–	0	–	90,344	0	–	–	–	–
Average 1989–2012	1,178,890	148,542	16.5	500,255	80,983	19.6	1,695,673	307,929	23.4

[a] Exploitation rates (%) from 1989 to 2008 reflect maximum rates because abundance sampling was primarily conducted from May through August (concurrently with the fishery) when most of the harvest occurred.

MANAGEMENT

Legal clam harvesting gear is limited to using a shovel, rake, clam gun, or hands. The bag limit of 60 initially imposed in 1960 was considered liberal enough that the majority of diggers would be incapable of digging the daily limit (Nelson *Unpublished*). Except 2000–2003, when the limit was reduced to 45 razor clams, the Alaska Board of Fisheries has maintained the limit at 60 razor clams. Possession limits were initially imposed in 1994 at 180 (3 bag limits), which was then dropped to 90 (2 bag limits) from 2000 to 2003 when the bag limit was set at 45 razor clams. In 2003, the possession limit was then set at 120 (2 bag limits) when the 60 razor clam limit was reinstated.

In 2013, trends of lowered abundances coupled with low recruitment and reduction of the number of broods on the Ninilchik beaches prompted managers to reduce the bag and possession limit to the first 25 razor clams for all Eastside beaches beginning 23 May 2013 by emergency order (EO). Despite the reductions, the exploitation rate of razor clams on Ninilchik South Beach was the highest detected. As a result, in 2014 an EO was issued that closed the Ninilchik beaches to harvesting clams and the bag and possession limit was set to the first 25 clams dug for the remaining Eastside beaches. In 2015, all Cook Inlet Eastside beaches were closed to all clam harvest due to the record low abundance of razor clams at Ninilchik South Beach and Clam Gulch beaches. In 2014, the assessment of length and age of juvenile size razor clams suggests poor recruitment to mature size razor clams for the next 2 to 3 years.

OBJECTIVES

PRIMARY OBJECTIVES

1) Estimate the age and length composition of razor clams on 9 beaches (Deep Creek, Ninilchik South, Ninilchik Bar, Ninilchik North, Setnet Access, Oil Pad Access, Clam Gulch South, Clam Gulch North, and Cohoe) such that estimates are within 5 percentage points of the true value 92.5% of the time.

2) Estimate the abundance of razor clams on 5 beaches such that the estimates by beach are within the levels of precision 90% of the time as follows:

Beach	Relative precision (%)
Clam Gulch North	22
Clam Gulch South	26
Oil Pad Access North	31
Ninilchik North	31
Ninilchik South	30

SECONDARY OBJECTIVES

1) Estimate mean length-at-age for the major age classes.

2) Collect 150 ageable clams from Deep Creek and Whisky Gulch Beach.

3) Assess spatial distribution and abundance of razor clams using ArcGIS[1] mapping software for Ninilchik South Beach and Clam Gulch Beach (north and south).

STUDY DESIGN

OVERVIEW

With the sport fishery closed in 2015, no aerial surveys will be conducted. Abundance surveys will continue in 2015 as well as age-length composition sampling. Since 2011, ADF&G has partnered with Alaska Pacific University (APU) professors and students to estimate razor clam densities. This partnership will continue in 2015.

STUDY AREA

The study area extends from the Anchor River to the Kasilof River for the Cook Inlet Eastside beaches. The area is divided into the 6 management areas established by Nelson (*Unpublished*) and some of the management areas (NMA, OPMA, and CGMA) are further divided into subsections and are referred to as "beaches" (Figure 1, Table 1).

AGE-LENGTH COMPOSITION

In 2015, 150 unbroken razor clams will be collected from 9 beaches: Deep Creek, Ninilchik South, Ninilchik Bar, Ninilchik North, Set Net Access, Oil Pad Access, Clam Gulch South, Clam Gulch North and Cohoe.

DENSITY AND ABUNDANCE

In 2015, abundance will be accessed at the 5 beaches listed in Table 5.

Table 5.–Width, length, and location of beaches used in the 2015 abundance survey.

Beaches	Width (m)	Length (km)	North Boundary	South Boundary
Clam Gulch North	320	2.5	First A-frame cabin	Clam Gulch access road
Clam Gulch South	320	2.9	Clam Gulch access road	Clam Gulch Tower
Oil Pad Access North	320	4.8	Clam Gulch Tower	Second A-frame cabin
The Ninilchik North	183	4.8	Lehman's Point	Ninilchik River
Ninilchik South	396	1.6	Ninilchik River	Deep Creek

The methods used for sampling the 5 beaches will be the same as those described for sampling the Ninilchik South Beach. The Ninilchik South Beach begins at the Ninilchik River (north boundary) and extends 1.6 km south and is bounded by the gravel bar at the top (west) and Cook Inlet at the bottom (east). The beach is divided into a 5 × 26 grid with 5 locations running north to south (perpendicular to the water) and 26 strata running west to east (parallel to the water, Figure 2). A sample site is located within each of the grid cells. The sample sites are rectangular areas 5.53 m long by 0.79 m wide and within a site there are 7 possible 0.5 m^2 circular plots. A water pump will be used to sample density of clams within a plot (Figure 3).

[1] Product names used in this publication are included for completeness but do not constitute product endorsement.

