

# **Fishery Management Report No. 06-01**

---

---

## **Report to The Board of Fisheries, Miscellaneous Dive Fisheries**

by

**Scott Walker,**

**Zac Hoyt**

and

**Marc Pritchett**

---

---

January 2006

Alaska Department of Fish and Game

Divisions of Sport Fish and Commercial Fisheries



## Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the *Système International d'Unités* (SI), are used without definition in the following reports by the Divisions of Sport Fish and of Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

<b>Weights and measures (metric)</b>		<b>General</b>		<b>Measures (fisheries)</b>	
centimeter	cm	Alaska Administrative		fork length	FL
deciliter	dL	Code	AAC	mid-eye-to-fork	MEF
gram	g	all commonly accepted		mid-eye-to-tail-fork	METF
hectare	ha	abbreviations	e.g., Mr., Mrs., AM, PM, etc.	standard length	SL
kilogram	kg			total length	TL
kilometer	km	all commonly accepted			
liter	L	professional titles	e.g., Dr., Ph.D., R.N., etc.		
meter	m	at	@	<b>Mathematics, statistics</b>	
milliliter	mL	compass directions:		<i>all standard mathematical</i>	
millimeter	mm	east	E	<i>signs, symbols and</i>	
		north	N	<i>abbreviations</i>	
		south	S	alternate hypothesis	H <sub>A</sub>
		west	W	base of natural logarithm	<i>e</i>
		copyright	©	catch per unit effort	CPUE
		corporate suffixes:		coefficient of variation	CV
		Company	Co.	common test statistics	(F, t, $\chi^2$ , etc.)
		Corporation	Corp.	confidence interval	CI
		Incorporated	Inc.	correlation coefficient	
		Limited	Ltd.	(multiple)	R
		District of Columbia	D.C.	correlation coefficient	
		et alii (and others)	et al.	(simple)	r
		et cetera (and so forth)	etc.	covariance	cov
		exempli gratia	e.g.	degree (angular)	°
		(for example)		degrees of freedom	df
		Federal Information	FIC	expected value	<i>E</i>
		Code		greater than	>
		id est (that is)	i.e.	greater than or equal to	≥
		latitude or longitude	lat. or long.	harvest per unit effort	HPUE
		monetary symbols		less than	<
		(U.S.)	\$, ¢	less than or equal to	≤
		months (tables and		logarithm (natural)	ln
		figures): first three		logarithm (base 10)	log
		letters	Jan, ..., Dec	logarithm (specify base)	log <sub>2</sub> , etc.
		registered trademark	®	minute (angular)	'
		trademark	™	not significant	NS
		United States		null hypothesis	H <sub>0</sub>
		(adjective)	U.S.	percent	%
		United States of		probability	P
		America (noun)	USA	probability of a type I error	
		U.S.C.	United States	(rejection of the null	
			Code	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

<b>Weights and measures (English)</b>					
cubic feet per second	ft <sup>3</sup> /s				
foot	ft				
gallon	gal				
inch	in				
mile	mi				
nautical mile	nmi				
ounce	oz				
pound	lb				
quart	qt				
yard	yd				

<b>Time and temperature</b>					
day	d				
degrees Celsius	°C				
degrees Fahrenheit	°F				
degrees kelvin	K				
hour	h				
minute	min				
second	s				

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

***FISHERY MANAGEMENT REPORT NO. 06-01***

**REPORT TO THE BOARD OF FISHERIES, MISCELLANEOUS DIVE  
FISHERIES**

by

Scott Walker,  
Alaska Department of Fish and Game, Commercial Fisheries, Ketchikan

Zac Hoyt  
Alaska Department of Fish and Game, Commercial Fisheries, Petersburg  
and

Marc Pritchett  
Alaska Department of Fish and Game, Commercial Fisheries, Douglas

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

January 2006

The Division of Sport Fish Fishery Management Reports series was established in 1989 for the publication of an overview of Division of Sport Fish management activities and goals in a specific geographic area. Since 2004, the Division of Commercial Fisheries has also used the Fishery Management Report series. Fishery Management Reports are intended for fishery and other technical professionals, as well as lay persons. Fishery Management Reports are available through the Alaska State Library and on the Internet: <http://www.sf.adfg.state.ak.us/statewide/divreports/html/intersearch.cfm>. This publication has undergone regional peer review.

*Scott Walker,*  
*Alaska Department of Fish and Game, Division of Commercial Fish,*  
*2030 Sea Level Drive, Suite 205, Ketchikan Alaska, 99901 USA*

*Zac Hoyt ,*  
*Alaska Department of Fish and Game, Division of Commercial Fish*  
*16 Sing Lee Alley, Petersburg Alaska, 99833-0667 USA*

*and*  
*Marc Pritchett*  
*Alaska Department of Fish and Game, Division of Commercial Fish,*  
*Douglas Island Center Building, 802 3<sup>rd</sup> Street, Douglas Alaska, 99824-0020 USA*

*This document should be cited as:*

*Walker, S., Z. Hoyt, and M. Pritchett. 2006. Report to the Board of Fisheries, miscellaneous dive fisheries. Alaska Department of Fish and Game, Fishery Management Report No. 06-01, Anchorage.*

The Alaska Department of Fish and Game administers all programs and activities free from discrimination based on race, color, national origin, age, sex, religion, marital status, pregnancy, parenthood, or disability. The department administers all programs and activities in compliance with Title VI of the Civil Rights Act of 1964, Section 504 of the Rehabilitation Act of 1973, Title II of the Americans with Disabilities Act of 1990, the Age Discrimination Act of 1975, and Title IX of the Education Amendments of 1972.

If you believe you have been discriminated against in any program, activity, or facility, or if you desire further information please write to ADF&G, P.O. Box 25526, Juneau, AK 99802-5526; U.S. Fish and Wildlife Service, 4040 N. Fairfax Drive, Suite 300 Webb, Arlington, VA 22203 or O.E.O., U.S. Department of the Interior, Washington DC 20240.

For information on alternative formats for this and other department publications, please contact the department ADA Coordinator at (voice) 907-465-6077, (TDD) 907-465-3646, or (FAX) 907-465-6078.

# TABLE OF CONTENTS

	Page
LIST OF TABLES.....	ii
LIST OF FIGURES.....	ii
ABSTRACT.....	1
INTRODUCTION.....	1
Southeast Alaska Dive Fisheries.....	1
Commercial Fisheries Entry Commission.....	2
Southeast Alaska Regional Dive Fisheries Association.....	2
SEA OTTERS.....	3
Background.....	3
Commercial Fishery Interaction.....	4
Data Collection.....	4
ABALONE.....	5
Background.....	5
Fishery Development and History.....	6
Management Strategy and Regulation Development.....	7
Fishery Outlook.....	7
SEA CUCUMBER.....	8
Background.....	8
Fishery Development and History.....	8
Management Strategy and Regulation Development.....	9
2004-2005 Sea Cucumber Commercial Harvest Season.....	10
2005-2006 Outlook.....	10
GEODUCK CLAM.....	10
Background.....	10
Fishery Development and History.....	11
Management Strategy and Regulation developement.....	12
2004-2005 Geoduck Commercial Harvest Season.....	14
2005-2006 Outlook.....	14
RED SEA URCHIN.....	15
Background.....	15
Fishery Development and History.....	15
Management Strategy and Regulation Development.....	16
2004-2005 Sea Red Urchin Commercial harvest Season.....	17
2005-2006 Outlook.....	17
GREEN SEA URCHIN.....	17
Fishery Development and History.....	17
2005-2006 Outlook.....	18
REFERENCES CITED.....	18

## LIST OF TABLES

<b>Table</b>		<b>Page</b>
1.	Registration Area A (Southeast Alaska) commercial abalone harvests, effort, value, and season length, 1970-1971 through 1996-1997.....	20
2.	Registration Area A (Southeast Alaska) commercial sea cucumber harvests, effort, value and season length, 1986-1987 through 2005-2006.....	21
3.	Registration Area A (Southeast Alaska) commercial geoduck clam harvest areas, current guideline harvest levels, original open season, and recent reconnaissance/survey funding sources, 1987-1988 through 2005-2006.....	22
4.	Registration Areas A (Southeast Alaska) commercial geoduck clam harvests, effort, value and season length, 1985-1986 through 2005-2006.....	23
5.	Registration Area A (Southeast Alaska) commercial red sea urchin harvests, effort, and value, 1980-1981 through 2005-2006.....	24
6.	Red sea urchins maximum harvest losses due to presumed sea otter predation in the commercial Fishery, 1990-1991 through 2005-2006.....	25
7.	Sea cucumber losses due to presumed sea otter predation in the commercial fishery 1990-1991 through 2005-2006.....	26

## LIST OF FIGURES

<b>Figure</b>		<b>Page</b>
1	Sea otter observations recorded by the Alaska Department of Fish and Game during dive assessment surveys in Southeast Alaska, 2004 and 2005.....	27
2	Sea cucumber commercial harvest areas for the 2005-2006 season.....	28
3	Geoduck clam commercial harvest areas for the 2005-2006 season.....	29
4	Red sea urchin commercial harvest areas for the 2005-2006 season.....	30

## ABSTRACT

The miscellaneous shellfish commercial fisheries in Registration Area A (Southeast Alaska) and Registration Area D (Yakutat) consist of geoduck clams, red sea urchins and sea cucumbers. The Southern Southeast Regional Dive Fisheries Association (SARDFA) represents the 585 divers that qualify for the limited entry fisheries in Registration Area A, which are operated using management plans developed by the Alaska Board of Fisheries, Alaska Department of Fish and Game and the commercial fishing industry.

Key words: Abalone, Commercial Fisheries Entry Commission, Dive Fisheries, Geoduck Clams, Green Sea Urchins, Red Sea Urchins, Sea Cucumbers, Sea Otters, SARDFA.

## INTRODUCTION

### SOUTHEAST ALASKA DIVE FISHERIES

This report provides a general overview of the dive fisheries in Southeast Alaska and Yakutat. Southeast Alaska dive fisheries harvest three species of invertebrates: geoduck clams *Panope abrupta*, sea cucumbers *Parastichopus californicus*, and red sea urchins *Strongylocentrotus franciscanus*. All three fisheries occur primarily in southern Southeast Alaskan waters. The abalone *Haliotis kamschatkana* fishery is currently closed to commercial harvest. No dive fishery occurs in the Yakutat area.

The Southeast Alaska/Yakutat area (Region I) consists of Alaska waters between Cape Suckling on the north and Dixon Entrance on the south. The region is divided into two registration areas: Area A, the Southeast Alaska area, extends from Dixon Entrance to Cape Fairweather and Area D, the Yakutat area, extends from Cape Fairweather to Cape Suckling. Southeast Alaska dive fisheries occur in miscellaneous shellfish registration Area A. The Southeast Alaska area is divided into 16 regulatory districts (Districts 1 through 16) with each district divided into several statistical subdistricts for catch reporting. For management purposes, the Ketchikan area office is primarily concerned with fisheries that occur in Districts 1–4, the Petersburg and Wrangell area offices with Districts 5–10 (excluding Section 9-A), the Sitka area office with Section 9-A and District 13, and the Juneau area office with Districts 11–15.

Southeast dive fisheries are relatively recent entrants into the region's commercial fishing industry. The first commercial landings for abalone occurred in the mid 1960s, and red sea urchins, sea cucumbers, and geoduck clams in the early to mid 1980s. Participation in each fishery was often limited to just one or two divers initially and only recently has expanded to current effort levels. Currently, each fishery is a competitive limited entry fishery. Fish ticket information indicates 286 permits reported landings during the 2004-2005 season including 194 sea cucumber, 61 geoduck clam, and 31 red sea urchin permits.

The exvessel value of the 2004-2005 Southeast Alaska dive fisheries was estimated at approximately \$5,461,000. This estimate is considered conservative as it is based on the price reported on fish tickets and does not include unreported price adjustments or situations where price information was not reported. The actual exvessel value will not be known until final processor reports are received and analyzed through the Commercial Fisheries Entry Commission (CFEC). The harvest of sea cucumbers was valued at \$2,769,116 (51% of total 2004-2005 dive fishery value), followed by geoduck clams at \$2,115,288 (39%) and red sea urchins at \$576,605 (11%).

