

**Fishery Management Report No. 24-32**

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**Southeast Alaska 2022/2023 Miscellaneous Shellfish  
Fisheries Management Report**

by

**Quinn Smith**

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December 2024

Alaska Department of Fish and Game

Divisions of Sport Fish and Commercial Fisheries



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<b>Weights and measures (metric)</b>		<b>General</b>		<b>Mathematics, statistics</b>	
centimeter	cm	Alaska Administrative Code	AAC	<i>all standard mathematical signs, symbols and abbreviations</i>	
deciliter	dL	all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.	alternate hypothesis	$H_A$
gram	g	all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.	base of natural logarithm	$e$
hectare	ha	at	@	catch per unit effort	CPUE
kilogram	kg	compass directions:		coefficient of variation	CV
kilometer	km	east	E	common test statistics	(F, t, $\chi^2$ , etc.)
liter	L	north	N	confidence interval	CI
meter	m	south	S	correlation coefficient	
milliliter	mL	west	W	(multiple)	R
millimeter	mm	copyright	©	correlation coefficient	
		corporate suffixes:		(simple)	r
<b>Weights and measures (English)</b>		Company	Co.	covariance	cov
cubic feet per second	ft <sup>3</sup> /s	Corporation	Corp.	degree (angular)	°
foot	ft	Incorporated	Inc.	degrees of freedom	df
gallon	gal	Limited	Ltd.	expected value	$E$
inch	in	District of Columbia	D.C.	greater than	>
mile	mi	et alii (and others)	et al.	greater than or equal to	≥
nautical mile	nmi	et cetera (and so forth)	etc.	harvest per unit effort	HPUE
ounce	oz	exempli gratia	e.g.	less than	<
pound	lb	(for example)		less than or equal to	≤
quart	qt	Federal Information Code	FIC	logarithm (natural)	ln
yard	yd	id est (that is)	i.e.	logarithm (base 10)	log
		latitude or longitude	lat or long	logarithm (specify base)	log <sub>2</sub> , etc.
<b>Time and temperature</b>		monetary symbols		minute (angular)	'
day	d	(U.S.)	\$, ¢	not significant	NS
degrees Celsius	°C	months (tables and figures): first three letters	Jan, ..., Dec	null hypothesis	$H_0$
degrees Fahrenheit	°F	registered trademark	®	percent	%
degrees kelvin	K	trademark	™	probability	P
hour	h	United States (adjective)	U.S.	probability of a type I error	
minute	min	United States of America (noun)	USA	(rejection of the null hypothesis when true)	$\alpha$
second	s	U.S.C.	United States Code	probability of a type II error	
		U.S. state	use two-letter abbreviations (e.g., AK, WA)	(acceptance of the null hypothesis when false)	$\beta$
<b>Physics and chemistry</b>				second (angular)	"
all atomic symbols				standard deviation	SD
alternating current	AC			standard error	SE
ampere	A			variance	
calorie	cal			population	Var
direct current	DC			sample	var
hertz	Hz				
horsepower	hp				
hydrogen ion activity (negative log of)	pH				
parts per million	ppm				
parts per thousand	ppt, ‰				
volts	V				
watts	W				

***FISHERY MANAGEMENT REPORT NO. 24-32***

**SOUTHEAST ALASKA 2022/2023 MISCELLANEOUS SHELLFISH  
FISHERIES MANAGEMENT REPORT**

by

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December 2024

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## ABSTRACT

The commercial miscellaneous shellfish (or “dive”) fisheries in the Southeast Region (Registration Area A/Southeast Alaska and Registration Area D/Yakutat) are a group of fisheries targeting geoduck clams, red sea urchins, sea cucumbers, and abalone. The common feature of these fisheries is that all are limited to hand picking by divers. Except for abalone, all of the dive fisheries have well developed management plans, with abundance-based stock assessment programs at their core. Most development of these fisheries has occurred since the 1990s, making the dive fisheries relatively new to Alaska. The Alaska Department of Fish and Game (ADF&G or the department) works closely with the Southeast Alaska Regional Dive Fisheries Association (SARDFA) to develop management plans for these fisheries. SARDFA is a nonprofit organization that represents limited entry permit holders of the dive fisheries, and that generates funds for management, research, and the promotion of dive fisheries. Sea otters pose a major threat to the dive fisheries in Southeast Alaska. The department has documented substantial declines in population levels of sea cucumbers, sea urchins, and geoducks in areas occupied by sea otters. Consequently, guideline harvest levels have been reduced, and a growing number of areas have been closed to commercial harvest.