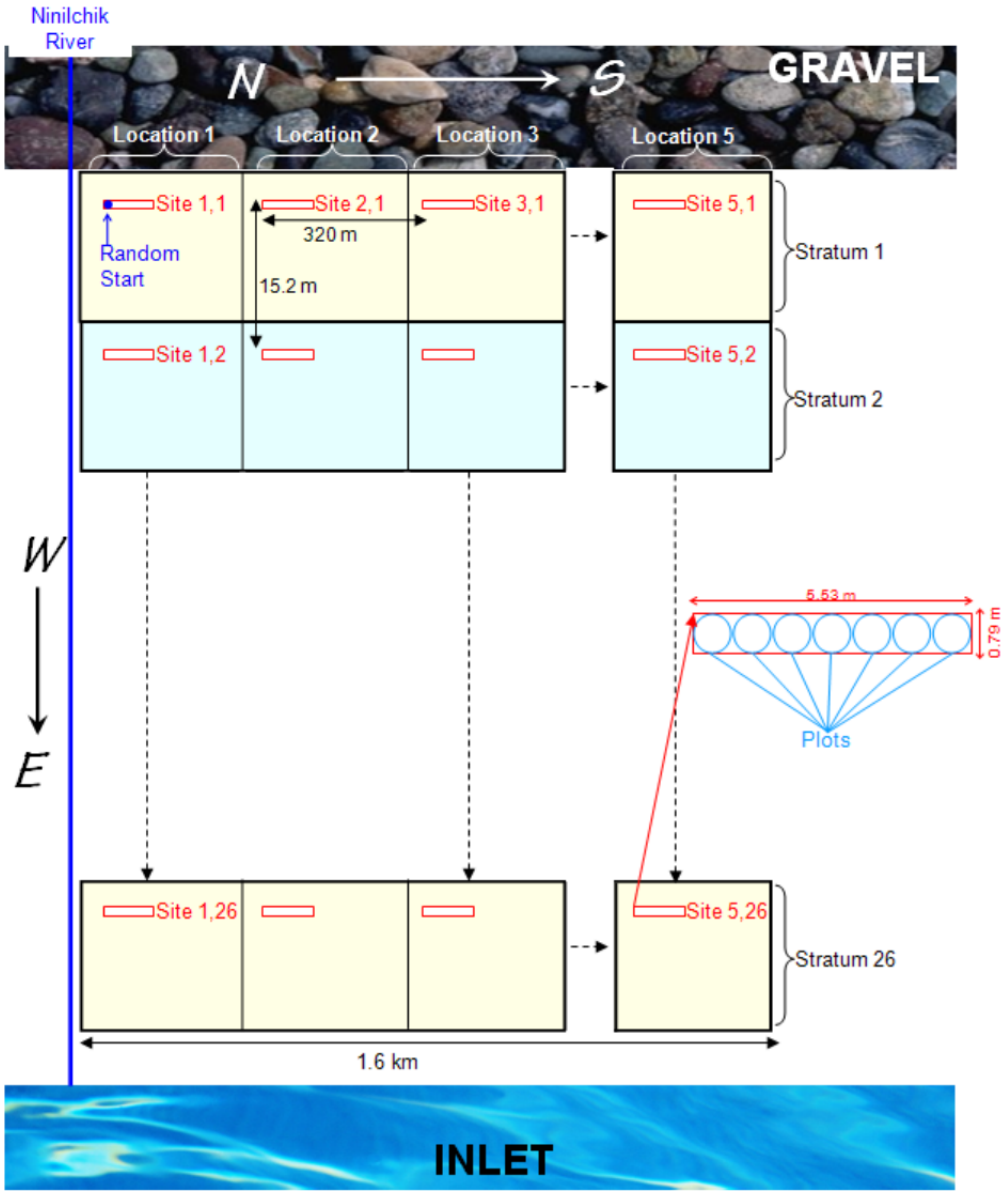

Figure 2.–Diagram of density pump, plot, site, stratum sample design (not to scale).