## **COMMERCIAL FISHERIES ENTRY COMMISSION**

Prior to July 1, 1996, entry into Southeast Alaska's dive fisheries was open access, requiring a permit be issued by the CFEC for participation. Historically, most fisheries began slowly with little effort but interest grew relatively quickly as exvessel value increased, new markets opened, and fishers explored for new ways to expand beyond the more traditional fisheries such as salmon or groundfish. Effort quickly soared to levels that made it difficult for the department to manage each fishery, and individual fisher's proceeds quickly diminished.

In 1996 the Alaska State Legislature established a four-year moratorium on interim-use permits for the Southeast dive fisheries. The legislation, HB 547, was incorporated into statute as AS 16.43.228. The moratorium specified a cap on the total number of interim-use permits in the Southeast Alaska abalone, geoduck, sea cucumber, and sea urchin fisheries. This legislation temporarily halted growth in the number of participants in these fisheries and provided specific eligibility criteria to be used in each fishery.

The effective date of the moratorium was July 1, 1996 and expired automatically on June 30, 2000. During the moratorium, the legislation directed the CFEC to consult with the Board of Fisheries, the Alaska Department of Fish and Game (ADF&G), and the participants in these fisheries about a permanent limited entry program. The legislation also directed the CFEC to determine the type of limited entry program that would be most appropriate for these fisheries. These fisheries would have returned to open access on the expiration date unless the CFEC limited these fisheries under the current limited entry law.

In September 1999, the CFEC proposed to adopt regulations for limiting entry into the geoduck and sea urchin dive fisheries. For these fisheries, the CFEC proposed to establish: 1) the maximum numbers of permits to be issued for each fishery; 2) July 1, 1996 as the date for determining an applicant's qualifications for a Southeast Alaska geoduck or sea urchin dive entry permit; 3) time periods for each fishery in which an individual must have participated in the fishery as an interim-use permit holder to be eligible to apply for an entry permit; and 4) definitions for the proposed limitation of the geoduck and sea urchin dive fisheries. The CFEC originally proposed a return to open access status for the sea cucumber and abalone dive fisheries at the end of the then current moratorium. Following a series of public comment periods and meetings, and after obtaining staff developed options for limiting entry, current dive fisheries became limited entry fisheries. Red urchins were finalized on November 2000 and sea cucumbers and geoducks on May 2001. The maximum number of limited entry permits originally authorized for each fishery was 104 for geoduck clams, 436 for sea cucumber, and 95 for red sea urchins. Currently a total of 585 individuals are eligible for the Southeast Alaska dive fisheries, 112 for geoduck clams, 389 for sea cucumbers and 84 for red urchins. Abalone is currently an open access fishery.

## **SOUTHEAST ALASKA REGIONAL DIVE FISHERIES ASSOCIATION**

State general funds have not been sufficient to fund the costs of management and research activities required for the dive fishery program. This funding gap has been filled through financial contributions by industry processors, local municipalities, federal funding, voluntary diver assessments, and test fishing projects in which the resource was harvested and sold by the state. These were ad hoc attempts to keep the dive fisheries open. The industry divers throughout Southeast saw a need to establish an organization and provide for a funding mechanism to meet the funding gap and continue to expand the dive fisheries. Through municipality funding,

industry divers hired a project coordinator to develop and promote state legislation addressing this need. The legislation, CSHB 198, passed unanimously in the House and Senate, was signed by the governor June 20, 1997 and became effective June 21, 1997. CSHB 198 allowed for the creation of the Southeast Alaska Regional Dive Fisheries Association (SARDFA), which is empowered to enact taxes on dive fishery landings to help pay for fishery development.

SARDFA is a non-profit, economic development corporation, whose voting members are all permit holders for the three southeast dive fisheries (geoduck clams, sea cucumbers, and red sea urchins). SARDFA is managed by a board of directors which is elected by the membership. The board is composed of one member from each of five Southeast communities (Ketchikan, Craig, Sitka, Petersburg, and Wrangell), one member from Washington, one at-large director, one municipal director, and one processor director, for a total of nine directors.

SARDFA has created committees to focus on the individual needs of each dive fishery. Currently, the urchin, geoduck, and sea cucumber committees add another twenty-eight voices to fishery management. This diversity helps to air concerns and allows for industry input. These committees are advisory to the SARDFA Board. The Board reviews and votes on committee recommendations and negotiates approved recommendations with ADF&G. The department is required by the State of Alaska to protect the integrity of the state's fisheries, therefore ADF&G managers will not approve any recommendations which they do not feel coincide with a sustainable fishery.

SARDFA's mission is to develop, expand, and enhance new and existing dive fisheries in Southeast Alaska in a sustainable and economically feasible manner. The first year of collected tax on the dive fisheries totaled \$227,986. For the 2004–2005 season total tax collected was \$409,243. This represents an economic growth of the dive fisheries of approximately 80%.

## **SEA OTTERS**

### **BACKGROUND**

During the first half of the 20<sup>th</sup> century sea otters *Enhydra lutris* were not present in the Alexander Archipelago due to their near extermination roughly 100 years ago (Kenyon 1969). As a result of this absence, many of the prey populations of sea otters may have responded to the reduced predation. Prey responses may have included increases in mean size, density, and biomass. These responses have been documented in sea urchin populations *Strongylocentrotus spp* (Estes and Palmisano 1974). In 1965 sea otters were first captured near Amchitka Island and in Prince William Sound and transferred to various locations in southeast Alaska where it was thought they would subsequently establish new populations (Jameson et al 1982). On the outer coast of Southeast Alaska 412 otters were successfully released. The population remained low until 1987 when it began a period of rapid growth (Pitcher and Imamura 1990).

The annual rate of increase for the Southeast stock ranged from 15.7% to 23.3% between 1966 and 1988. A survey conducted for the entire Alexander Archipelago from Cape Spencer to Dixon Entrance was conducted in 1994 estimated 11,697 individual otters (Agler et al. 1995). In 2002, there were an estimated 3,188 sea otters in the northern half of Southeast Alaska with 1,266 of those occurring in Glacier Bay and an additional estimated 6,008 in the remaining portions of the Alexander Archipelago (Bodkin et al. *Unpublished*). The available data suggests the population has been holding steady in the last decade and may be reaching carrying capacity. This data should be interpreted carefully for the estimates have large error components.

Predation by sea otters on a variety of invertebrates, including species of crab, clams, mussels, and urchins will likely have effects on the benthic community structure and function of Southeast Alaska. As unoccupied habitats become limiting, however, density-dependent mechanisms may dramatically reduce sea otter abundance. The predation of invertebrate species by sea otters may have profound ecosystem level changes as other predators such as octopus, sea stars, fishes and birds modify their diet to compete with sea otters.

Though anecdotal, ADF&G notations made during dive survey assessments for geoduck clams, sea cucumbers, and red sea urchins note an increase in sea otter predation in Southeast Alaska (Figure 1). These were *ad hoc* comments and are not presented as definitive evidence of sea otter population expansion, a complete record of observations, nor collected through a structured sea otter assessment. These observations confirm the presence of sea otters in many areas of Southeast Alaska, suggest the rapid expansion of range in Southeast Alaska in the previous decade and provide evidence for the disappearance of macro invertebrates. Sea otters may continue to expand their range and may eventually be common in inside waters of Southeast Alaska (Kelley *Unpublished*).

Observations made by ADF&G divers on the outside coast of Southeast Alaska suggest otters select red sea urchins and pinto abalone when foraging on rock habitat and on several species of clams including geoduck clams when foraging on soft sand and mud substrate. Once these species have been depleted it appears they turn to less desirable prey such as sea cucumbers and snails. At Torch Bay in Southeast Alaska, red, purple, and green sea urchins were plentiful and kelps were rare from 1976 to 1978 in the absence of sea otters. Otters were introduced at nearby Surge Bay and urchins were depleted but kelps were abundant during 1978 to 1988 (O'Clair and O'Clair 1998).

## **COMMERCIAL FISHERY INTERACTION**

The population of sea otters in coastal waters of Southeast Alaska is having negative effects to the region's dive fisheries. The commercial harvest of sea urchins in Sitka Sound has likely been eliminated by sea otter predation. Sea otters moved into the southern Sitka Sound red sea urchin fishery area in 1992 (Davidson *Unpublished*) and, over the next year, apparently removed an estimated 16,000,000 urchins or the majority of the standing stock (Davidson et al. 1993). Sea urchins biomass declined by nearly 100% in Southeast Alaska following the spread of sea otters into previously unoccupied habitats (Estes and Duggins 1995). Sitka Sound is currently closed to the harvest of red sea urchins due to lack of available product. The Southeast Alaska abalone population is at very low levels due in part to continued predation by sea otters. Sea otters have likely had a serious impact on numerous sea cucumber, geoduck clam, and red sea urchin commercial harvest areas with several areas closed to commercial harvest (Tables 6 and 7). ADF&G has documented areas where sea otters have been seen where no large invertebrates can be found to depths of 70 feet where they coincide with surveys for commercially important invertebrate species.

## **DATA COLLECTION**

ADF&G supports a substantial dive program for biomass assessments in Southeast Alaska, primarily for red sea urchins, sea cucumbers, geoduck clams, and herring spawn deposition as well as various studies for green sea urchins, horse clams, abalone, and other miscellaneous species. Annually, over 2,000 logged dives are completed. These studies occur throughout much of Southeast Alaska providing opportunities to observe sea otter population distribution, range

expansion, and their effect on invertebrate populations. To date, these observations have not been recorded through a structured program nor are resources available to prioritize these observations. Beginning in 2004 the ADF&G dive assessment crew and vessel support crew have been systematically recording all observations of sea otters (Figure 1) during the field season which typically begins in mid-March and continues to approximately early September. These *ad hoc* observations suggest that sea otter competition for shellfish, crabs, and other species is high and the department and industry have expressed concern about those resources. Industry divers have indicated that sea otters have dramatically and negatively affected their harvest of shellfish. It is expected that the outer coastline will eventually become continuously populated with sea otters from Dixon Entrance to north of Cape Spencer (Kelly 1995) with the concomitant reduction of prey biomass and reduction, if not elimination, of commercially harvested species.

No specific funds or resources are available to ADF&G for a formal sea otter census in Southeast Alaska. ADF&G may be able to implement a limited but useful program that will not interfere with scheduled department surveys nor require already limited resources, but may lend insight regarding sea otter populations in Southeast Alaska. Methods for the 2004 and 2005 field seasons include; 1) a wheelhouse logbook documenting sea otter sightings, coordinates (latitude and longitude), number of animals, whether the animals are dependent (juveniles) or independent of each other, and any notable behavior; 2) dive skiff logs recording the same information as the wheelhouse log; 3) while diving, a more structured and consistent documentation of sea otter predation (e.g. sea otter diggings, numerous broken sea urchin spines and tests, cracked and broken clam shells) will be noted.

## **ABALONE**

### **BACKGROUND**

The Alaskan abalone fishery targeted the pinto, or northern abalone (*Haliotis kamtschatkana*), which inhabits the rocks, lower intertidal, and subtidal surge zones of the outer coasts of Southeast Alaska. Commercially harvestable quantities of abalone occurred in parts of Districts 1, 2, 3, 4, 5, and 13. Life history information for this species in Alaska is very limited. Information from other North Pacific locations is useful in understanding the basic biology of this species. Tagging studies indicate it is a slow growing, long-lived species. Spawning occurs during the summer and through early autumn in the most productive areas. Size frequency information indicates that, in at least some areas, a climax population may have existed prior to recent commercial exploitation. Recruitment levels appear to be low and sporadic and fecundity increases greatly with increasing shell length. Known predators include rockfish, starfish, octopus, sea otter, and man. Throughout the range of this and various other abalone species, exploitation has usually resulted in stock depletion and restrictive management.

Abalone can be picked by hand from the shoreline during extreme low tides. However, until recently, most of the subsistence and personal use and the entire commercial fishery utilized scuba or hookah umbilical diving gear and most of the harvest occurred subtidally. Current subsistence and personal use regulations prohibit the use of compressed gas systems (e.g. scuba or hookah).

## **FISHERY DEVELOPMENT AND HISTORY**

The abalone fishery was marked by a boom in harvests and effort in the late 1970s followed by declining harvests and increasing effort (Table 1). The decline in harvests may be attributed to a mix of excessive fishing, predation by a growing sea otter population, and apparent low productivity of abalone stocks when heavily harvested. Driving the effort changes was an increase in value from one dollar a pound in the early 1970s to more than ten dollars a pound in the last four seasons.