Keywords: abalone, Commercial Fisheries Entry Commission, dive fisheries, geoduck clams, red sea urchins, sea cucumbers, sea otters, Southeast Alaska Regional Dive Fisheries Association, SARDFA, Alaska Board of Fisheries

## INTRODUCTION

### SOUTHEAST ALASKA DIVE FISHERIES

This report provides a general overview of miscellaneous shellfish fisheries, commonly referred to as “dive fisheries”, in Southeast Alaska and Yakutat, and summarizes the 2022/2023 season. Southeast Alaska dive fisheries currently harvest 3 species of invertebrates: geoduck clams *Panopea generosa* (hereafter referred to as geoducks), California sea cucumbers *Apostichopus californicus*, and red sea urchins *Mesocentrotus franciscanus*. All 3 fisheries occur primarily in southern Southeast Alaska waters. The pinto abalone *Haliotis kamschatkana* fishery has been closed to commercial harvest since 1995. A small experimental sea cucumber fishery was prosecuted during the 2007/08 season in the Yakutat area but discontinued because of lack of harvestable sea cucumber biomass.

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 2 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 primarily 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 harvest reporting. For management purposes, the Ketchikan area office oversees fisheries that occur in Districts 1–4, the Petersburg and Wrangell area offices oversee Districts 5–10 (excluding Section 9-A), the Sitka area office oversees Section 9-A and District 13, and the Juneau area office oversees Districts 11–12 and 14–15.

Southeast dive fisheries are relatively recent additions to the region’s commercial fishing industry. The first commercial landings for abalone occurred in the mid-1960s, and red sea urchins, sea cucumbers, and geoducks in the early to mid-1980s (Tables 1–4). Initial participation in each fishery was often limited to just 1 or 2 divers and has developed to current effort levels. All dive fisheries except abalone are competitive limited entry fisheries. Fish ticket information indicates 217 permits reported landings during the 2022/23 season, the most recent season with complete information available, including 160 sea cucumber, 55 geoduck clam, and 2 red sea urchin permits.

The Commercial Fisheries Entry Commission (CFEC) preliminary estimates of exvessel value of the Southeast Alaska dive fisheries in the 2022/23 season is \$9,045,650, not including confidential sea urchin fishery value. The harvest value by fishery was \$5,723,539 for sea cucumbers, \$3,322,111 for geoducks.

## **COMMERCIAL FISHERIES ENTRY COMMISSION**

Prior to July 1, 1996, entry into Southeast Alaska's dive fisheries was open access, requiring an interim-use permit by the CFEC for participation. Historically, most fisheries began slowly with little effort, but interest grew quickly as exvessel value increased, new markets opened, and participants expanded beyond the more traditional fisheries such as salmon or groundfish. Effort quickly increased to levels that made it difficult for the Alaska Department of Fish and Game (ADF&G or the department) to manage each fishery.

In 1996, the Alaska State Legislature established a 4-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 geoduck, sea cucumber, sea urchin, and abalone 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 it expired automatically on June 30, 2000. During the moratorium, the legislation directed the CFEC to consult with the Alaska Board of Fisheries (BOF or the board), the department, 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 regulations for limiting entry into the geoduck and sea urchin dive fisheries:

1. Limit the maximum numbers of permits to be issued for each fishery.
2. Establish July 1, 1996, as the date for determining an applicant's qualifications for a Southeast Alaska geoduck or sea urchin dive entry permit.
3. Establish 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.
4. Create 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 moratorium time period. Following a series of public comment periods and meetings, and options developed by staff for limiting entry, all current dive fisheries became limited entry fisheries. Regulations for red sea urchins were finalized in November 2000, and for sea cucumbers and geoducks in May 2001. The maximum number of limited entry permits originally authorized for each fishery was 104 for geoducks, 436 for sea cucumbers, and 95 for red sea urchins. In 2023, there were a total of 355 permits for the Southeast Alaska dive fisheries: 75 for geoducks, 227 for sea cucumbers, and 53 for red sea urchins. Abalone is currently an open access fishery.



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

Southeast Alaska Regional Dive Fisheries Association (SARDFA) is a nonprofit economic development corporation, whose voting members are all permit holders in at least one of the Southeast dive fisheries. SARDFA's mission is to develop, expand, and enhance new and existing dive fisheries in Southeast Alaska in a sustainable and economically feasible manner. SARDFA is managed by a board of directors which is elected by the membership. The board is composed of 9 directors, including: (1) 1 member from each of 5 Southeast communities: Ketchikan, Prince of Wales Island, Sitka, Petersburg, and Wrangell, (2) 1 member from out of state, (3) 1 at-large director, (4) 1 municipal director, and (5) 1 processor-director. SARDFA contributes funds for department management and stock assessment programs and has coordinated with the department to manage fishery areas during each season.