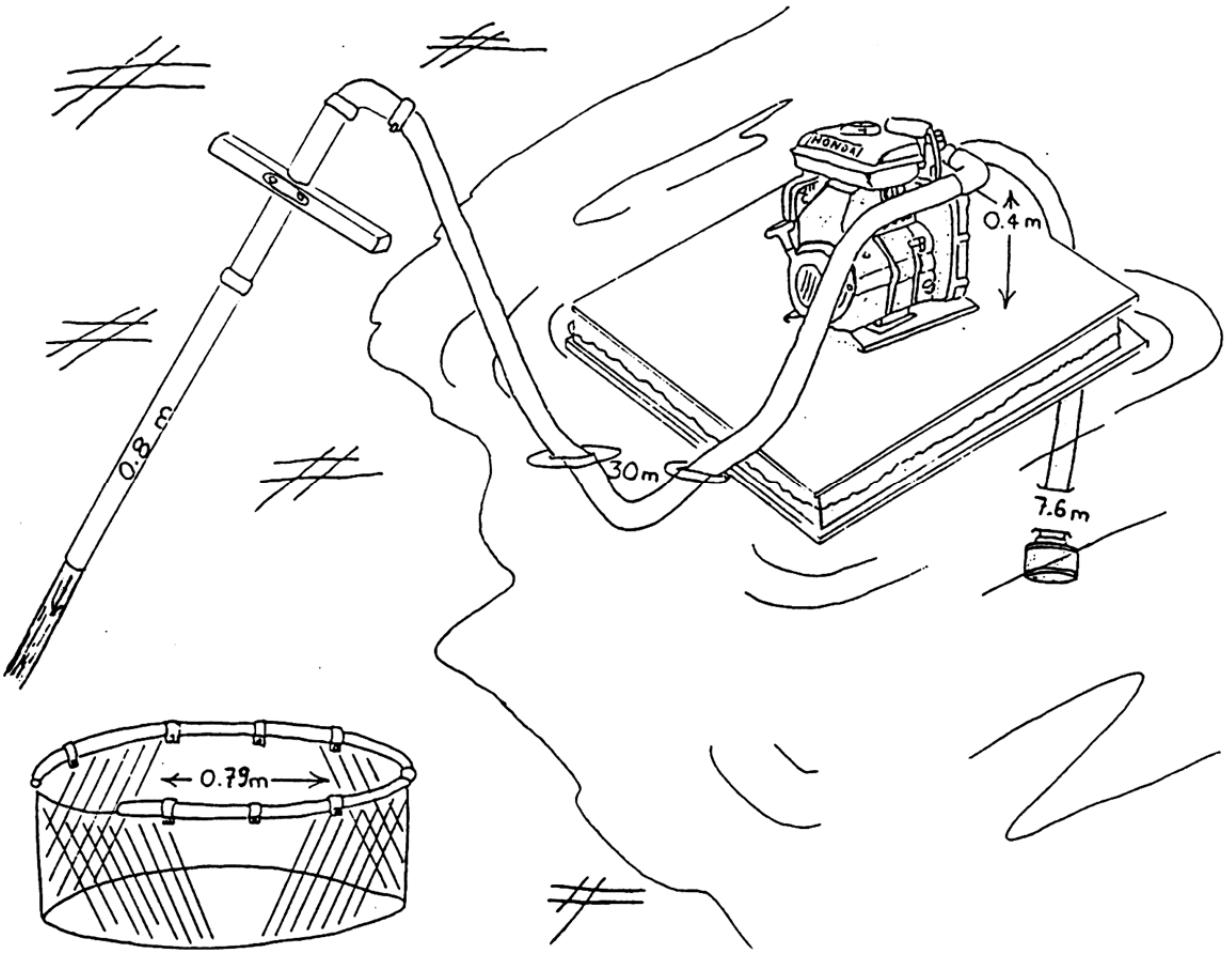

Figure 3.–Diagram of density pump generator and sample ring.

On each beach, abundance will be estimated independently for each stratum using a 2-stage sampling design. The primary units are sites and the secondary units are plots within a site (Figure 2)

The first sample site, located within Location 1, Stratum 1, will be chosen randomly; all subsequent samples will be chosen systematically. Randomization for the first site will take place both parallel and perpendicular to the shoreline. For the Ninilchik South beach, starting in the NW corner of the study area, the location of the first site will be determined by the intersection of two randomly chosen points; the first being a randomly chosen point along a 320 m line parallel to the shoreline (beach length/number of locations = 1.6 km/5 = 320 m) and the second being a randomly chosen point along a 15.2 m line perpendicular to the shoreline (beach width/number of stratum = 396 m/26 = 15.2 m). Subsequent samples will be taken systematically every 320 m along the line parallel to the beach (north to south) and every 15.2 m perpendicular to the beach (west to east).

At least 3 and up to seven 0.5 m^2 circular plots will be sampled at each sampling site. The number of plots sampled per site will depend on the tidal range, the rate at which the tide falls, and the beach substrate.

A systematic random sample will be used instead of a random sample because of the sampling time limitations due to tides, and difficulty moving the pump long distances. The systematic random sample is treated as a simple random sample for the calculation of variance.

All other beaches will be sampled following the protocol described above using the appropriate beach length, width, number of locations, and number of strata (Table 6).

Table 6.–Number of locations, strata, and sample sites for each beach.

Beach	Width (m)	Length (km)	Number of locations	Number of strata	Number of sample sites
Clam Gulch North	320	2.45	6	21	126
Clam Gulch South	320	2.92	6	21	126
Oil Pad Access North	320	4.80	5	21	105
Ninilchik North	160	4.83	8	12	96
Ninilchik South	396	1.54	6	26	156

This same sampling design has been used to estimate abundance of razor clams since 2011. The latest data from each beach were used to estimate the relative precision given the number of sites planned for 2015. A Monte Carlo simulation was used to add sites and the abundance and relative precision were recalculated (Table 7).

Table 7.–Anticipated relative precision of abundance estimates for each beach in 2015.

Beach	Year	Number of sites sampled	Relative precision (%)	Number of sample sites planned 2015	Anticipated 2015 relative precision (%)
Clam Gulch North	2014	109	24	126	22
Clam Gulch South	2014	113	28	126	26
Oil Pad Access North	2008	34	N/A	105	31
Ninilchik North	2011	77	37	96	31
Ninilchik South	2014	142	32	156	30

ArcGIS will be used to assess spatial distribution and abundance of razor clams on the beach sections. This assessment will allow for possible poststratification of the sampling to improve the abundance estimate and its variance.

DATA COLLECTION

AGE-LENGTH COMPOSITION

Sampling

Sampling to estimate razor clam age-length composition will occur on days listed in Appendix A1. Because beaches are closed to clam digging, staff will notify the Alaska State Troopers, Alaska State Parks, and other ADF&G staff before sampling. To help identify sampling staff, a state vehicle with an attached ADF&G sticker will be parked near the sampling site and the crew will wear orange vests and ADF&G hats. Meat from sampling efforts will be donated to the Ninilchik or Homer Senior Center. Samplers will walk throughout the beach area in a manner that mimics a typical clam digger, rather than sampling from a relatively small area of beach. All clams dug will be retained regardless of size or condition. Most specimens will be dug by shovel to minimize shell damage. A dowel rod placed in the clam "show" (a shallow dimple or depression in the sand), will helped facilitate collection. Collection will occur on tides ranging from −1.2 to −5.6 ft. For access to Ninilchik Bar, a tide lower than −3.0 is needed.

Processing

One unbroken valve will be used for measuring and aging. Shells from each beach will be stored in a labeled box and kept separate from the remaining beaches during processing, measuring, and aging.

Razor clams will be processed by removing the tissue and soaking the shell in a 50% household bleach solution until most of the periostracum is dissolved, revealing the heavy annuli layers. The shells will be removed from the bleach solution, rinsed, and subsequently dried. Each sample will be numbered sequentially on both valves.

Age and Length Measurements

Shells will be aged (aging) using the methods described by Nelson (*Unpublished*) and the recommendations of Coggins (1994). Before aging new shells, a test set of previously aged shells will be used to hone aging precision and ensure consistency within and between readers. Each sample will be independently aged twice. Every annulus will be measured on

every sample and age trial. Measurements and ages will be entered into an Access database. The Access database will be used to compare the ages from both age trials. Samples with differing ages will be re-aged to produce a final resolved age. The age of a clam will be considered final when the ages from 2 independent readings agree and the measurements of the annuli for each of the 2 readings are within ±2 mm of one another. For the samples with agreement between the 2 age trials, the measurements from the first age trial will be used for growth analysis. Each annulus and the total length measured will be automatically imported into the Access database using Mitutoyo Digimatic Calipers.