The marked increase in harvests and effort came in the 1978-1979 season, when effort increased more than three-fold and harvests jumped to 180,000 pounds from a long-term average of about 6,000 pounds. Harvests peaked at 378,685 pounds in the next season, the first of the seasonal accounting year. This peak exceeded the quota of 250,000 pounds adopted by the board in the spring of 1980 and the fishery was closed by emergency order for the first time.

High harvests continued through the 1981-1982 season when 371,000 pounds were landed, despite a further reduction in the Guideline Harvest Range (GHR) to a maximum of 125,000 pounds and a season shortened to two months. By the 1984-1985 season, it was apparent that the resource might be in trouble when the lower end of the GHR (86,000 pounds) was not reached despite 151 days of fishing.

The 1990-1991 through 1995-1996 seasons opened on October 1 and with the exception of District 13, which was managed separately and closed by emergency order, the length of the season for the rest of Southeast Alaska was set prior to the opening to avoid overharvest. A harvest of 68,400 pounds during the 1990-1991 season was the beginning of a second downward trend that was to continue through the remainder of the fishery.

As the 1994-1995 season progressed, it became apparent that harvests were much lower than anticipated, and dramatically lower than historic levels. Fish ticket data indicated that 15,055 pounds had been harvested during the eight-day opening. Despite requests from harvesters to reopen the fishery, the southern Southeast fishery was not reopened. The District 13 fishery was open from October 1-5, 1994 and October 12-14, 1994 for a total of eight days. A total of 7,824 pounds of abalone were harvested from a Guideline Harvest Level (GHL) of 8,000 pounds. Anecdotal information from harvesters indicated that good harvest areas were difficult to find. Harvest per unit effort for the fishery (lb/diver/day) declined to 64% of the 1993 level.

The 1995-1996 southern southeast abalone fishery extended from October 1-6, 1995 with an upper GHR of 10,000 pounds. A total of 8,524 pounds was taken by 44 divers with 48 landings in six days. The average price per pound was \$8.99 giving the fishery an exvessel value of \$74,074. Due to poor harvest rates and a concern by some harvesters that abalone populations were greatly reduced from historic levels, the fishery was not reopened despite not reaching the upper end of the GHR. The District 13 fishery extended from October 1-5, and from October 15-16, 1995 with an upper GHR of 6,000 pounds. Harvests of 3,833 pounds and 1,995 pounds occurred, respectively, during the two openings (5,828 pounds total). A total of 56 divers made 73 landings with an approximate exvessel value of \$52,452 in the District 13 fishery.

In response to a dramatic decrease in harvest rates observed during the last several seasons, the apparent lack of abalone in many of the important traditional harvest areas as noted by department divers conducting sea urchin assessment surveys, and the numerous comments from subsistence users and commercial divers regarding the diminishing numbers of abalone, ADF&G

closed the 1996–1997 abalone season by emergency order (1-M-05-96). The emergency closure is consistent with 5 AAC 38.035. AREA CLOSURES. (b) which states “When the commissioner finds that continued fishing would jeopardize the health of a shellfish species described in this chapter in a registration area or portion of a registration area, the commissioner, by emergency order, shall close fishing for that shellfish species in the registration area or portion of the registration area.” The closure applied to all of Southeast Alaska including both the Sitka area and southern Southeast fisheries.

## **MANAGEMENT STRATEGY AND REGULATION DEVELOPMENT**

Prior to the boom in harvest and effort in the late 1970s, abalone harvests were regulated primarily by response to local market conditions. Quotas, season limitations, and guideline harvest ranges were not imposed until 1980 after harvests began to soar.

The major fisheries are divided into District 13 (northern outer coast) and Districts 3, 4, and 5 (southern outer coast) fisheries. This division was established historically by early fishing and landing patterns that generally persisted throughout the fishery’s history. Closed waters around Craig, Klawock, Ketchikan, Sitka, and Coronation Island were adopted to protect stocks used for subsistence and personal use from commercial exploitation.

Size limits have undergone several increases prior to reaching the present four-inch minimum. The size limit was raised from 3 inches to 4 inches for Districts 1 through 6 in 1968 and from 3 inches to 3½ inches for Districts 9 through 14 to in 1976. A general change for all districts to 3½ inches occurred in 1977. The board adopted an increase in minimum size to 3¾ inches in the spring of 1979. In November 1993, the board again increased the legal size limit to 4.0 inches due to concerns that abalone stocks were declining. The intent of the larger size limit was to reduce the harvest rate on mature abalone thereby increasing the potential for improved stock abundance. The board also adopted a regulation prohibiting diving for fourteen days before and after the fishery.

Guideline harvest ranges and season length have dropped in several steps. In 1980 the harvest limit was set at 250,000 pounds and the season was reduced from all year to September 1 through May 31. In the spring of 1981, the GHR was reduced to 100,000–125,000 pounds, and the season was shortened to September 15 through May 15. In 1982 the board split the existing GHR, allocating 86,000–107,500 pounds to the Ketchikan area, and 14,000–17,500 pounds to the Sitka area. In 1983 the board split the season into autumn and spring segments in each of which 50% of the allowable harvest was to be taken. The BOF restricted the 1985-1986 harvest to a range of 25,000–50,000 pounds in the Ketchikan area and a maximum of 8,000 pounds in the Sitka area. The District 13 season was reduced to November 1 to May 15 and all other areas were changed to October 1 to May 15. In 1986 the season was changed to October 1 through May 15 for all areas. The upper GHR was further reduced for the 1995-1996 season to 10,000 pounds for southern Southeast and to 6,000 pounds for the Sitka area. The reduction was due to a continued decline in abalone abundance in many areas, especially southern Southeast Alaska. These conservative GHRs were intended to provide a limited commercial fishery while increasing the potential for increased stock abundance.

## **FISHERY OUTLOOK**

ADF&G believes that the current population is far below its historic level because of overfishing and predation by sea otters. As this low level does not promote significant recruitment, we are

unsure when, or if, the population will rebuild to a level needed to allow a commercial fishery. A fishery will not be opened until a management plan is developed that addresses the issues and information identified in 5 AAC 39.210, Management Plan for High Impact Emerging Fisheries. As part of that process, ADF&G would require: 1) a plan for determining productivity and abundance of abalone, and 2) a harvest strategy that would ensure a sustained fishery. Both of these elements would be difficult to achieve. Even with that information available, the department would be very concerned about local and serial depletion under any kind of open access or limited entry fishery. The department believes that it is highly unlikely that stocks will recover sufficiently to allow commercial fishing to resume.

## **SEA CUCUMBER**

### **BACKGROUND**

The commercial species of sea cucumber harvested in Southeast Alaska is the red or California sea cucumber (*Parastichopus californicus*). It is a common species distributed from Mexico to Southeast Alaska and has been observed at least as far west and north as Cook Inlet and Kodiak Island. It occupies a broad range of subtidal habitats from nearshore shallows to over 100 fathoms. The sea cucumber's primary food is detritus which it ingests along with significant amounts of fine substrate. Its ecological function seems to include recycling detrital material into nutrients for the primary producers in the marine food chain. *P. californicus* appears to favor locations with moderate current, avoiding mud bottoms and areas subject to inundation by freshwater or glacial runoff. The abundance of sea cucumbers in Southeast Alaska is greatest in the southern and western portions in protected bays and inlets.

### **FISHERY DEVELOPMENT AND HISTORY**

The first experimental fishing permits for sea cucumbers were requested in 1981. One or two permits were issued each year between 1981 and 1986, with only one vessel reporting landings during this period. The first fisheries were based in Ketchikan and, over the years, evolution of management strategy resulted in a partition of most of the statistical subdistricts into one of three seasonal rotations. The initial fishery had no established season; harvests are reported in Table 2 on an October to September basis for consistency with years since 1990.

Most of the vessels pioneering this fishery were small skiffs of limited range and capability operating in the vicinity of either Ketchikan or Sitka, mostly as a day fishery. Larger vessels with two divers and a crewman with living quarters and the capability of transporting product and divers during typical fall and winter weather conditions are now the norm. Harvest is conducted by scuba or hookah diving gear usually at depths of 30 to 60 feet. The number of hours each diver can work each day depends on the maximum working depths and may be as little as three or four hours. Harvest consists of collecting sea cucumbers in large mesh bags and transporting the filled bags to the tendering vessels.

Processing is currently conducted in a two-step process. The freshly caught animal is eviscerated on the fishing grounds usually by a process called "poking" where a knife is used to make an inch long puncture in the body wall of the animal. Drained sea cucumbers are then placed in totes and transported to the processing facility where they are processed immediately or held for up to two days in a refrigerator. Sea cucumbers have been purchased by the bucket in early years but are now sold exclusively by drained weight. Holding times for the eviscerated, densely packed sea cucumbers are limited by their rapid decomposition even when refrigerated.

Processing at the plant consists of separating the muscle bundles from the skin with a scraper or knife. The major products from this fishery are the longitudinal and transverse muscle bundles or meat, and the skins. Skin processing involves cooking or boiling the skins to a specific texture and drying the product. The dried skins are a preferred item in upscale oriental cuisine. Sea cucumbers harvested in Southeast Alaska are processed in Craig, Juneau, Ketchikan, Petersburg, Sitka, British Columbia and the state of Washington.

Effort increased in the fishery to a maximum of 424 divers during the 1995-1996 season. This high number can be attributed to high prices the previous year and concerns that the fishery was to be limited by the CFEC. Beginning July 1, 1996 the CFEC imposed a moratorium into Southeast dive fisheries that limited the number of divers able to participate in the sea cucumber fishery to 472. The CFEC moratorium ended July 1, 2000 with a maximum of 436 limited entry permits authorized for the sea cucumber fishery. Currently there are 389 permits in the Southeast Alaska sea cucumber fishery. The GHL has been approximately 0.9 to 1.6 million pounds (drained weight) for more than a decade (Table 2).

During the 2003, 2004, and 2005 survey seasons, and with SARDFa input, ADF&G surveyed nine and added eight new areas to the sea cucumber commercial harvest. For the 2003-2004 season three new areas added 600,700 pounds to the commercial harvest with three new areas adding 84,300 pounds in 2004-2005, and two new areas adding 166,100 pounds in 2005-2006.

Yakutat Bay was surveyed during the 2005 season with an estimated biomass of 225,006 pounds and a 31,222 pound GHL. If opened, this fishery would not fall within the limited entry jurisdiction in Southeast Alaska and would be an open access fishery. During its September 14, 2005 meeting, the SARDFa Sea Cucumber Committee agreed to not pursue a Yakutat sea cucumber fishery. SARDFa contacted the Yakutat city manager, explained their position, and declined to be involved in this decision. As of this writing (December 2005), there is no sea cucumber commercial fishery planned for the Yakutat area.

## **MANAGEMENT STRATEGY AND REGULATION DEVELOPMENT**

The fishery expanded rapidly in the late 1980s, and in 1989 the fishery exceeded the ability of ADF&G to manage by the permit system. The department closed the fishery in May 1990 and reopened it in October 1990 following development of the Southeast Alaska Sea Cucumber Commercial Fisheries Management Plan (5 AAC 38.140). This plan seeks to protect subsistence opportunities and provides for sustained commercial fishing harvests. To protect subsistence opportunities, the cucumber management plan established 18 areas closed to commercial fishing (5 AAC 38.140 (k)). There are also provisions to prevent the use of diving gear in the subsistence (5 AAC 02.020 (1)) and personal use (5 AAC 77.010 (1)(3)) fisheries in those areas. Annual commercial fishery guideline harvest levels are 6.4% of the total sea cucumber biomass taken on a three-year rotational basis (i.e. 19.2% on a three-year basis). Rotational fisheries have the advantage of lowering overall departmental assessment survey and management costs.

Initially the Sea Cucumber Management Plan provided for a season that began October 1 in 1990 with two 48-hour openings per week. The season was changed to a November opening in 1993, and in order to extend the season, weekly fishing periods were reduced to seven daylight hours on Mondays in November, plus an additional four daylight hours on Tuesdays from December through March. The Sea Cucumber Management Plan was amended by the board for the 1997 season and provided for an October 1 opening date with weekly fishing periods of seven daylight hours on Mondays in October, plus an additional four daylight hours on Tuesdays from

November through March. There are also provisions for limiting the numbers of divers per vessel to two, providing fishing period trip limits of 2,000 pounds per person, and limiting gear to scuba, surface-supplied systems, or snorkels. During the January 2000 board session the open weekly fishing period was amended providing for a Monday, 8:00 a.m. to 3:00 p.m. and Tuesday 8:00 a.m. to 12:00 p.m. opening in October (i.e. opening an additional half-day in October. The board also allowed the use of enhanced air nitrox of  $\leq 40\%$  oxygen with the balance consisting of nitrogen.