State general funds have not been sufficient to fund the costs of management and research activities required for the dive fishery program. In the early development of these fisheries, this funding gap was 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. Southeast industry divers saw a need to establish an organization and provide 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 SARDFA and empowered it to exact taxes on dive fishery landings to help pay for fishery development and continuity.

SARDFA has created committees to focus on the individual needs of each dive fishery. The committees are a valuable source of input to the department regarding fishery management concerns and ideas. These committees are advisory to the SARDFA board, which reviews and votes on committee recommendations and negotiates approved recommendations together with the department. The department is required by the State of Alaska to protect the integrity of the state's fisheries, and therefore, the department does not approve of any recommendations inconsistent with the state's constitutional and statutory fishery sustainability clauses.

Southeast dive fisheries permit holders pay self-imposed taxes (i.e., "assessments") in addition to the standard 3% shared fisheries business tax that is levied on all other commercial fisheries in the state. The assessment percentages vary by fishery depending on fishery development and management costs. The assessment on sea cucumbers and urchins started at 3% and 5%, respectively, but changed to 1% each by a vote of the membership in July 2019 for urchins, and August 2020 for sea cucumbers. The geoduck assessment has remained at 7%. The assessments collected from the dive fisheries in the first year totaled \$227,986. For the state fiscal year 2023, total tax collected was \$282,971.

## **SEA CUCUMBER**

### **BACKGROUND**

The commercial species of sea cucumber harvested in Southeast Alaska is the California sea cucumber *A. californicus*. It is a common species distributed from Mexico to Southeast Alaska and has been observed at least as far west and north as the Alaska Peninsula, Aleutian Islands, Bering Sea, and Kodiak Island where there is a small sea cucumber fishery. It occupies a broad

range of subtidal habitats from nearshore shallows to over 100 fathoms, although greatest abundance probably occurs in less than 60 feet of depth. The sea cucumber's primary food is detritus, which it ingests along with significant amounts of fine substrate. Its ecological function includes recycling detrital material into nutrients for the primary producers in the marine food chain (Lambert 1997; O'Clair and O'Clair 1998). California sea cucumbers 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 generally greatest in the southern and western portions in protected bays and inlets. The sea cucumber population is kept at very low levels by sea otters in 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.

## **FISHERY DEVELOPMENT AND HISTORY**

The first experimental fishing permits for sea cucumbers were requested in 1981. One or 2 permits were issued each year between 1981 and 1986, with only 1 vessel reporting landings. The first fisheries were based in Ketchikan and, over the years, evolution of management strategies resulted in a partition of most of the statistical subdistricts into 1 of 3 seasonal rotations. The initial fishery had no established season; now, harvests are reported from October to September, the current management season (Table 1).

Most of the vessels pioneering this fishery were small skiffs of limited range and capability operating in the vicinity of either Ketchikan or Sitka, mainly as a day fishery. Currently, larger vessels operate with 2 divers and a crewperson, with living quarters and the capability of transporting product and divers during typical fall and winter weather conditions. Harvest is accomplished from hand picking through use of scuba or surface-supplied air system (called "hookah"), usually at depths of 30 to 60 feet. The number of hours each diver can safely work each day depends on the maximum working depths, which may be as little as 3 or 4 hours. Harvest consists of collecting sea cucumbers in large mesh bags and transporting the filled bags to the tendering vessel.

Processing is conducted in a 2-step process. The freshly caught animal is eviscerated on the fishing grounds, 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 either processed immediately or held for up to 2 days in a refrigerator. Sea cucumbers were 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 (i.e., the meat) and the skins. Processing involves cooking or boiling the skins to a specific texture and drying the product. The dried skins are a preferred item in upscale Asian cuisine and are also used for medicinal purposes. Sea cucumbers harvested in Southeast Alaska have been 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 1995/96 season because of high prices the previous season 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. Typically, the guideline harvest level (GHL) has been established at between 1.0 and 1.5 million pounds (drained weight; Table 1).

Between 2006 and 2011, with SARDFFA input and funding, a period of growth in opportunity and harvest occurred in the sea cucumber fishery. The department surveyed 13 new areas and added 8 of those areas to the sea cucumber commercial fishery. Additionally, the fishing areas of 2 previously commercial areas were expanded. The increase in total GHL with the newly opened and expanded areas was approximately 430,100 lb.