DENSITY AND ABUNDANCE

Sampling to estimate abundance of razor clams at the Ninilchik, Clam Gulch, and Oil Pad Access beaches will occur on days listed in Appendix A2. At each beach, sample locations will be numbered from north to south and the order in which they are sampled will be scheduled to ensure different tide heights across the entire sampling area. Up to 2 teams will sample on a given day. Teams will comprised a combination of ADF&G staff, APU staff and students, and other volunteers. Teams will have a designated ADF&G staff leader that will assign duties prior to sampling. The gravel line (start of study area) at each sampling location will be located using a handheld GPS and the coordinates listed in Appendix B1. Sample sites will be located along a perpendicular transect and marked with a flag with the distances listed in Appendix B1. A compass will be used to follow a heading to keep the sample sites along a perpendicular transect. Flags will be numbered sequentially from the gravel line towards the maximum exposed water line. Samplers will attempt to sample all sites within a location but this may not be feasible due to the rate at which the tide recedes. A minimum of 3 and up to 7 circular plots will be sampled in each site if feasible. Data will be entered on data sheets (Appendix B2).

Sampling equipment will consist of a 4-cycle Honda pump with 30 m of firehose on the inlet (output) side and 12 m of stiff plastic hose on the outlet (intake) side (Figure 3). The outlet hose has a metal tube or "wand" attached to direct the flow of water into the substrate enclosed by a 0.5 m^2 sampling ring. Water will be pumped into the plot to loosen the substrate and expose the razor clams. This sampling equipment is described in greater detail by Szarzi (1991).

A 0.5 m^2 sampling ring will be used to define the circular plot. For each plot, substrate will be assessed for presence or absence of coal, clay, and gravel. The wand will be used to evaluate compaction using the following method. At full water pressure the wand will be balanced vertically on the beach, without any downward pressure at the center of the plot for 5 seconds to allow water from the wand to dig a hole that the wand will drop into. The depth that the wand sinks will be measured to the nearest 10 cm (start depth). Once the plot is emulsified, the depth of the probe will again be measured to the nearest 10 cm (end depth). Compaction will be estimated as the difference between start depth and end depth.

The wand will be repeatedly inserted into the substrate inside the sample ring as far as the wand will penetrate. The substrate enclosed in the ring will be loosened such that all clams within the ring (sample area) will be flushed to the surface. Sampling will cease when the entire area within the ring is fluid and no clams have surfaced for approximately 1 minute. A hand-held net with 2 mm mesh will be used to strain the loosened substrate to search for small clams not readily visible. All clams encountered inside the ring will be measured, aged, and

then released. The length and age of each clam captured from each plot will be recorded onto the data sheets.

A survey grade GPS (Trimble AG132) will be used to collect GPS coordinates of the study areas and at each sampled site. To define the study area, GPS coordinates will be collected along the transition from gravel to sand (starting side of study area) and along the waterline during slack tide of each survey. Additionally any areas that are not suitable razor clam habitat (large coal seams or areas with mostly gravel) will be surveyed, mapped, and potentially removed from the sample area.

DATA REDUCTION

Age and length data will be directly recorded into an Access database containing the historical data and stored in relational based tables in Access with the information detailed in the column headings in Appendices C1 and C2 for analysis.

Abundance data will be recorded on waterproof data sheets (Appendix B2). Data collected for each location will be recorded separately. After sampling, the data will be proofed and entered into an Access database (Appendices C1 and C3).

A biologist will examine each file for completeness (e.g., total length and length for each age [annulus] are recorded). Age data will be summarized by management area or beach sub-section to detect any aberrant ages (i.e., <0, ≥15). Minimum and maximum length by age will also be inspected for each management area or beach subsection to find any errors.

All data will be archived on the Sport Fish network hard drive at O:\DSF\SportF\Clam\razor clams\RazorMasterFiles\Razor_Database. Field notebooks and data sheets will be stored in the Homer office until final data analysis and archiving are complete.

All GPS data will be recorded directly into a hand-held data logger and postprocessed in the Homer ADF&G office immediately after the survey is complete. Data will be imported into ArcGIS and proofed against previously collected GPS data. All GPS point data for the study area will be used to develop a polygon layer for the study. The estimate of area will be produced from the polygon layer in ArcGIS. The GPS point data for the sampled sites will be converted into a point layer within ArcGIS and will include other sampling data such as number of sampled plots, number of clams found, and habitat information.

DATA ANALYSIS

AGE-LENGTH COMPOSITION

The proportion of clams in age (or length) class *i* on beach *b* will be estimated as follows:

$$\hat{p}_{bi} = \frac{n_{bi}}{n_b} \tag{1}$$

where

n_{bi} = the number of clams sampled of age (or length) class *i* from beach *b*, and

n_b = the total number of "ageable" (or measureable) clams sampled from beach *b*.