The time series of stock assessment data was used to evaluate sea cucumber population response to harvest under the current management plan. Preliminary analysis reveals highly diverse response among management units. Although changes in mean density, mean weight, and biomass are apparent in many areas, variability makes detection of statistically significant differences difficult. In general, more areas open to commercial harvest have decreased in mean density, increased in mean weight, and decreased in biomass. In several surveyed areas which are closed to commercial harvest, decreases have been observed in density, weight, and biomass, indicating that populations respond to environmental variables in addition to exploitation. Overall, based on trends observed in stock assessment data, ADF&G does not have serious concerns about conservation for this species.

### **2004-2005 SEA CUCUMBER COMMERCIAL HARVEST SEASON**

The 2004-2005 season opened by regulation on October 4, 2004 with a GHL estimated at 1,381,200 pounds of sea cucumbers. This is the sixth highest GHL on record with the lowest number of divers since the 1991-1992 season. Ex-vessel price was the second highest at \$2.12 per pound (Table 2).

### **2005-2006 OUTLOOK**

Biomass estimates made during the summer of 2005 indicated a harvestable surplus of 1,475,800 pounds of sea cucumbers was available for the 2005-2006 season. This is the fourth highest GHL on record with three new areas contributing 166,100 pounds to the GHL (Figure 2). The fishery opened by regulation at 8:00 a.m., October 3, 2005.

## **GEODUCK CLAM**

### **BACKGROUND**

Known geoduck clam (*Panopea abrupta*) beds have a patchy distribution in the central and southern portions of Southeast Alaska, primarily in protected waters near the outside coast. Studies conducted in Washington State, British Columbia and in Southeast Alaska indicate this clam lives to be over 100-years old (Bureau et al. 2003). Southeast Alaska is the extreme northern limit of the geographic range of this species and recruitment is sporadic or very low seasonally. Sporadic recruitment, low growth rates, and high maximum age makes this species susceptible to overharvest.

A reoccurring problem in the geoduck commercial fishery is the tendency for geoduck clams to bioaccumulate undesirable microorganisms or compounds. In particular, high levels of paralytic shellfish poisoning (PSP) have been found in geoducks in Southeast Alaska, most strongly associated with the viscera. However, the mantle and necks are the usual body parts consumed and PSP concentrations are lower in these parts. Though this situation permits the sale of

processed clams with viscera removed, exvessel value for processed clams is significantly less than that for whole, live product.

In order to protect consumers, the state requires that each individual fishery be sampled and clams tested by the Alaska Department of Environmental Conservation (ADEC). The sample, which represents clams within a commercial fishing area, must fall under a PSP criteria of 80 ug/100 grams of tissue prior to the opening of a fishery by the ADF&G. In addition, water quality for commercial beds is tested for human pathogenic microorganisms and certified safe by the ADEC. Time required for transport and testing of samples, and the relatively short shelf life of the fresh product, require a close working relationship between fishery managers and industry to successfully market the product than is necessary for most other seafood products. The current PSP protocol is a modified version that was initially adopted prior to the 2003-2004 season. This modification was based on the two seasons (2003-2004 and 2004-2005) of PSP data collected by ADEC. These modifications will allow an additional day of harvest, and fewer test samples prior to allowing harvest and market of live product. The additional day of harvest can be used as a travel or management day. These changes will reduce cost to the industry and increase marketing opportunities.

## **FISHERY DEVELOPMENT AND HISTORY**

Starting in 1978 with the Noyes Island survey, state grants were used to find and qualitatively assess commercial geoduck clam beds in the Ketchikan, Craig, Petersburg-Wrangell, and Sitka areas. A number of potential commercial beds were located near Ketchikan, Craig, and Sitka. Procedures for testing and certifying the product for human consumption were established by the ADEC. Population assessment surveys were conducted on three beds on Noyes Island near Craig, a harvestable biomass estimated, and the ADEC completed sanitation surveys on these areas. Two processors conducted the required modifications to their facilities and procedures to handle batch processing, lot testing, and product quarantine and were certified to process geoducks. ADEC required a PSP test of each divers harvest or lot prior to live shipment. In late 1985, the first permit was issued for the commercial harvest of geoduck clams. During the 1985-1986 season almost 144,000 pounds of the 300,000 pound, five-year quota (Table 3) were harvested by eight divers in the Noyes Island area. During the 1986-1987 season, 28,191 pounds were harvested by only three divers. The decline was mainly due to poor marketing conditions and high operational costs. Increased interest in this fishery began after ADF&G completed a population estimate on the west side of Gravina Island in 1987. During the 1987-1988 season all harvest occurred in the spring of 1988 with a harvest of 124,568 pounds from Vallenar Bay on Gravina Island, and 60,577 pounds from Noyes Island. Biorka Island near Sitka was included in the geoduck fishery during the 1989-1990 season, Kah Shakes was included in the 1990-1991 season, and the Goddard area entered the fishery during the 1998-1999 season. As of the 2005 department survey season, a total of 34 distinct commercial fisheries have been identified and surveyed in Southeast Alaska. It is anticipated that additional new areas will be surveyed for potential commercial harvest as funds are available. Several of the fisheries were redefined when ADEC adopted the current PSP protocol prior to the 2003/04 season and as a result of areas being resurveyed in 2005.

The 1991-1992 geoduck fishery saw an increased interest in participation and harvest by divers from Washington State. Prior to the 1991-1992 season non-resident participation was minimal. Exvessel value and the number of divers began to increase with the 1992-1993 season. Participation fluctuated in the late 1990's due to decreasing exvessel value with sales of

processed product. However, the changes in PSP testing protocol by ADEC which allowed for over 90% percent of the harvest product to be sold live, generated increased effort in the fishery. The exvessel value of the fishery for the 2004/05 season was estimated at \$2.1 million dollars in Southeast Alaska.

## **MANAGEMENT STRATEGY AND REGULATION DEVELOPEMENT**

The objective of geoduck fishery management is to allow only a very low exploitation rate because the species is long-lived and recruitment is sporadic and low. Harvests are by permit only and have been allowed from October through May 31, to avoid the summer spawning and recruitment period and to minimize PSP toxin levels.

Harvests are restricted to beds for which biomass estimates are available. Only four areas had been surveyed prior to 1997: Symonds Bay on Biorka Island in the Sitka Management Area, West Gravina Island (Vallenar Bay, South Vallenar Point, Middle Gravina and Nehentna Bay), Kah Shakes (Kirk Point/Bullhead Cove), and northern Noyes Island (Ulitka Bay, Little Steamboat Bay, and Steamboat Bay) in the Ketchikan Management Area. The GHL for each area is estimated as 2% of the harvestable adult population. Following reassessment dive surveys during the summer of 1997, it became apparent that the abundance of geoducks in areas currently being fished was much lower than expected and the distribution of geoduck clams more limited than previous surveys had indicated. These preliminary results suggested that previous GHLS established for the geoduck clam fishery may not be sustainable. As a result, ADF&G delayed the opening, originally scheduled for October 1, 1997, until further analysis and review of the survey results were completed.

ADF&G held public meetings to discuss possible management options for the fishery including a season opening date. Representatives of the CFEC, Fish and Wildlife Protection (FWP), and the ADEC attended. An opening date and daily open hours were agreed on as well as a GHL for each area. Generally, the 2% per year harvest rate was maintained for all areas but the number of years an area would remain fallow was increased to four years in Symonds Bay and 13–16 years on west Gravina Island with Steamboat Bay and Kah Shakes remaining on a two-year rotation. This expanded rotational cycle in Symonds Bay and west Gravina Island allowed for a viable fishery and provided an opportunity for industry self assessment; potentially providing funds for future reconnaissance and assessment surveys.

As a result of the meeting held prior to the 1997-1998 season, the Southeast Alaska Geoduck Task Force was formed. On January 7, 1998 the task force voted to assess themselves \$0.25 on the pound for the February 1998 commercial opening. Through a cooperative agreement between ADF&G and SARDFa, portions of funds generated through the voluntary self-assessment were used to estimate the geoduck clam biomass in Port Alice (summer 1998), and Turn Point, Cone Bay, and Nakat Inlet (Cape Fox and Lord/Sitklan Islands) (summer 1999). Port Alice was scheduled to open during the 1998-1999 season but ADEC water quality sampling was not available in time for the general opening on November 15, 1998 and this area was therefore not opened. Without ADEC approval for Port Alice for the 1998-1999 season, the general industry consensus during the October 14, 1998 Geoduck Task Force meeting was to delay opening Port Alice until the 1999-2000 season.

A cooperative agreement was entered into between the ADF&G and the Sitka Harvest Divers Association (SHDA). Using funds provided by the SHDA, ADF&G conducted a survey of the geoduck clam populations on the west coast of Baranof Island and nearby islands in portions of

Subdistricts 113-31 and 113-41. This area has since become known as the Goddard area due to the proximity of the Goddard Hot Springs and currently includes three fisheries (Biorka/Legma Island, Taigud/Kolosh Island, Elovoi/Golf/Gornoi Island) (Figure 3).

Reconnaissance surveys within Sea Otter Sound (Port Alice/Cone Bay, Turn Point), Nakat Inlet (Cape Fox, Lord/Sitklan Island), and the Goddard area were conducted by SARDFa and SHDA prior to population assessment surveys by the ADF&G. The purpose of the reconnaissance surveys was for industry to identify the most likely sites capable of supporting commercial geoduck fisheries. This data was then given to the ADF&G for biomass assessment surveys. The department has also received Federal Nearshore Funds<sup>1</sup> that have been used through industry contracts to complete reconnaissance surveys for potential commercial beds in a substantial portion of Southeast Alaska during the spring of 2001, 2002, and 2003. Funds provided by SARDFa were available for additional reconnaissance surveys during the spring of 2004 and 2005. Five existing fisheries had additional reconnaissance work done at industry request to better define existing beds and identify additional, new beds not identified during original reconnaissance surveys. The 2005 reconnaissance was conducted in Cone Island North, Cone Island South/Paloma Pass, Port Real Marina, Portillo Channel, and Bucareli Bay fisheries. Cone Island North and Cone Island South/Paloma Pass were surveyed during the 2005 survey season. The results from these surveys increased both survey precision and GHL. Since 1998, nineteen new fisheries that were defined by industry reconnaissance, subsequently surveyed by ADF&G, and opened to commercial harvest (Table 3). Additional reconnaissance is scheduled for the spring of 2006.

Prior to the January 2000 Board of Fisheries meeting, regulations (5 AAC 38.110.) referred to the general harvest of clams; requiring a permit that specifies the species, method of fishing, area of operation, and harvest levels. There were no regulations that specifically addressed the Southeast Alaska geoduck clam fishery. ADF&G, in cooperation with the SARDFa Geoduck Committee, developed regulations and a management plan for the Southeast Alaska commercial fishery. The Alaska Board of Fisheries formally adopted the geoduck management plan (5 AAC 38.142), during their regular meeting in January 2000, which was in place beginning with the 2000-2001 commercial fishery. The core elements are:

1. There are no size limits for geoducks and all geoducks harvested must be retained.
2. Annual guideline harvest levels must be established for an area before it is open to commercial harvest. The GHL must be based on biomass estimates where biomass surveys have been conducted within the previous 12 years.
3. Commercial harvest gear is limited to dive gear while using a hand-held, manually operated, water jet device.