Yakutat Bay was surveyed during the 2005 season with an estimated biomass of 225,006 lb and a corresponding GHL of 31,200 lb. This fishery did not fall within the limited entry jurisdiction in Southeast Alaska and was an open access fishery. Six divers participated in the fishery making 34 landings and harvesting 31,353 lb. Yakutat Bay was surveyed again in 2010 but the biomass was too low to support a commercial fishery.

## **MANAGEMENT STRATEGY AND REGULATION DEVELOPMENT**

The Southeast Alaska Sea Cucumber Commercial Fisheries Management Plan (5 AAC 38.140) was developed because the sea cucumber fishery was expanding rapidly in the late 1980s, and ADF&G could not manage the fishery with the interim-use permit system. ADF&G closed the fishery in May 1990 and reopened it in October 1990 following development of the plan. This plan sought to protect subsistence opportunities and provide for sustained commercial fishing harvests. To protect subsistence opportunities, the sea cucumber management plan established 16 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 (l)(3)) fisheries in those areas. Before the 2019/20 season, the annual commercial fishery GHLs were based on an annual harvest rate of 6.4% of the lower bound of the confidence interval of the estimated sea cucumber biomass, taken on a 3-year rotational basis (i.e., 19.2% of standing stock once every 3 years; Figure 1). Rotational fisheries have the advantage of lowering overall ADF&G assessment survey and management costs. In response to proposals from the commercial fishing fleet requesting relief stemming from the impacts of sea otter predation on the sea cucumber fishery, in 2018, the BOF adopted a new, less conservative harvest rate. The new harvest rate is calculated as the product of (1) a 0.4 scaling factor relating maximum sustainable fishing mortality to unexploited population size; (2) a 0.6 correction factor to allow for errors in assumptions upon which the surplus production model is based (previously 0.5); and (3) a 0.32 instantaneous mortality rate. This change increased the annual harvest rate to 7.68%. The GHL is calculated by applying this harvest rate to the lower bound of the confidence interval of the estimated sea cucumber biomass, taken on a 3-year rotational basis (i.e., 23.04% of standing stock once every 3 years).

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 7 daylight hours on Mondays in November, plus an additional 4 daylight hours on Tuesdays from December through March. The Sea Cucumber Management Plan was amended by the BOF for the 1997 season and provided for an October 1 opening date with weekly fishing periods of 7 daylight hours on Mondays in October, plus an additional 4 daylight hours on Tuesdays from November through March. There are also provisions for limiting the number of divers per vessel to 2, providing fishing

period trip limits of 2,000 lb per person, and limiting gear to scuba, surface-supplied systems, or snorkels. During the January 2000 BOF meeting, the open weekly fishing period was amended, providing for a Monday 8:00 AM to 3:00 PM and Tuesday 8:00 AM to 12:00 PM opening in October (i.e., opening an additional half-day in October). The BOF also allowed the use of enriched air nitrox ( $\leq 40\%$  oxygen), which is a breathing gas used for diving that allows longer bottom time at depth without increasing the risk of decompression illness due to the lower partial pressure of nitrogen.

## **2022/23 SEA CUCUMBER COMMERCIAL HARVEST SEASON**

The 2022/23 season opened by regulation on Monday, October 3, 2022, with a GHL of 1,962,300 lb of sea cucumbers. A total of 160 permit holders reported landings of 1,820,895 lb with a fish ticket exvessel value of \$5,723,539 (Table 1).

## **2023/24 OUTLOOK**

The GHL for the 2023/24 season in Southeast Alaska is 1,673,000 lb. The fishery opened by regulation October 2, 2023.

# **GEODUCK CLAM**

## **BACKGROUND**

Geoduck clam beds have a patchy, habitat-specific distribution in the central and southern portions of Southeast Alaska, primarily in protected waters near the outside coast. Highest densities are found in fine-to-coarse sand substrates with minimal surge energy. Highest densities of geoducks within Southeast, Alaska, have been observed in the large island groups just west of Craig, including shorelines adjacent to Suemez Island, Baker Island, Lulu Island, and Noyes Island. Studies conducted in the state of Washington, British Columbia, and Southeast Alaska indicate this clam can live 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 annually. Research from British Columbia and Washington indicates geoducks have sporadic recruitment, low growth rates, and high maximum age, making this species susceptible to overharvest. The geoduck population is kept at very low levels by sea otters in 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.

A troubling problem for consumption of the clams is the tendency for geoducks to bioaccumulate undesirable microorganisms or compounds. In particular, high levels of the toxin that causes paralytic shellfish poisoning (PSP) have been found in geoducks in Southeast Alaska, most strongly associated with the viscera. The mantle and necks are the usual body parts consumed, and PSP toxin concentrations are lower in these parts. Although the sale of processed clams with viscera removed is permitted, exvessel value for processed clams is substantially less than that for the whole, live product.