The variance of the proportion will be estimated (Cochran 1977) as follows:

$$\hat{V}\left[\hat{p}_{bi}\right] = \frac{\hat{p}_{bi}\left(1-\hat{p}_{bi}\right)}{n_b - 1} \tag{2}$$

ESTIMATED ABUNDANCE BY BEACH:

The number of clams greater than or equal to 80 mm in each stratum will be estimated as follows:

$$\hat{N}_b = S_b \hat{\bar{N}}_b \tag{3}$$

where

S_b = the number of possible sites in area stratum b, and

$$\hat{\bar{N}}_b = \frac{\sum_{i=1}^{s_b} \hat{N}_{bi}}{s_b} \tag{4}$$

where

$\hat{\bar{N}}_b$ = mean estimated clam abundance of sites in area stratum b,

s_b = the number of sites sampled in area stratum b, and

$$\hat{N}_{bi} = P_{bi} \hat{\bar{N}}_{bi} \tag{5}$$

where

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

P_{bi} = the number of possible plots at site i in area stratum b, and

$$\hat{\bar{N}}_{bi} = \frac{\sum_{j=1}^{p_{bi}} \hat{N}_{bij}}{p_{bi}} \tag{6}$$

where

$\hat{\bar{N}}_{bi}$ = mean estimated abundance of plots in site i, area stratum b,

$\hat{N}_{bij}$ = the estimated abundance in plot j, site i, and area stratum b, and

p_{bi} = the number of plots sampled at site i in area stratum b.

with variance

$$Var\left[\hat{N}_b\right] = \left(1-f_{1b}\right) S_b^2 \frac{s_{1b}^2}{s_b} + f_{1b}^{-1} P_{bi}^2 \sum_{i=1}^{s_b} \left[\left(1-f_{2bi}\right)\frac{s_{2bi}^2}{p_{bi}}\right] \tag{7}$$

where

$$s_{1b}^2 = \frac{\sum_{i=1}^{s_b}\left(\hat{N}_{bi} - \hat{\bar{N}}_b\right)^2}{s_b - 1} \tag{8}$$

is the variance among sites,

$$s_{2bi}^2 = \frac{\sum_{j=1}^{p_{bi}}\left(\hat{N}_{bij} - \hat{N}_{bi(j-1)}\right)^2}{p_{bi} - 1} \tag{9}$$

is the variance among plots within a site,

$$f_{1b} = \frac{s_b}{S_b} \tag{10}$$

is the number of sites sampled in a stratum relative to the total possible sites, and

$$f_{2bi} = \frac{p_{bi}}{P_{bi}} \tag{11}$$

is the number of plots sampled in a site relative to the total possible plots.

The abundance of clams on the entire given beach will be the sum of the number of clams in each stratum:

$$\hat{N}_a = \sum_{b=1}^{B} \hat{N}_b \tag{12}$$

The variance of abundance of clams on the given beach will be estimated as follows:

$$V\left(\hat{N}_a\right) = \sum_{b=1}^{B} V\left(\hat{N}_b\right) \tag{13}$$

Adjacent strata with similar clam densities may be combined to reduce the variance of the overall abundance estimate. Evaluation to determine if strata should be combined will include testing for differences in mean clams per site between strata (2-sample *t*-test) and examination of changes in the abundance estimate.

SCHEDULES AND REPORTS

Schedules for sampling appear in Appendices A1–A2. Estimates of abundance will be produced within 2 weeks of the last sampling. Processing and aging of shells will occur inseason as time permits and during August. A report summarizing the results of data collected in 2015 will be completed by March 2016 and published in an ADF&G Sport Fishery Data Series.

RESPONSIBILITIES

List of Personnel and Duties:

1. Carol Kerkvliet, Assistant Area Management Biologist, ADF&G
   Duties: Project leader. Overall project supervision. Will prepare operational plan, administer the project budget, hire seasonal field staff, assist with field sampling, and write the report.
2. Patricia Hansen, Biometrician, ADF&G
   Duties: Technically reviews study design, sampling methods, and data analysis of operational plan, and co-authors the report. Will provide assistance in drafting operational plan and technical assistance inseason should changes in the design be necessary.
3. Michael Booz, Fisheries Biologist I, Project Assistant, ADF&G
   Duties: Assist with operational planning, train project technicians, participate in project activities, and assist with data analysis, summarization, and reporting.
4. Tim Blackmon, Fisheries Technician III
   Duties: Crew leader. Oversees and participates in the collection of field data as outlined in the operational plan, including biological sampling and specimen processing. Responsible for maintenance and repair of sampling equipment.
5. Brad Harris PhD, Assistant Professor of Marine Biology
   Duties: Schedule Alaska Pacific University students to assist area staff with 5 days of field sampling. Responsible for insuring that the students collect the field data as outlined in the operational plan, including biological sampling, and specimen processing.
6. Other assisting personnel
   Duties: Will collect field data as outlined in operational plan, including biological sampling and specimen processing. Responsible for maintenance and repair of sampling equipment.

BUDGET

Line Item	Category	Budget ($K)
100	Personal Services	48.9
200	Travel	0.0
300	Contractual Services	4.7
400	Commodities	4.7
500	Equipment	6.0
Total		64.3

Budget Manager: Carol Kerkvliet

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APPENDIX A: SAMPLING SCHEDULES

Appendix A1.–Schedule for razor clam age-length sampling.

Date	Tide (ft)	Time	Beach section
3 Jun	−3.0	10:52 AM	Ninilchik South
15 Jun	−3.6	9:29 AM	Ninilchik North
16 Jun	−4.1	10:13 AM	Ninilchik Bar
17 Jun	−4.0	10:54 AM	Deep Creek
18 Jun	−3.5	11:34 AM	Clam Gulch North
19 Jun	−2.6	12:13 PM	Clam Gulch South
1 Jul	−2.5	9:54 AM	Oil Pad Access North
3 Jul	−4.0	11:14 AM	Oil Pad Access South
4 Jul	−4.0	11:56 AM	Cohoe
5 Jul	−3.4	12:39 PM	Clam Gulch South
6 Jul	−2.3	1:25 PM	Oil Pad Access South

Appendix A2.–Schedule for razor clam abundance sampling.