Previous to the 2003-2004 season, ADF&G opened commercial geoduck fisheries in Southeast Alaska with little or no preliminary knowledge of current PSP levels. ADEC also did not have a live shipment program in place for geoducks that was based on preliminary fishery testing previous to the 2003-2004 season. Geoducks were harvested and then tested for a live market in lots. Due to requests by SARDFa for changes to ADEC's program, ADEC held a geoduck

---

<sup>1</sup> The reconnaissance and biomass surveys were funded, in part, by grants NA06FN0385 and NA16FN1560 from the National Oceanic and Atmospheric Administration (NOAA). The views expressed are those of the authors and do not necessarily reflect the views of NOAA or any of its sub-agencies.

conference in Anchorage on August 5 and 6, 2002. A result of this conference was implementation of an enhanced live shipment program for geoducks. This required ADF&G fishery management considerations and changes in order to target live geoduck sales. This program was enacted prior to the 2003-04 fishery. During the 2003-04 and 2004-05 seasons a significant amount of PSP data was collected by ADEC. Further, upwards of 90% of the GHL was shipped live, significantly increasing the value of the fishery (Table 4)

The fluid opening (i.e. openings based on geoduck passing ADEC PSP testing) necessitates relatively short notice for announcing openings. As openings for specific areas may be delayed, then opened on short notice, permit holders are required to closely monitor PSP test results which are posted on ADEC's and SARDFA's web site. Divers may not be 'in position' to take advantage of a short-noticed opening (i.e. divers may be involved in other fisheries/activities and not be able to participate given short notice). This may prohibit a diver from harvesting lower valued product for the processed market, but may leave the product for a higher valued live market. There is no guarantee that an area will ever pass PSP testing before the end of a season which means the product may eventually be harvested for the processed market. By managing the fishery based on PSP results, the fishery may be extended over a longer time period. Though the objective of the management plan is to realize a higher valued fishery, allocative issues may occur that may need to be addressed by the board in the future.

During the January 2003 Board of Fisheries meeting, regulation (5 ACC 38.142) was amended. The significant addition to the regulation was the establishment of a control site (Port Mayoral) within Subdistrict 103-50. Regulations were also amended to allow ADF&G to consider PSP levels in geoduck management (5 AAC 38.142 (a)).

### **2004-2005 GEODUCK COMMERCIAL HARVEST SEASON**

The GHL for the 2004-05 season 477,000 pounds harvested by 61 divers and was open from Nov. 2, 2004 until April 14, 2005. This was the largest GHL since geoduck fishing began in Southeast Alaska and all fishing areas were harvested live. Exvessel value averaged \$3.95 per pound for a total value of \$2,115,288 (Table 4). Harvest for live product was allowed for two days a week and areas had to pass two consecutive weeks of samples before a fishery could be certified to ship live product.

### **2005-2006 OUTLOOK**

A total of 403,800 pounds of whole geoduck clams will be available for harvest during the 2005-2006 season (Figure 3 and Table 4). Information from processors and divers indicate a potential of approximately \$4.00 per pound delivering to the live market. The exvessel value for the 2005-06 season is expected to be approximately \$1,615,200.

Prefishery testing of each area is scheduled to begin during the final week of October 2005. Once areas pass a single PSP test, ADF&G will issue a news release opening that area for up to three days in the Ketchikan management area and up to seven days in the Sitka management area. These changes are a result of analysis of PSP data collected during each of the previous two seasons by ADEC.

Daily open periods will initially be from 9:00 a.m. to 3:00 p.m. but may change, depending on the number of divers anticipated in an individual area and the GHL for that area. If an area does not pass PSP testing by the last week of April ADF&G may open all remaining areas for commercial harvest of processed product.

# RED SEA URCHIN

## BACKGROUND

Two commercial species, red sea urchins *Strongylocentrotus franciscanus* and green sea urchins *S. droebachiensis*, are common in Southeast Alaska. The red sea urchin occurs primarily on rocky shorelines of the outside coast with largest concentrations in southern Southeast Alaska. Green sea urchins are most common in protected waters of Southeast Alaska in a wider variety of habitats. The red sea urchin population is kept at very low levels by sea otters on many areas of the outside coasts, including, the Barrier Islands, Baker Island, Chichagof Island, Dall Island, Kuiu Island, Lulu Island, Maurelle Islands Noyes island, Sumez Island, southern Prince of Wales Island, and nearby areas. The only commercial fishery for urchins in recent years in Southeast Alaska has been for red sea urchins. Urchins are harvested for their gonads, commonly called roe or uni, with no distinction made between males or females. The product is most valuable fresh and is marketed primarily in Japan.

## FISHERY DEVELOPMENT AND HISTORY

Harvests of red sea urchins in Southeast Alaska began in 1981 near Ketchikan, primarily around Gravina Island. Both red and green sea urchins were harvested, with the vast majority of the harvest comprised of red urchins. Participation and harvest built through the mid-1980s (Table 5), expanding to include Districts 1, 2, 3, and 4. Harvests peaked at 890,092 pounds in 1986-1987 and then tapered off due to difficulties in marketing. In 1988, harvests were restricted to District 1, Gravina Island, District 3 and the West Coast of Prince of Wales Island due to lack of staff time and budget support. Once the major processor ceased operations in 1989 the fishery was closed.

Interest in establishing a commercial urchin fishery in Southeast Alaska resurged in 1990 due to the success of urchin fisheries in California, Washington, and British Columbia. This interest was directed towards the Sitka area; however, lacking basic stock information, further commercial harvest was postponed until completion of a test fishery there in late 1990 and early 1991 to estimate population size and to gather size frequency data. A limited commercial fishery opened in southern Sitka Sound in January 1991 with a harvest of 174,233 pounds before it was closed in April. Subsequent fisheries were opened in 1992 and 1993, and then closed indefinitely due to extreme predation by sea otters. It is estimated that 16,000,000 sea urchins were consumed by sea otters in a 15 month period from December 1, 1992 to February 24, 1993 (Davidson et al. 1993). All other areas of Southeast Alaska remained closed pending development of a management plan, stock assessments, harvest quotas, and means of monitoring and managing the fishery.

ADF&G initiated a test fishery in District 1 near Ketchikan in the spring 1995 as a method to pay for population assessment surveys. The test fishing contract was awarded to Ocean Fresh Seafoods of Fort Bragg, California, the sole bidder. Under the contract, Ocean Fresh paid the department \$139,567 in exchange for the opportunity to harvest 3,000,000 pounds of red sea urchins. The test fishery spanned 14 months from March 1995 through April 1996, and harvested 2,965,607 pounds of red sea urchins (Table 5). Monthly roe recovery averaged between 5.5% and 12.2%. The average price per pound ranged from \$0.29 to \$0.81. The test fishery provided considerable employment and revenues to Southeast Alaska, and was estimated to have an ex-vessel value of approximately \$1,402,837 paid to dive harvesters.

Since the test fishery, regular population assessment surveys have been completed in portions of Districts 1, 2, 3, and 4 on a three-year rotational basis. Surveys are conducted only in subdistricts where commercially viable populations exist. Fully developed red sea urchin fisheries have occurred ever since the 1996-1997 fishing season. The overall quota has remained between 4.4 and 6.8 million pounds, however, selected areas have seen reductions in biomass due to sea otter predation (Table 6). Most areas in Southeast Alaska supporting red sea urchin populations are threatened by the rapidly expanding sea otter population. The numbers of participating divers and landings have decreased during recent years (Table 5), most likely due to poor market conditions in Japan and Asia.

One of the most notable changes affecting the red urchin fishery has been the formation of the Southeast Regional Dive Fishery Association (SARDFa) in February 1998. Prior to the SARDFa formation, funding of the sea urchin fishery was obtained through industry processors, local municipalities, diver assessments, federal funding and test fishing conducted by the state. Federal Nearshore Funds have been used extensively to complete reconnaissance and conduct surveys from 1999 through 2005. Currently, sea urchin landings are assessed by SARDFa at 7% which supports management of the fishery.

## **MANAGEMENT STRATEGY AND REGULATION DEVELOPMENT**

Prior to 1996, permits to fish for sea urchins were given under authority of 5 AAC 38.062. In 1984, the first year with significant landings of red urchins, there was a size limit of 3–5 inches test diameter to protect small urchins for recruitment, to provide large urchins as a protective spine canopy for small urchins, and to give processors the desired size urchin. An interim management plan was in place in 1987 for the Ketchikan area with a three-year area rotation and size limits modified slightly to 3–4.5 inches. A second interim plan was developed for 1991 through 1993 for the Sitka area. The Sitka area plan included a 3.2% annual harvest rate on the estimated biomass, three-year area rotations, weekly fishing periods of noon, Saturday through noon, Thursday, and no size limits.

In 1996, ADF&G, in cooperation with the sea urchin fishing industry, developed interim regulations and a management plan for a commercial fishery in Southeast Alaska beginning with the 1996-1997 season. The regulations were adopted by the commissioner under authority of 5 AAC 39.210 for High Impact Emerging Fisheries and became effective in December 1996. The Alaska Board of Fisheries formally adopted the red sea urchin management plan during their regular meeting in January 1997. Since the management plan became effective, no major regulatory changes have been made to the red urchin fishery. The core elements are:

1. Annual guideline harvest levels are 6% of the biomass estimate. Fisheries will only be opened where biomass surveys have been conducted in the previous three years.
2. Harvest opportunities are to be distributed to each week of every month that the fishery is open. The fishery is to be managed to span approximately four months, subject to needs for conservation, law enforcement, reducing waste, and promoting fishery development. Size limits and trip limits may be imposed if needed to slow the pace of the fishery.
3. Processing vessels must carry observers, and vessels transporting unprocessed product out of Registration Area A must first obtain a transport permit.
4. In addition to fish ticket requirements, processors must submit records of the roe recovery within 30 days of landing.

The board made a modification to the regulation requiring onboard observers during the 2002-2003 cycle. New regulations with a three-year sunset clause allowed a catcher-seller to catch and process his own product onboard the harvest vessel (5 AAC 38.145 (n)).

### **2004-2005 SEA RED URCHIN COMMERCIAL HARVEST SEASON**

The 2004-2005 season opened by regulation on October 1, 2004 with a GHJ estimated at 5,518,300 of red sea urchins. This is the sixth highest GHJ on record with the lowest number of divers since the 1996-1997 season. Ex-vessel price was the lowest seen since the fishery management plan was established in 1996-1997 (Table 5).

### **2005-2006 OUTLOOK**

Department biomass estimates indicate a harvestable surplus of 5,753,100 pounds of red sea urchins are available for the 2005-2006 season. The fishery opened by regulation October 1, 2005 with daily open periods from 8:00 a.m. to 6:00 p.m., seven days per week. Daily open periods may be adjusted during the season as warranted.

## **GREEN SEA URCHIN**

### **FISHERY DEVELOPMENT AND HISTORY**

The red sea urchin fishery was developed in response to an original request by the urchin industry to develop a green sea urchin fishery. The request was set aside because ADF&G lacked several key elements required to formalize a harvest rate management plan for green urchins: information on the distribution of commercially viable populations, a statistically valid and reasonably precise survey method, and life history information useful in setting a harvest rate.

ADF&G obtained Federal monies to initiate a stock assessment and research program for green sea urchins similar to ADF&G's program for red sea urchins. Specific objectives were to 1) determine the distribution of commercially viable green urchin populations in 10 or more statistical harvest areas in internal waters of Southeast Alaska, 2) investigate potential stock assessment methods that would provide reasonably precise estimates of abundance, 3) develop preliminary estimates of appropriate harvest rates, and 4) establish a baseline of stock assessment data for monitoring effects of future harvests.

Initially, the primary focus of the green urchin fishery research was to contract with industry to conduct reconnaissance surveys delineating specific areas or beds with commercial potential. In general, green urchins occur in more sheltered waters than do red sea urchins. Fourteen sections of shoreline were chosen, encompassing many statistical harvest areas, where reconnaissance surveys were completed. Survey products submitted to ADF&G included: 1) charts delineating areas surveyed and boundaries of green urchin beds with commercial potential, 2) a list of dive sites, identified on the charts, with coordinates and descriptions, and 3) an overall summary with impressions of the area as having commercial harvest potential.

ADF&G, in consultation with SARDFA and the reconnaissance surveyors, selected areas having potential for a green sea urchin commercial fishery, and conducted biomass surveys. Reconnaissance results indicated that, though green urchins are ubiquitous throughout Southeast Alaska, they generally exist in densities too low and of a size too small to support a commercial fishery. ADF&G conducted biomass surveys in several areas and concluded that the green sea urchin population in Southeast Alaska was not sufficient to support a commercial fishery.

## 2005-2006 OUTLOOK

During the 2005 survey season, monies were made available for a ADF&G survey of green urchins in Yakutat Bay. Very few urchins were seen due to poor habitat and predation by abundant sea otters. ADF&G currently has no plans to pursue a commercial green urchin fishery in Southeast Alaska or Yakutat.