In order to protect consumers, the Alaska Department of Environmental Conservation (ADEC) requires that geoducks be sampled from each individual commercial fishery area and tested for PSP toxin level. Before a commercial fishery may be opened, PSP toxin levels from sampled geoducks must test below 80 micrograms ( $\mu\text{g}$ ) per 100 grams of tissue. In addition, ADEC samples

water quality in commercial fishery areas to test for human pathogenic microorganisms. Because of the time required for transport and testing of samples, and the relatively short shelf life of the fresh harvested product, a close working relationship is required between department fishery managers, ADEC, and SARDFFA for a successful fishery opening. The current PSP protocol was adopted prior to the 2003/04 season. Using PSP data collected since the inception of this program, ADEC modified the PSP testing protocol prior to the 2006/07 season. These modifications allow an additional day of harvest before test results expire and require fewer test samples prior to allowing the harvest and marketing of live product. These changes have reduced cost to industry and increased marketing opportunities.

## **FISHERY DEVELOPMENT AND HISTORY**

The development and expansion of the geoduck fishery in Southeast Alaska has been a direct result of the working relationship between the industry (SARDFFA), ADF&G, and ADEC. Additional fishery areas have been identified by the industry and surveyed by ADF&G. The approval by ADEC of prefishery PSP sampling has allowed live marketing of all geoducks, which has substantially increased fishery value. Although fishery value is high now, it began with small fisheries in a few locations.

Starting in 1978 with the Noyes Island survey, state grants were used to find and qualitatively assess commercial beds in the Ketchikan, Craig, Petersburg, Wrangell, and Sitka areas. Several potential commercial beds were located near Ketchikan, Craig, and Sitka. Procedures for testing and certifying the product for human consumption were established by ADEC. Population assessment surveys occurred on 3 beds around Noyes Island near Craig, for which ADF&G estimated a harvestable biomass and ADEC completed sanitation surveys. Two processors conducted the required modifications to their facilities and procedures to handle batch processing, lot testing, and product quarantine, and were consequently certified to process geoducks.

In late 1985, the first permit was issued for the commercial harvest of geoducks. During the 1985/86 season, 143,868 lb of the 300,000 lb 5-year quota was harvested by 8 divers in the Noyes Island area. During the 1986/87 season, only 28,191 lb were harvested by only 3 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. Biorka Island, near Sitka, was included in the geoduck fishery during the 1989/90 season, and Kah Shakes was included in the 1990/91 season.

In the 1991/92 season, participation of divers from the state of Washington caused increased effort and harvest. Prior to this, nonresident participation was minimal. Participation fluctuated in the late 1990s due to decreasing exvessel value with sales of processed product. However, changes in PSP testing protocol by ADEC prior to the 2003/04 season, which allowed over 90% percent of the harvested product to be sold live, generated increased effort in the fishery. During the last 12 seasons, all the harvest has been sold as live product. The addition of geoduck fisheries and GHF between the 2004/05 and 2009/10 seasons was primarily due to 3 reasons:

1. Federal funding was received for surveys (the *Nearshore Marine Grant*).
2. Industry reconnaissance was conducted to identify new commercially harvestable areas.
3. The commercial fisheries logbook program provided the department with additional information about location of geoduck beds.

As of the 2022/23 season, a total of 38 distinct commercial fisheries (Figures 2 and 3) have been identified and surveyed in Southeast Alaska.

## **MANAGEMENT STRATEGY AND REGULATION DEVELOPMENT**

An objective of the department's geoduck fishery management is to be conservative to protect stocks by restricting the rate of exploitation to a very low level. The species is long-lived, and recruitment is low and sporadic, making this species particularly vulnerable to overharvest. Fisheries are closed during the summer to avoid the summer spawning and recruitment period and to minimize PSP toxin levels.

Fisheries are restricted to areas having a biomass estimate. Only 4 locations 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 Nehenta Bay areas), Kah Shakes (Kirk Point/Bullhead Cove), and northern Noyes Island (Ulitka Bay, Little Steamboat Bay, and Steamboat Bay areas) in the Ketchikan Management Area. The GHL for each area is calculated as 2% of the lower bound confidence interval of the harvestable adult population, multiplied by the number of years in the fishery rotation (e.g., 2 if fished every other year). Following reassessment dive surveys during the summer of 1997, it became apparent that the abundance of geoducks in some areas was much lower than expected, and the distribution of geoducks was less than previous surveys. These preliminary results suggested that previous GHLs established for the geoduck fishery were not sustainable. As a result, the department delayed the opening, originally scheduled for October 1, 1997, until further analysis and review of the survey results were completed.