Date	Tide (ft)	Slack low tide time	Meet at office time	Approximate start time	Survey beach	Location [a]	
						Team 1	Team 2
5 Apr	−1.0	11:01 AM	7:30 AM	8:45 AM	Clam Gulch	S-4	
6 Apr	−1.1	11:34 AM	8:00 AM	9:15 AM	Ninilchik	S-6	
7 Apr	−0.9	12:07 PM	8:45 AM	10:00 AM	Clam Gulch	N-3	
17 Apr	−2.7	9:14 AM	5:30 AM	6:50 AM	Ninilchik	S-4	S-1
18 Apr	−4.2	9:59 AM	6:00 AM	7:15 AM	Ninilchik		S-5
19 Apr	−5.0	10:43 AM	7:00 AM	8:15 AM	Clam Gulch		N-4
20 Apr	−5.0	11:27 AM	7:30 AM	8:45 AM	Clam Gulch	N-2	N-6
21 Apr	−4.2	12:10 PM	8:15 AM	9:30 AM	Ninilchik	S-3	S-2
22 Apr	−2.7	12:55 PM	9:15 AM	10:30 AM	Clam Gulch	S-6	
4 May	−1.8	10:37 AM	6:45 AM	8:15 AM	Clam Gulch	N-5	
5 May	−2.2	11:11 AM	6:45 AM	8:15 AM	Clam Gulch	N-1	
6 May	−2.2	11:47 AM	7:30 AM	9:00 AM	Clam Gulch	S-2	
7 May	−1.9	12:25 PM	8:30 AM	9:45 AM	Clam Gulch	N-2	
16 May	−3.1	8:57 AM	5:15 AM	6:30 AM	Ninilchik	N-2	N-5
17 May	−4.4	9:43 AM	5:15 AM	6:30 AM	Clam Gulch	S-1	S-5
18 May	−4.9	10:27 AM	6:30 AM	7:45 AM	Clam Gulch	S-3	
19 May	−4.8	11:09 AM	7:15 AM	8:30 AM	Ninilchik	N-1	
20 May	−4.0	11:52 AM	8:00 AM	9:15 AM	Ninilchik	N-3	N-4
31 Aug	−3.4	11:04 AM	7:00 AM	8:45 AM	Oil Pad Access	N-2	N-4
1 Sep	−2.9	11:46 AM	8:00 AM	10:00 AM	Oil Pad Access	N-1	N-5
2 Sep	−1.3	12:29 PM	8:45 AM	10:45 AM	Oil Pad Access	N-3	

[a] N = north; S = south.

APPENDIX B: ABUNDANCE START LOCATIONS AND COMPASS HEADINGS

Appendix B1.–Abundance start locations and compass headings.

Beach	Location	Start distance (m)	Heading	Site 1 distance (m)	Site >1 distance (m)	Start GPS	
						Latitude	Longitude
Clam Gulch North	1	389	333	2.7	15.2	60.261132	−151.392566
	2	797	333	2.7	15.2	60.257518	−151.393856
	3	1205	333	2.7	15.2	60.253908	−151.395233
	4	1613	333	2.7	15.2	60.250266	−151.396206
	5	2021	333	2.7	15.2	60.246744	−151.397742
	6	2429	307	2.7	15.2	60.243216	−151.400014
Clam Gulch South	1	324	332	7.3	15.2	60.237120	−151.403733
	2	811	332	7.3	15.2	60.232858	−151.405761
	3	1298	332	7.3	15.2	60.228709	−151.408438
	4	1785	332	7.3	15.2	60.224594	−151.411328
	5	2272	332	7.3	15.2	60.220679	−151.415037
	6	2759	316	7.3	15.2	60.216813	−151.419089
Oil Pad Access North	1	649	316	11.0	15.2	60.211017	−151.426489
	2	1609	316	11.0	15.2	60.204249	−151.437710
	3	2569	316	11.0	15.2	60.197044	−151.447295
	4	3529	316	11.0	15.2	60.190112	−151.457277
	5	4489	316	11.0	15.2	60.183371	−151.467311
Ninilchik North	1	333	323	8.5	15.2	60.089565	−151.624642
	2	936	323	8.5	15.2	60.084516	−151.628663
	3	1539	312	8.5	15.2	60.079758	−151.633849
	4	2142	310	8.5	15.2	60.075150	−151.639739
	5	2745	310	8.5	15.2	60.070591	−151.645570
	6	3348	319	8.5	15.2	60.066043	−151.651400
	7	3951	314	8.5	15.2	60.061197	−151.656305
	8	4554	302	8.5	15.2	60.056922	−151.662953
Ninilchik South	1	310	310	4.9	15.2	60.052405	−151.669307
	2	310	310	4.9	15.2	60.050430	−151.671680
	3	310	310	4.9	15.2	60.048072	−151.673866
	4	310	310	4.9	15.2	60.046222	−151.675452
	5	297	297	4.9	15.2	60.044149	−151.677623
	6	297	297	4.9	15.2	60.041842	−151.682972

Appendix B2.–Data sheet for abundance start locations and compass headings.

Date: Beach: Transect: Crew: Page x of x

Site	Time	Plot	Sediment[1]			Wand Depth		Total Clams	Clam Size (mm) & Age										More Clams[4]
			Coal	Clay	Gravel	Start[2]	End[3]		1		2		3		4		5		
1		1																	
1		2																	
1		3																	
1		4																	
1		5																	
1		6																	
1		7																	
Position: N 60._____° W -151._____°									Comments:										
2		1																	
2		2																	
2		3																	
2		4																	
2		5																	
2		6																	
2		7																	
Position: N 60._____° W -151._____°									Comments:										
3		1																	
3		2																	
3		3																	
3		4																	
3		5																	
3		6																	
3		7																	
Position: N 60._____° W -151._____°									Comments:										
4		1																	
4		2																	
4		3																	
4		4																	
4		5																	
4		6																	
4		7																	
Position:									Comments:										

[1] Yes for present, No for absent.