## REFERENCES CITED

- Agler, B. A., S. J. Kendall, P. E. Seiser, and J. R. Lindell. 1995. Estimates of marine bird and sea otter abundance in southeast Alaska during summer 1994. Unpublished report to U.S. Fish and Wildlife Services. Migratory Bird Management and Ecological Services Anchorage Alaska.
- Bodkin, J. L., K. A. Kloecker, G. G. Esslinger, D. H. Monson, J. D. DeGroot, J. Doherty. Unpublished. Sea otter studies in Glacier Bay National Park and Preserve. 2002 report to Glacier Bay National Park and Preserve. United States Geological Services, Alaska Biological Science Center, Anchorage. 48pp.
- Bureau, D., W. Hajas, C. M. Hand, and G. Dovey. 2003. Age, size structure and growth parameters of geoducks (*Panopea abrupta*, Conrad 1849) from seven locations in British Columbia sampled in 2001 and 2002. Canadian Technical Report of Fisheries and Aquatic Sciences 2494.
- Davidson, B., D. Woody, and B. DeJong. 1993. Interim management measures for the red sea urchin in southeast Alaska for the 1993 season. Regional Information Report No. 1J93-01. Alaska Department of Fish and Game, Division of Commercial Fisheries. Juneau, Alaska. 12 pp.
- Davidson, B. Unpublished. Urchin fishery recap. 1992 data.
- Estes, J. A. and D. O. Duggins. 1995. Sea otter, *Enhydra lutris*, prey composition and foraging success in the northern Kodiak Archipelago. Fishery Bulletin 92:704-710.
- Estes J. A. and D. O. Duggins. 1995. Sea otters and kelp forests in Alaska: generality and variation in a community ecological paradigm. Ecological Monographs 65(1):75-100.
- Estes, J. A. and J. F. Palmisano. 1974. Sea otters: their role in structuring nearshore communities. Science 185:1058-1060.
- Jameson, R. J., K. W. Kenyon, A. M. Johnson, and H. M. Wight, 1982. History and status of translocated sea otter populations in North America. Wildlife Society Bulletin 10:100-107.
- Kelley, B. P. 1995. *Unpublished* Southeast Alaska draft regional management plan for sea otters (*Enhydra lutris*). School of Fisheries and Ocean Science, University of Alaska Fairbanks and the Alaska Sea Otter Commission.
- Kenyon, K. W. 1969. The sea otter in the eastern Pacific Ocean. North American Fauna 68. 352 pp.
- O'Clair, R. M. and C. E. O'Clair. 1998. Southeast Alaska's rocky shores: animals. Plant Press. Auke Bay, Alaska, 563 pp.
- Pitcher, K. W. and K. K. Imamura. 1990. Impacts of sea otter predation on Dungeness crab abundance in Cross Sound-Icy Strait Area, southeastern Alaska. U. S. Fish and Wildlife Services Cooperative Agreement No. 14-16-0009-954 Final Report:1-18.

## **TABLES AND FIGURES**

**Table 1.**—Registration Area A (Southeast Alaska) commercial abalone harvests, effort, value, and season length, 1970-1971 through 1996-1997.

Season	Guideline Harvest Range or Quota (lb)	Southern Southeast Harvest (lb)	District 13 Harvest (lb)	Total Southeast Harvest (lb)	Number of Divers	Exvessel Value	Season Length (days)
70-71							365
71-72		Confidential Data – Less than 3 divers reporting landings					365
72-73		65	2,610	2,675	6	\$2,675	365
73-74			3,000	3,000	3	\$4,500	365
74-75			13,826	13,826	3	\$20,739	365
75-76		55	8,497	8,552	8	\$17,104	365
76-77		Confidential Data – Less than 3 divers reporting landings					365
77-78		805	10,861	11,666	10	\$14,816	365
78-79		130,607	49,320	179,927	35	\$253,697	365
79-80		316,952	61,733	378,685	43	\$408,980	287
80-81	250,000	233,589	18,382	251,971	40	\$420,792	273
81-82	100,000-125,000	338,305	32,589	370,894	54	\$445,073	59
82-83	100,000-125,000	100,458	12,826	113,284	41	\$240,162	36
83-84	100,000-125,000	99,294	8,735	108,029	31	\$302,481	126
84-85	100,000-125,000	59,237	8,379	67,616	25	\$165,659	151
85-86	25-58,000	32,817	7,720	40,537	18	\$117,963	71
86-87	25-58,000	47,404	13,820	61,224	24	\$168,366	146
87-88	25-58,000	57,209	10,406	67,615	42	\$208,930	36
88-89	25-58,000	65,928	10,172	76,100	45	\$307,444	33
89-90	25-58,000	57,784	4,020	61,804	67	\$330,651	40
90-91	25-58,000	62,779	5,607	68,386	97	\$374,071	9
91-92	25-58,000	35,987	8,095	44,082	95	\$267,578	35
92-93	25-58,000	26,905	9,083	35,988	99	\$386,151	19
93-94	25-58,000	27,680	7,172	34,852	85	\$487,928	7
94-95	25-58,000	15,055	7,824	22,879	101	\$330,373	8
95-96	0-16,000	8,524	5,828	14,352	101	\$125,580	7
96-97	closed						

**Table 2.**—Registration Area A (Southeast Alaska) commercial sea cucumber harvests, effort, value and season length, 1986-1987 through 2005-2006.

Season <sup>a</sup>	Guideline Harvest Level (lb)	Total Pounds Landed (lb)	Average Price Per Pound <sup>b</sup>	Estimated Exvessel Value <sup>b</sup>	Number of Divers	Number of Landings	Total Days Open	Average Pounds per Diver	Average Earnings per Diver <sup>b</sup>
Data prior to 1986-1987 season is confidential.									
86-87	34,043	34,043	\$0.21	\$7,149	7	44	N/A	4,863	\$1,021
87-88	65,056	65,056	\$0.21	\$13,662	11	143	N/A	5,914	\$1,242
88-89	801,405	801,405	\$0.21	\$169,096	57	922	N/A	14,060	\$2,967
89-90	2,318,305	2,318,305	\$0.42	\$969,142	205	2,263	N/A	11,309	\$4,728
90-91	704,491 <sup>c</sup>	804,184	\$0.59	\$472,386	143	890	80	5,624	\$3,303
91-92	839,160 <sup>c</sup>	869,988	\$0.80	\$697,970	187	704	56	4,652	\$3,732
92-93	1,100,440	1,249,621	\$0.79	\$988,628	240	1,003	29	5,207	\$4,119
93-94	799,235	964,343	\$1.03	\$995,783	320	949	18	3,014	\$3,112
94-95	1,351,000	1,322,219	\$1.79	\$2,361,541	261	1,379	39	5,066	\$9,048
95-96	1,157,500	1,332,095	\$1.39	\$1,846,556	424	1,582	13	3,142	\$4,355
96-97	939,300	909,789	\$1.29	\$1,169,612	294	1,234	11.5	3,095	\$3,978
97-98	892,410	894,739	\$1.63	\$1,458,425	226	976	8	3,959	\$6,453
98-99	1,026,345	1,055,572	\$1.55	\$1,636,137	219	971	8	4,820	\$7,471
99-00	1,580,000	1,569,626	\$1.95	\$3,060,771	200	1,378	18.5	7,848	\$15,304
00-01	1,122,500	1,158,385	\$2.23	\$2,583,199	220	913	7.5	5,265	\$11,742
01-02	1,425,200	1,438,451	\$1.75	\$2,517,289	235	1,201	10.5	6,121	\$10,712
02-03	1,576,700	1,639,440	\$1.26	\$2,042,882	201	1,313	24	8,156	\$10,164
03-04	1,637,700	1,698,650	\$1.42	\$2,472,456	195	1,296	15	8,711	\$12,679
04-05	1,381,200	1,374,532	\$2.12	\$2,769,116	194	1,139	13.5	7,085	\$14,274
05-06	1,475,800								

<sup>a</sup> Season = October 1 thru September 30. Experimental fishing program prior to 1990-1991 season.

<sup>b</sup> Based on CFEC (annual) data prior to the 1998-1999 season, then based on ADF&G fish ticket data.

<sup>c</sup> Quota originally calculated in numbers of sea cucumbers.

**Table 3.**—Registration Area A (Southeast Alaska) commercial geoduck clam harvest areas, current guideline harvest levels, original open season, and recent reconnaissance/survey funding sources, 1987-1988 through 2005-2006.

Harvest Area	Current Annual GHL (lb)	First Open Season	Funding Source (recent areas only)
Biorka / Legma Islands	10,200	1998-99	SHD <sup>a</sup>
Taigud / Kolosh Islands	3,600	1998-99	SHD <sup>a</sup>
Elovoi / Golf Islands	600	1998-99	SHD <sup>a</sup>
Symonds Bay	3,100	1989-90	
Port Alice / Cone Bay	11,800	1998-99	SARDF <sup>a</sup> <sup>b</sup>
Turn Point	1,700	1998-99	SARDF <sup>a</sup> <sup>b</sup>
Steamboat Bay	20,700	1985-86	
Little Steamboat Bay	7,900	1985-86	
Ulitka Bay	4,600	1985-86	
Cone Island North	106,900	2002-03	SARDF <sup>a</sup> <sup>b</sup> , NSIV <sup>c</sup>
Cone I. South / Paloma Pass	134,000	2002-03	SARDF <sup>a</sup> <sup>b</sup> , NSIV <sup>c</sup>
Vallenar Bay	7,000	1987-88	
South Vallenar Point	0	1988-89	
Middle Gravina	7,800	1989-90	
Nehenta Bay	4,000	1990-91	
Foggy Bay	25,500	1990-91	
Kirk Point / Bullhead Cove	7,600	1991-92	
Cape Fox	7,800	1999-2000	SARDF <sup>a</sup> <sup>b</sup>
Lord / Sitlan Is.	6,700	1999-2000	SARDF <sup>a</sup> <sup>b</sup>
Blanquiza Islands	9,400	2002-03	SARDF <sup>a</sup> <sup>b</sup>
Palisades Islands	19,300	2002-03	SARDF <sup>a</sup> <sup>b</sup>
Port Santa Cruz	26,500	2000-01	SARDF <sup>a</sup> <sup>b</sup>
Percy Islands	14,900	2001-02	NSII <sup>d</sup>
Vegas / Hotspur Islands	11,800	2001-02	NSII <sup>d</sup>
Bucareli Bay	3,600	2001-02	NSII <sup>d</sup>
Portillo Channel	36,100	2001-02	NSII <sup>d</sup>
Port Real Marina	6,800	2001-02	NSII <sup>d</sup> , SARDF <sup>a</sup> <sup>b</sup>
East San Fernando Island	7,100	2002-03	NSII <sup>d</sup>
Kelp Island	10,900	2003-04	NSIII <sup>e</sup>
Northwest Dall Island	21,400	2004-05	NSIV <sup>c</sup>
North Lulu Island	35,500	2004-05	NSIV <sup>c</sup>
Kaigani Strait	24,500	2003-04	NSIII <sup>e</sup> , NSIV <sup>c</sup>
Cat and Dog Island	7,900	2004-05	NSII <sup>d</sup> , NSIII <sup>e</sup> , NSIV <sup>c</sup>
Slate Island	4,700	2004-05	NSIV <sup>c</sup>

<sup>a</sup> SHD = Sitka Harvest Divers.

<sup>b</sup> SARDF<sup>a</sup> = Southeast Alaska Regional Dive Fisheries Association.

<sup>c</sup> NSIV = Nearshore IV federal funding.

<sup>d</sup> NSII = Nearshore II federal funding.

<sup>e</sup> NSIII = Nearshore III federal funding.

**Table 4.** –Registration Areas A (Southeast Alaska) commercial geoduck clam harvests, effort, value and season length, 1985-1986 through 2005-2006.