During the fall of 1997, the department held public meetings to discuss possible management options for the fishery including a season opening date. Representatives of CFEC, Fish and Wildlife Protection (FWP), and 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 closed or "fallow" was increased to 4 years in Symonds Bay and west Gravina Island, with Steamboat Bay and Kah Shakes remaining on a 2-year rotation. This expanded rotational cycle in Symonds Bay and west Gravina Island produced a GHL that was large enough to reliably target during the fishery.

As a result of the meeting held prior to the 1997/98 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 the department and SARDF, portions of funds generated through the voluntary self-tax helped fund surveys to estimate the geoduck biomass in Port Alice (summer 1998), Turn Point, Cone Bay, and Nakat Inlet (Cape Fox and Lord/Sitklan Islands, summer 1999). The opening of Port Alice was delayed until 1999/2000 season because of the need for water quality testing.

A cooperative agreement was also formed between the department and the Sitka Harvest Divers Association (SHDA). Using funds provided by SHDA, the department 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 includes 3 present day fisheries (Biorka/Legma Islands, Taigud/Kolosh Islands, Elovoi/Golf/Gornoi Islands; Figure 2).

As previously stated, reconnaissance surveys were integral to the expansion and development of the geoduck fisheries in Southeast Alaska. The purpose of the reconnaissance surveys was for the

industry to identify the most likely sites capable of supporting commercial geoduck fisheries. These data were given to the department to aid in the development of biomass assessment surveys. Many of these industry reconnaissance surveys were funded using contracts with Federal Nearshore Funds.<sup>1</sup>

Between 2001 and 2003, reconnaissance surveys were done by SHDA and SARDFa in a substantial portion of Southeast Alaska which resulted in the department conducting stock assessment surveys in Sea Otter Sound (Port Alice/Cone Bay, Turn Point), Nakat Inlet (Cape Fox, Lord/Sitklan Island), and the Goddard area. Additional funds from Federal Nearshore grants were used to conduct surveys from 2005 through 2008. Five of these reconnaissance surveys were done in existing areas, better defining beds and increasing survey precision and subsequently GHLS. The 2005 reconnaissance work was conducted in Cone Island North, Cone Island South/Paloma Pass, Port Real Marina, Portillo Channel, and Bucareli Bay fisheries.

At the 2000 BOF meeting, the geoduck management plan was adopted (5 AAC 38.142); prior to that there were only general regulations about clams (5 AAC 38.110), and no regulations that specifically addressed the Southeast Alaska geoduck clam fishery. The department, in cooperation with the SARDFa Geoduck Committee, developed these regulations for the Southeast Alaska commercial fishery that were adopted by the board. There are 3 core elements to those regulations:

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.

Prior to the 2003/04 season, the department opened commercial geoduck fisheries in Southeast Alaska without knowledge of the PSP level in the area. Instead, geoducks were harvested and then tested for PSP in “lots” to determine if shipped geoducks should be recalled. This post-harvest testing procedure only allowed for sale of geoducks that were already processed (dressed and packaged), which prevented access to the lucrative market of live geoducks. Due to requests by SARDFa for changes to ADEC’s program, ADEC held a geoduck conference in Anchorage on August 5 and 6, 2002. A result of this conference was the implementation of an enhanced live shipment program for geoducks. This required changes in the department’s fishery management in order to target live geoduck sales. This PSP testing program was enacted prior to the 2003/04 fishery. During the 2003/04 through 2006/07 seasons, a significant amount of PSP data were collected by ADEC, and changes to the testing protocol were adopted. Because of this change in protocol, more than 90% of the GHL was shipped live, which significantly increased the value of the fishery.

Because fishery area openings are based on PSP testing within a small time window, short notice of openings occurs. Permit holders are required to closely monitor PSP test results which are posted on ADEC’s and SARDFa’s websites. In past years, if a fishery area did not pass PSP standards, permit holders chose to wait until the area had passed because the value of live product is much

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<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 subagencies.

greater than processed product. This approach causes the overall geoduck fishery to extend over a longer period.

During the January 2003 BOF meeting, the geoduck management plan was amended with the establishment of a control site (Port Mayoral) within Subdistrict 103-50. The board also amended regulations that the department may consider PSP levels in geoduck management (5 AAC 38.142 (a)). During the February 2006 board meeting, the geoduck management plan was amended to allow the department to require a harvest logbook from commercial divers. A second geoduck clam control site was also established within Subdistrict 101-27 (Blank Inlet).