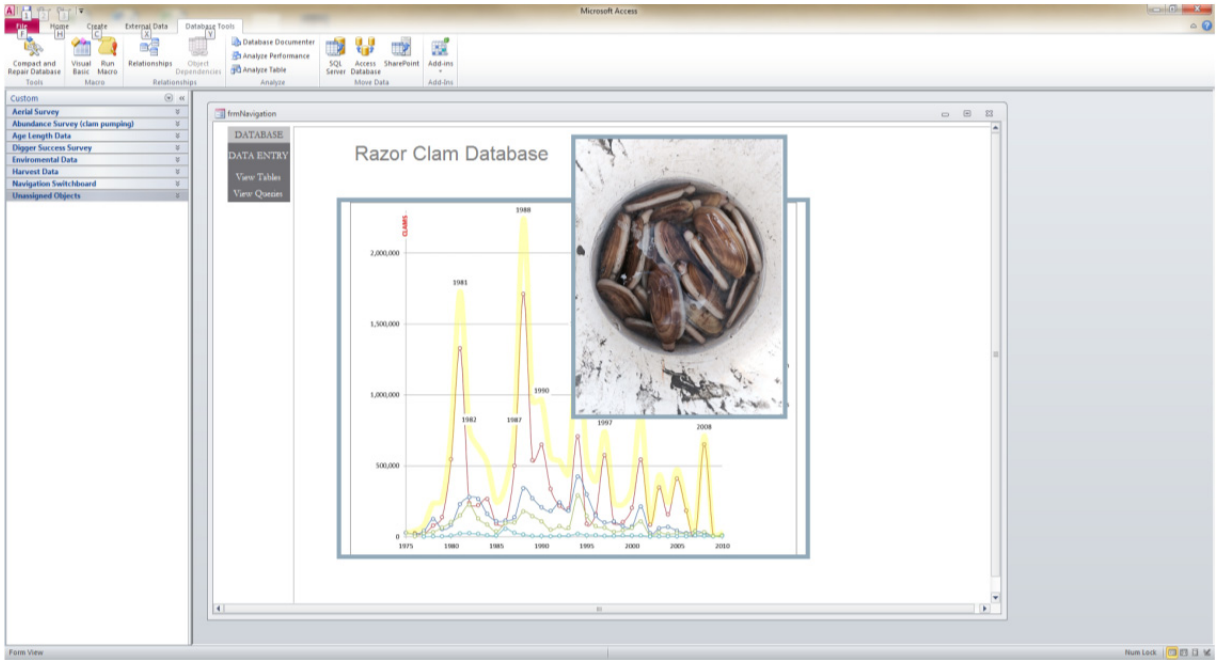
[2] Wand depth to the nearest 10 cm after 5 seconds.

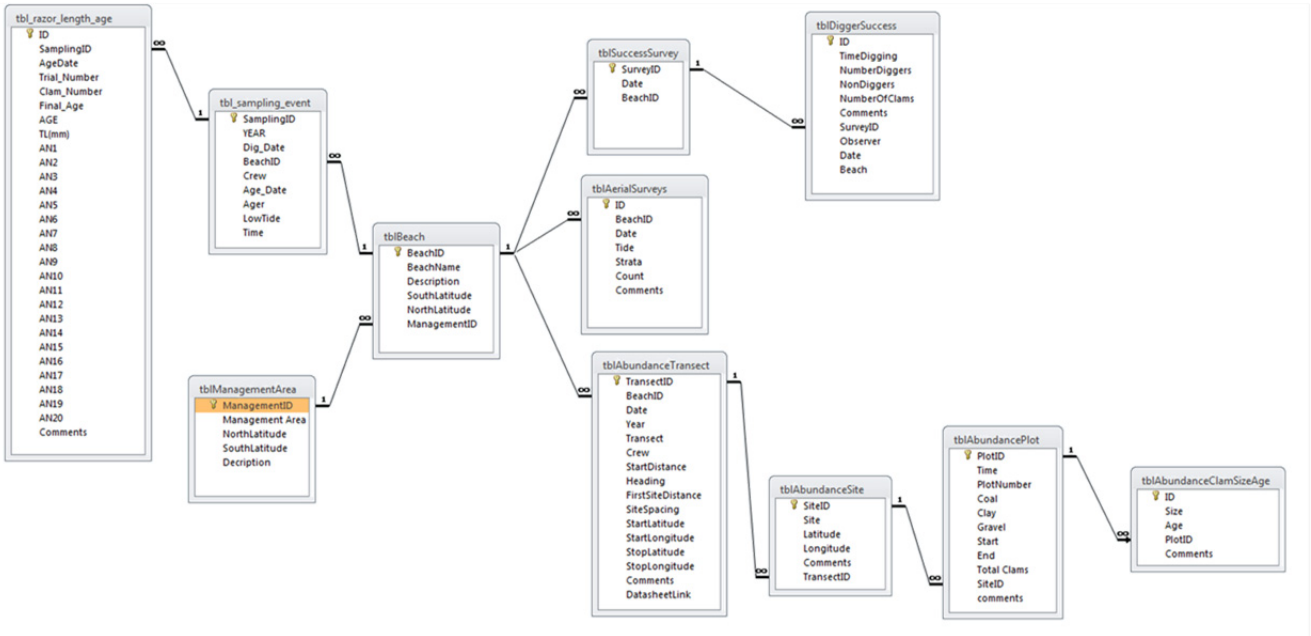
[3] Wand depth to the nearest 10 cm after plot is emulsified.

[4] Yes for when there are additional clams on other datasheet. No when there are ≤5 clams.

APPENDIX C: FILE FORMATS

Appendix C1.–Razor clam database and relationship structure.