Season <sup>a</sup>	Guideline Harvest Level (lb)	Total Pounds Landed	Average Price per Pound <sup>b</sup>	Estimated Exvessel Value <sup>b</sup>	Number of Divers	Number of Landings	Total Days Open	Average Pounds per Diver	Average Earnings per Diver <sup>b</sup>
1985-86	<sup>c</sup>	143,868	\$0.20	\$28,774	8	40	240	17,984	\$3,597
1986-87	<sup>c</sup>	28,191	\$0.25	\$7,048	3	9	240	9,397	\$2,349
1987-88	125,000	185,674	\$0.30	\$55,702	6	156	240	30,946	\$9,284
1988-89	189,232	143,188	\$0.30	\$42,956	9	127	240	15,910	\$4,773
1989-90	199,000	207,083	\$0.51	\$105,612	18	165	240	11,505	\$5,867
1990-91	196,000	189,585	\$0.51	\$96,688	15	130	176	12,639	\$6,446
1991-92	219,000	193,074	\$0.63	\$121,637	20	131	33	9,654	\$6,082
1992-93	196,000	189,379	\$1.12	\$212,104	22	109	19	8,608	\$9,641
1993-94	219,000	209,322	\$1.48	\$309,797	39	115	10.5	5,367	\$7,944
1994-95	195,000	197,246	\$1.64	\$323,483	64	190	14	3,082	\$5,054
1995-96	209,000	229,681	\$2.25	\$516,782	109	401	10	2,107	\$4,741
1996-97	196,000	203,017	\$2.55	\$517,693	97	359	6	2,093	\$5,337
1997-98	196,000	180,440	\$4.00	\$721,760	110	312	3	1,640	\$6,561
1998-99	112,500	111,311	\$2.12	\$235,979	98	206	66	1,136	\$2,408
1999-00	250,400	202,260	\$1.60	\$400,640	61	240	50	4,105	\$6,568
2000-01	391,100	438,334	\$1.06	\$414,566	74	544	148	5,285	\$5,602
2001-02	285,322	283,405	\$0.72	\$204,052	37	324	78	7,711	\$5,515
2002-03	382,100	392,406	\$1.69	\$663,166	50	537	35	7,848	\$13,263
2003-04	341,000	377,584	\$2.87	\$1,083,666	49	482	25	7,706	\$22,116
2004-05	477,000	535,516 <sup>d</sup>	\$3.95	\$2,115,288	61	724 <sup>d</sup>	24	8,779	\$34,676
2005-06	403,800								

<sup>a</sup> Season = October 1 thru September 30.

<sup>b</sup> Based on CFEC (annual) data prior to the 1998-1999 season, then based on ADF&G fish ticket data.

<sup>c</sup> Only Noyes Island open (Subdistrict 103-70). Five-year GHIL established of 300,000 pounds for all three areas. Separate GHILs first established for 1988-1989 season. Therefore, 1987-1988 GHIL does not include remaining GHIL from Noyes Island (e.g. 125,000 for Gravina Island only).

<sup>d</sup> Excludes 2005 mariculture site purge fishery harvest of 167,822 pounds.

**Table 5.** –Registration Area A (Southeast Alaska) commercial red sea urchin harvests, effort, and value, 1980-1981 through 2005-2006.

Season	Guideline Harvest Level (lb)	Total Pounds Landed (lb)	Average Price Per Pound <sup>a</sup>	Estimated Exvessel Value <sup>a</sup>	Number of Divers	Number of Landings	Average Pounds per Diver	Average Earnings per Diver <sup>a</sup>
1980-81 <sup>b</sup>				Confidential				
1981-82 <sup>b</sup>				Confidential				
1982-83 <sup>b</sup>				Confidential				
1983-84		23,303	\$0.12	\$2,796	4	9	5,826	\$699
1984-85		188,023	\$0.17	\$31,906	16	84	11,751	\$1,994
1985-86		58,303	\$0.13	\$7,288	8	32	7,288	\$911
1986-87		890,092	\$0.14	\$125,335	26	459	34,234	\$4,821
1987-88 <sup>b</sup>				Confidential				
1988-89		223,883	\$0.41	\$91,106	11	128	20,353	\$8,282
1989-90		23,617	\$0.25	\$5,833	9	33	2,624	\$648
1990-91		174,233	\$0.26	\$45,823	6	91	29,039	\$7,637
1991-92		428,220	\$0.30	\$128,894	37	256	11,574	\$3,484
1992-93		143,485	\$0.29	\$41,467	17	108	8,440	\$2,439
1993-94		0		0	0	0		
1994-95 <sup>c</sup>	3,000,000	2,088,395	\$0.45	\$944,329	1	1,391	2,088,395	\$944,329
1995-96 <sup>c</sup>		877,212	\$0.52	\$458,508	1	705	877,212	\$458,508
1996-97	6,093,579	4,929,280	\$0.38	\$1,878,056	150	3,483	32,862	\$12,520
1997-98	4,255,364	4,083,877	\$0.34	\$1,408,397	129	2,465	31,658	\$10,918
1998-99	4,822,700	3,075,095	\$0.40	\$1,230,038	62	1,524	49,598	\$19,839
1999-00	5,748,700	2,676,456	\$0.38	\$1,017,053	47	1,094	56,946	\$21,639
2000-01	6,806,700	2,373,993	\$0.36	\$854,637	56	842	42,393	\$15,261
2001-02	5,689,300	2,720,241	\$0.34	\$924,882	32	995	85,008	\$28,903
2002-03	5,309,900	3,578,493	\$0.32	\$1,133,706	36	1,265	99,403	\$31,492
2003-04	5,095,100	2,834,872	\$0.33	\$895,369	40	1,019	70,872	\$22,384
2004-05	5,518,300	1,801,893	\$0.32	\$576,605	31	651	58,125	\$18,600
2005-06	5,753,100							

<sup>a</sup> Based on CFEC (annual) data prior to the 1998-1999 season, then based on ADF&G seasonal fish ticket data. Harvest data is from Districts 1–4 except for years 1990-1991, 1991-1992, 1992-1993, 1997-1998 and 1999-2000 which include information for District 13.

<sup>b</sup> Confidential information, ≤ 3 permits participating.

<sup>c</sup> Department test fishery. GHL is the agreed test fishery maximum poundage taken during spring 1995–spring 1996, in exchange for research funds.

**Table 6.**—Red sea urchins maximum harvest losses due to presumed sea otter predation in the commercial Fishery, 1990-1991 through 2005-2006.

Season	Guideline Harvest Level or Amount Available for Harvest (lb)	Total Pounds Landed (lb)	Number of Fisheries Lost to Commercial Harvest Due to Sea Otters in District 13	Number of Fisheries Lost to Commercial Harvest Due to Sea Otters in Districts 1-4	Estimated Poundage Loss Due to Sea Otters (lbs)	Estimated Exvessel value Loss Due to Sea Otters (dollars) <sup>a</sup>
1990-91	220,000	174,233				
1991-92	450,000	428,220				
1992-93	140,000	143,485				
1993-94			2		310,000	\$89,900
1994-95 <sup>b</sup>	3,000,000	2,088,395	2			
1995-96 <sup>b</sup>		877,212	2			
1996-97	6,093,579	4,929,280	2			
1997-98	4,255,364	4,083,877	2			
1998-99	4,822,700	3,075,095	2		113,000	\$45,200
1999-00	5,748,700	2,676,456	2	1	263,000	\$99,940
2000-01	6,806,700	2,373,993	4	1	444,400	\$159,984
2001-02	5,689,300	2,720,241	4	4	523,400	\$177,956
2002-03	5,309,900	3,578,493	4	4	910,400	\$291,328
2003-04	5,095,100	2,834,872	4	4	1,310,400	\$432,432
2004-05	5,518,300	1,801,893	4	4	1,310,400	\$419,328
2005-06	5,753,100		4	6	1,410,400	\$451,328 <sup>c</sup>

<sup>a</sup> Based on ADF&G seasonal fish ticket data.

<sup>b</sup> Department test fishery. GHF is the agreed test fishery maximum poundage taken during spring 1995–spring 1996, in exchange for research funds.

<sup>c</sup> 2005-2006 value estimated using 2004-2005 price per pound.

**Table 7** -Sea cucumber losses due to presumed sea otter predation in the commercial fishery 1990-1991 through 2005-2006.

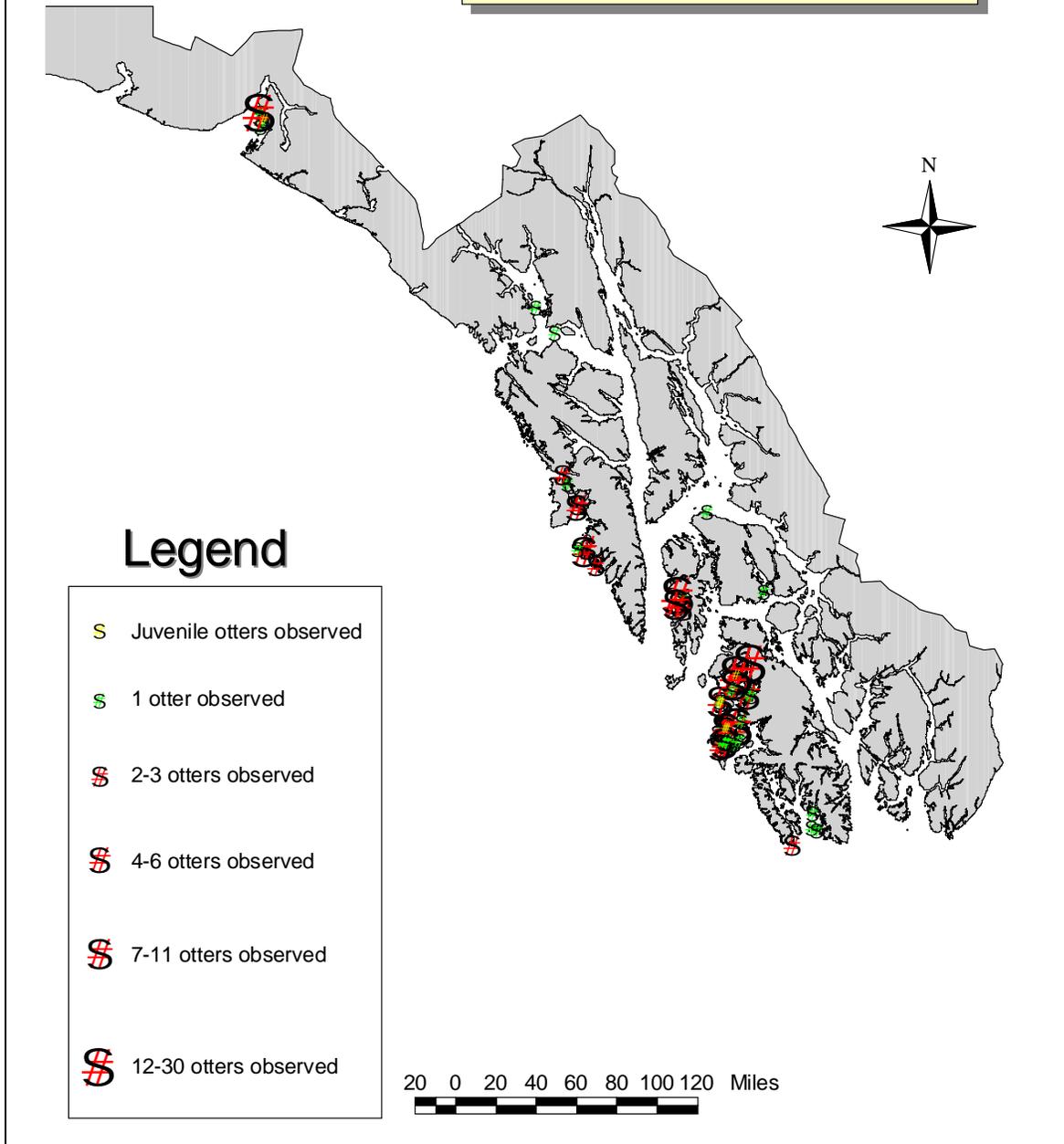
Season	Guideline Harvest Level or Amount Available for Harvest (lb)	Total Pounds Landed (lb)	Number of Fisheries Lost to Commercial Harvest Due to Sea Otters	Estimated Poundage Loss to Commercial Harvest Due to Sea Otters (lbs)	Estimated Exvessel Value Loss Due to Sea Otters (dollars) <sup>a</sup>
1990-91	704,491 <sup>b</sup>	804,184			
1991-92	839,160 <sup>b</sup>	869,988			
1992-93	1,100,440	1,249,621			
1993-94	799,235	964,343	1	34,000	\$35,020
1994-95 <sup>b</sup>	1,351,000	1,322,219		-	\$0
1995-96 <sup>b</sup>	1,157,500	1,332,095		-	\$0
1996-97	939,300	909,789	2	34,000	\$43,860
1997-98	892,410	894,739	1	90,000	\$146,700
1998-99	1,026,345	1,055,572		40,000	\$62,000
1999-00	1,580,000	1,569,626	2	59,000	\$115,050
2000-01	1,122,500	1,158,385	1	130,000	\$289,900
2001-02	1,425,200	1,438,451	1	100,000	\$175,000
2002-03	1,576,700	1,639,440	3	84,000	\$105,840
2003-04	1,637,700	1,698,650	1	150,000	\$213,000
2004-05	1,381,200	1,374,532	2	140,000	\$296,800
2005-06	1,475,800		3	184,000	\$390,080 <sup>c</sup>

<sup>a</sup> Based on ADF&G seasonal fish ticket data.