## **2022/2023 GEODUCK COMMERCIAL HARVEST SEASON**

The 2022/23 season GHL was 386,000 pounds of geoducks, with 373,600 pounds in 9 fishery areas managed together in Ketchikan, and an additional 12,400 pounds in 2 fishery areas managed in Sitka (Table 2; Figure 3). Fifty-five divers harvested 381,310 pounds of geoducks. Two areas in Ketchikan that are normally open on this rotation, Lower Cordova Bay (102-10, 103-11, 21) and East San Fernando (103-60-001), were closed due to their survey biomass falling below 30% of the original biomass estimate.

## **2023/2024 OUTLOOK**

The GHL for the 2023/24 season in Southeast Alaska is 467,100 lb. The fishery opened by regulation October 1, 2023.

# **RED SEA URCHIN**

## **BACKGROUND**

Two urchin species that have commercial potential, red sea urchins *M. franciscanus* and green sea urchins *Strongylocentrotus 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, but generally have been below marketable size. The red sea urchin population is kept at very low levels by sea otters in 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 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 composed of red urchins. Participation and harvest increased through the mid-1980s (Table 3), expanding to include Districts 1, 2, 3, and 4. Harvest grew to 890,092 lb in 1986/87, 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 budgetary support for the fishery.



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 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 lb before it was closed in April. Subsequent fisheries opened in 1992 and 1993, and then closed indefinitely due to extreme predation by sea otters. All other areas of Southeast Alaska remained closed pending development of a management plan, stock assessments, harvest quotas, and a means of monitoring and managing the fishery.

The department initiated a test fishery in District 1 near Ketchikan in the spring of 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 lb of red sea urchins. The test fishery spanned 14 months from March 1995 through April 1996, and harvested 2,965,607 lb of red sea urchins (Table 3). 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, with an estimated exvessel value of approximately \$1,402,837 for dive harvesters.

Fully developed red sea urchin fisheries have occurred since the 1996/97 fishing season. The overall quota has ranged between 3.0 and 6.8 million pounds; however, selected areas have seen reductions in biomass, probably due to sea otter predation. Most areas in Southeast Alaska supporting red sea urchin populations are threatened by the rapidly growing sea otter population. The number of participating divers and landings have been low in recent years, relative to the early years of the fishery.

## **MANAGEMENT STRATEGY AND REGULATION DEVELOPMENT**

Prior to 1996, permits to harvest sea urchins were given under authority of a commissioner's permit, 5 AAC 38.062. In 1984, the first year with significant landings of red urchins, there was a size limit of 3–5 inches 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 market sized urchin. An interim management plan was in place in 1987 for the Ketchikan area with a 3-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, 3-year area rotations, weekly fishing periods of noon, Saturday through noon, Thursday, and no size limits.

In 1996, the department and the sea urchin industry developed interim regulations and a management plan for the commercial urchin fishery in Southeast Alaska. This plan was implemented during the 1996/97 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 board formally adopted the red sea urchin management plan during their regular meeting in January 1997. The plan included 4 core elements:

1. Annual GHIs are 6% of the biomass estimate. Fisheries will only be opened where biomass surveys have been conducted in the previous 3 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 4 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 2003 board meeting. New regulations with a 3-year sunset clause allowed a catcher–seller to catch and process product onboard the harvest vessel (5 AAC 38.145 (n)). This regulation was permanently adopted during the January 2006 board meeting.

During the 2006 meeting, the board extended the interval between assessment surveys from 3 to 6 years for management areas where no more than the equivalent of the combined 3-year annual GHL was harvested within those 6 years. This reduced the number of surveys required to maintain red sea urchin areas open to commercial harvest when those area’s GHLs were not entirely taken; the GHL not taken in any one year can be forwarded into subsequent year’s GHL. This regulation allowed the more efficient and cost-effective surveying of areas whose GHL is not taken each year, without increasing the overall harvest between surveys.

## **2022/23 RED SEA URCHIN COMMERCIAL HARVEST**

The 2022/23 season opened by regulation on October 1, 2022, with a GHL of 2,600,500 lb in Districts 1 and 2. The total harvest for the 2022/23 season was confidential due to less than 3 permit holders making a landing.

## **2023/24 OUTLOOK**

The GHL for the 2023/24 season in Southeast Alaska is 2,318,500 lb. The fishery opened by regulation October 1, 2023.

# **ABALONE**

## **BACKGROUND**

The former Alaska abalone fishery targeted the pinto abalone, which inhabits the rocky substrate of the 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 and relies on information from other North Pacific locations to understand the basic biology of this species. Tagging studies indicate it is a slow growing, long-lived species. Spawning occurs during the summer through early autumn. 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, and sea otters. Throughout the range of this and various other abalone species, exploitation has usually resulted in stock depletion and restrictive management (Sloan and Breen 1988; Woodby et al. 2000).