Appendix C2.–Razor clam database tables with age-length data descriptions..

tblManagementArea

Field Name	Data Type	Description
ManagementID	Number	Unique number assigned to each Management Area
Management Area	Text	Name of management area
NorthLatitude	Number	Latitude in decimal degrees of northern boundary
SouthLatitude	Number	Latitude in decimal degrees of southern boundary
Decription	Text	Desription of management area

Field Properties

tblBeach

Field Name	Data Type	Description
BeachID	Number	Unique number assigned to each beach sub-section
BeachName	Text	Name of beach sub-section
Description	Text	Description of boundaries of beach sub-section
SouthLatitude	Number	Latitude in decimal degrees of southern boundary
NorthLatitude	Number	Latitude in decimal degrees of northern boundary
ManagementID	Number	One to many relationship with tblManagementArea

Field Properties

tbl_sampling_event

Field Name	Data Type	Description
SamplingID	AutoNumber	Unique number assigned to each sampling event
YEAR	Number	Year when sampling occured
Dig_Date	Date/Time	Date sampling occured
BeachID	Number	One to many relationship
Crew	Memo	List of members obtaining sample
Age_Date	Date/Time	Date when shells were aged
Ager	Text	Name of person who aged clams
LowTide	Number	Height of Low Tide during sampling
Time	Date/Time	Time of Low Tide during sampling

Field Properties

-continued-

Appendix C2.–Page 2 of 2.

tbl_razor_length_age

Field Name	Data Type	Description
ID	AutoNumber	Unique number assigned to each clam
SamplingID	Number	One to many relationship with tbl_sampling_event
AgeDate	Date/Time	Date when clam was aged
Trial_Number	Number	The iteration number of aging and measuring.
Clam_Number	Number	Number assigned to clam sequentially in each sample
Final_Age	Yes/No	(Yes/No) on whether both aging trials agree or have been resolved
AGE	Number	Age of clam
TL(mm)	Number	Total length in mm of clam
AN1	Number	Length of first annulus
AN2	Number	Length of second annulus
AN3	Number	Length of third annulus
AN4	Number	Length of forth annulus
AN5	Number	Length of fifth annulus
AN6	Number	Length of sixth annulus
AN7	Number	Length of seventh annulus
AN8	Number	Length of eighth annulus
AN9	Number	Length of ninth annulus
AN10	Number	Length of tenth annulus
AN11	Number	Length of eleventh annulus
AN12	Number	Length of twelveth annulus
AN13	Number	Length of thirteenth annulus
AN14	Number	Length of fourteenth annulus
AN15	Number	Length of fifteenth annulus
AN16	Number	Length of sixteenth annulus
AN17	Number	Length of seventeenth annulus
AN18	Number	Length of eighteenth annulus
AN19	Number	Length of nineteenth annulus
AN20	Number	Length of twentieth annulus
Comments	Memo	Any notes pertinent to aging and measuring

Field Properties

Appendix C3.–Razor clam database tables with abundance data descriptions..

tblManagementArea

Field Name	Data Type	Description
ManagementID	Number	Unique number assigned to each Management Area
Management Area	Text	Name of management area
NorthLatitude	Number	Latitude in decimal degrees of northern boundary
SouthLatitude	Number	Latitude in decimal degrees of southern boundary
Decription	Text	Desription of management area

Field Properties

tblBeach

Field Name	Data Type	Description
BeachID	Number	Unique number assigned to each beach sub-section
BeachName	Text	Name of beach sub-section
Description	Text	Description of boundaries of beach sub-section
SouthLatitude	Number	Latitude in decimal degrees of southern boundary
NorthLatitude	Number	Latitude in decimal degrees of northern boundary
ManagementID	Number	One to many relationship with tblManagementArea

Field Properties

tblAbundanceTransect

Field Name	Data Type	Description
TransectID	AutoNumber	Unique number assigned for each transect
BeachID	Number	Number corresponding to beach sub-section where sampling occured
Date	Date/Time	Date of sampling
Year	Number	Year of sampling
Transect	Text	Number of Transect: also referred to as Location in Fig. 3
Crew	Text	List of Crew, commonly (APU or ADFG)
StartDistance	Number	Distance in meters from start of beach
Heading	Number	Direction of Transect in degrees
FirstSiteDistance	Number	Distance from gravel line to first site in meters
SiteSpacing	Number	Distance between sites along transect in meters
StartLatitude	Number	GPS Latitude of Transect Start in Decimal Degrees
StartLongitude	Number	GPS Longitude of Transect Start in Decimal Degrees
StopLatitude	Number	GPS Latitude of Transect End in Decimal Degrees
StopLongitude	Number	GPS Longitude of Transect Start in Decimal Degrees
Comments	Text	Any pertinent notes about transect
DatasheetLink	Hyperlink	Hyperlink to scanned datasheet if applicable

Field Properties

tblAbundanceSite

Field Name	Data Type	Description
SiteID	AutoNumber	Unique number assigned to each site; also known as strata
Site	Number	Number associated with the strata
Latitude	Number	Latitude in decimal degrees
Longitude	Number	Longitude in decimal degrees
Comments	Text	Any pertinent notes regarding the site
TransectID	Number	One to many relationship to tblAbundanceTransect

Field Properties

-continued-

Appendix C3.–Page 2 of 2.

tblAbundancePlot

Field Name	Data Type	Description
PlotID	AutoNumber	Unique number assigned for each plot
Time	Date/Time	Time of plot sampling
PlotNumber	Number	Sequential number of plot at each site
Coal	Yes/No	(Yes/No) of whether coal was present in plot
Clay	Yes/No	(Yes/No) of whether clay was present in plot
Gravel	Yes/No	(Yes/No) of whether gravel was present in plot
Start	Number	How far in mm, sampling wand penetrates in to substrate initially
End	Number	How far in mm, sampling wand penetrates in to substrate after emulsification
Total Clams	Number	Number of clams found in plot
SiteID	Number	One to many relationship to tblAbundanceSite
Comments	Text	Any pertinent notes about plot

Field Properties

tblAbundanceClamSizeAge

Field Name	Data Type	Description
ID	AutoNumber	Unique number assigned to each clam
Size	Number	Length in mm of clam
Age	Number	Age in years of clam
PlotID	Number	One to many relationship with tblAbundancePlot
Comments	Text	Any pertinent notes about clam

Field Properties