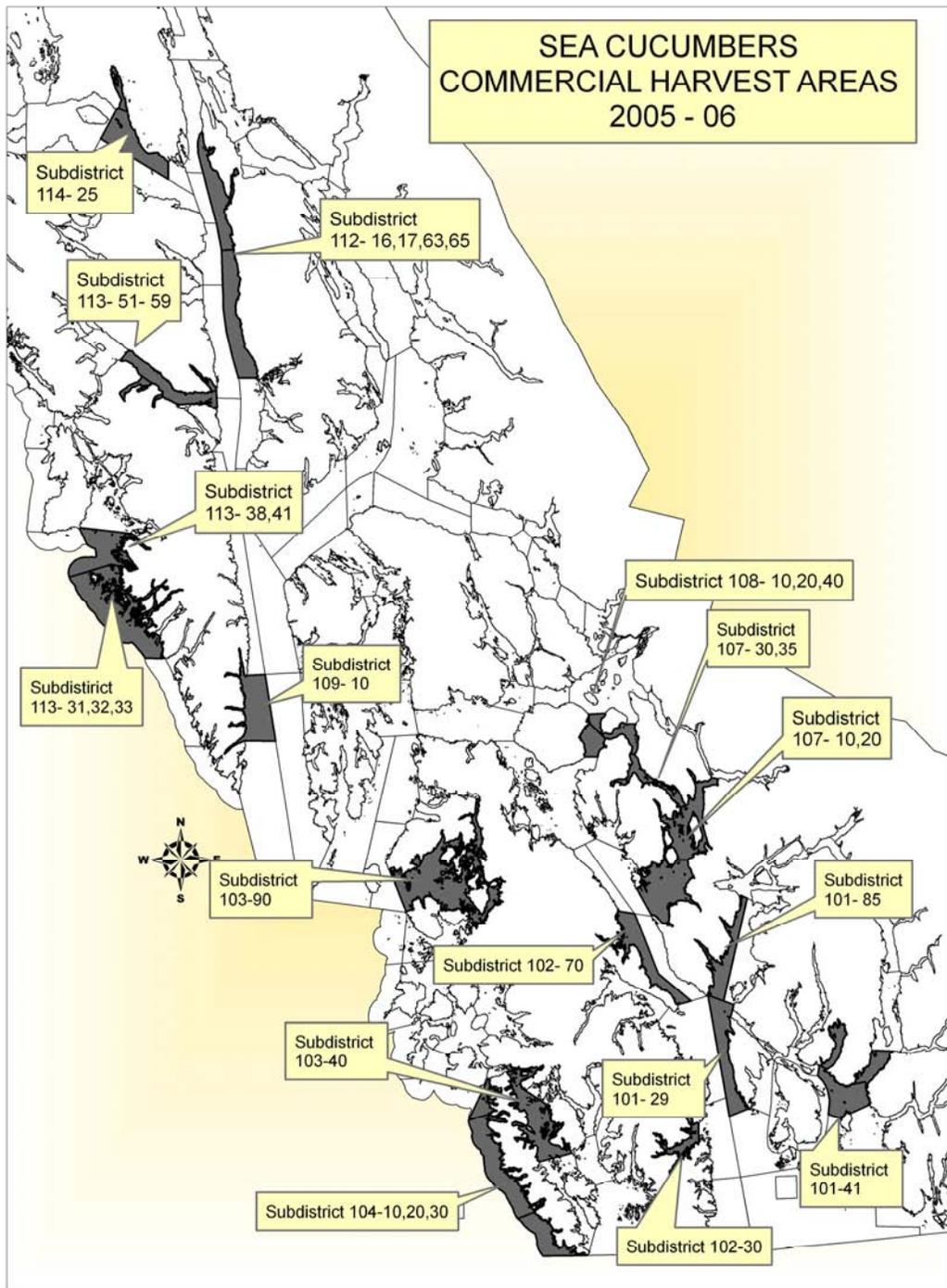
<sup>b</sup> Quota originally calculated in numbers of sea cucumbers.

<sup>c</sup> 2005-2006 value estimated using 2004-2005 price per pound.

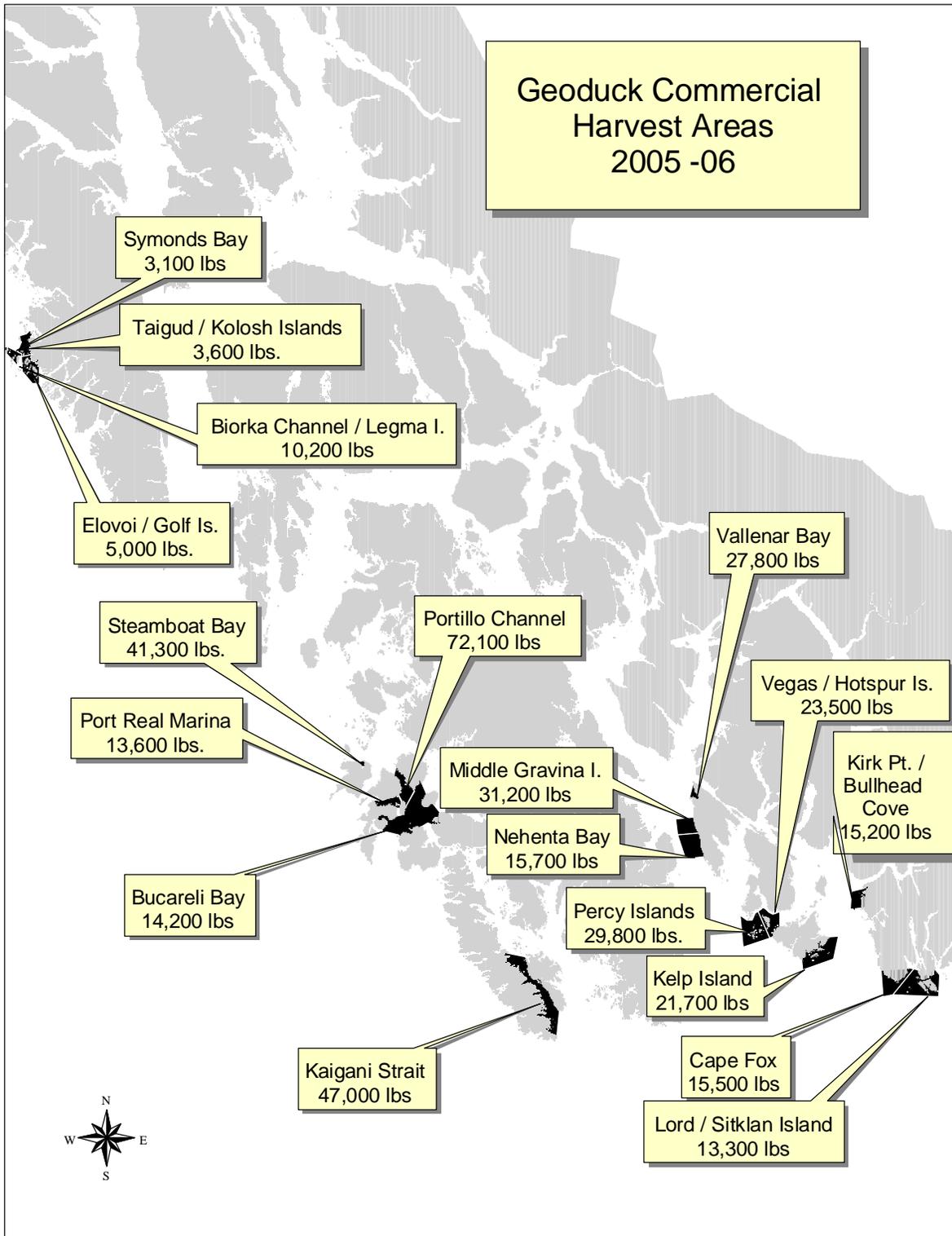
## 2004 and 2005 ADF&G Sea Otter Observations



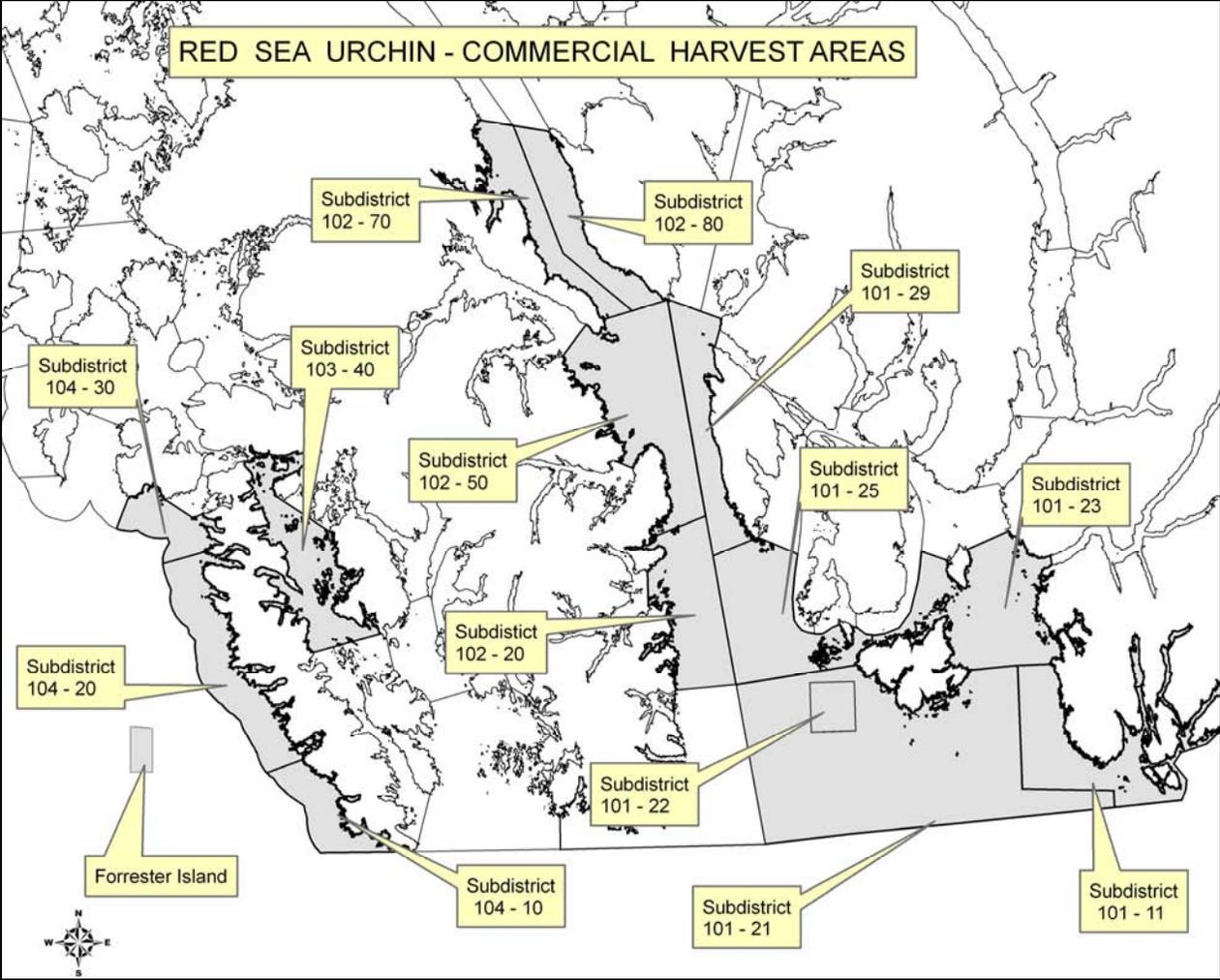
**Figure 1.** –Sea otter observations recorded by the Alaska Department of Fish and Game during dive assessment surveys in Southeast Alaska, 2004 and 2005.



**Figure 2.**—Sea cucumber commercial harvest areas for the 2005-2006 season.



**Figure 3.**—Geoduck clam commercial harvest areas for the 2005-2006 season.



**Figure 4.**–Red sea urchin commercial harvest areas for the 2005-2006 season.