Abalone may be picked by hand from the shoreline during extreme low tides. Current subsistence and personal use regulations prohibit the use of compressed gas systems (e.g., scuba or hookah) to harvest abalone.

## **FISHERY DEVELOPMENT AND HISTORY**

The abalone fishery was marked by a boom in harvests and effort in the late 1970s and early 1980s, followed by declining harvests and an even higher amount of effort (Table 4). The decline in harvest, and subsequent long-term depressed population level, may be attributed to a combination of excessive fishing, predation by a growing sea otter population, and apparent low productivity of abalone stocks when heavily harvested. The increase in fishing effort was partially due to an increase in value from \$1 per lb in the early 1970s to more than \$10 per lb during the last 4 seasons (1992–1996).

The marked increase in harvests and effort occurred in the 1978/79 season, when effort increased more than 3-fold and harvests increased to 180,000 lb from a long-term average of about 6,000 lb. Harvests peaked at 378,685 lb the next season (Table 4). This peak exceeded the quota of 250,000 lb adopted by the BOF in the spring of 1980, and the fishery was closed by emergency order for the first time.

High harvests continued through the 1981/82 season when almost 371,000 lb were landed, despite a reduction in the guideline harvest range (GHR) to a maximum of 125,000 lb and a reduction in the fishing season. By the 1984/85 season, there was concern for the population when the lower end of the GHR was not reached despite 151 days of fishing.

The 1990/91 through 1995/96 seasons opened on October 1 and except for 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 lb during the 1990/91 season was the beginning of a second downward trend that continued through the remainder of the fishery.

As the 1994/95 season progressed, harvest levels were much lower than anticipated and dramatically lower than historical levels. Fish ticket data indicated that 15,055 lb had been harvested during the 8-day opening. Despite requests from harvesters to reopen the fishery in southern Southeast Alaska, it did not reopen. The District 13 fishery opened for a total of 8 days for 7,824 lb of abalone (GHL of 8,000 lb). For all areas, anecdotal information from harvesters indicated that productive harvest areas were difficult to find. Harvest per unit effort for the fishery (lb per diver per day) declined to 64% of the 1993 level.

During the 1995/96 season, the southern Southeast abalone fishery opened for 6 days with an upper GHR of 10,000 lb. A total of 8,524 lb was taken by 44 divers with 48 landings in 6 days. The average price per lb 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 historical levels, the fishery did not reopen despite not reaching the upper end of the GHR. The District 13 fishery lasted 6 days with an upper GHR of 6,000 lb. Harvests of 3,833 lb and 1,995 lb occurred during the 2 openings (5,828 lb 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 decrease in harvest rates observed during the 1990s, the apparent lack of abalone in many of the traditional harvest areas, and numerous comments from subsistence users and commercial divers regarding the diminishing numbers of abalone, the fishery closed by emergency

order October 16, 1995, and has remained closed to protect the remaining, reduced population (Woodby et al. 2000). The closure is consistent with 5 AAC 38.035 (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 Southeast Alaska including both the Sitka area and southern Southeast fisheries. Anecdotal information from ADF&G staff and harvest divers suggest continued low abalone abundance.

## **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 GHRs were not imposed until 1980, after harvests were rising dramatically.

The major fisheries were 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 implemented to protect stocks used for subsistence and personal use from commercial exploitation.

Size limits have undergone several increases prior to reaching the present 4-inch minimum. The size limit was raised from 3 inches to 4 inches for Districts 1–6 in 1968, and from 3 inches to 3½ inches for Districts 9–14 in 1976. A 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 about declining abalone stocks. The intent of the larger size limit was to reduce the harvest rate on mature abalone thereby encouraging reproduction and rebuilding populations.

GHRs and season length both decreased in several steps. In 1980, the harvest limit was set at 250,000 lb, and the year-round season reduced to September 1 through May 31. In the spring of 1981, the GHR was reduced from 100,000 lb to 125,000 lb, and the season further shortened to September 15 through May 15. In 1982, the board split the existing GHR, allocating 86,000–107,500 lb to the Ketchikan area and 14,000–17,500 lb to the Sitka area. In 1983, the board split the season into autumn and spring segments, each getting 50% of the allowable harvest. The board restricted the 1985/86 harvest to a range of 25,000–50,000 lb in the Ketchikan area and a maximum of 8,000 lb in the Sitka area. The District 13 season was reduced to November 1 through May 15, and all other areas changed to October 1 to May 15. In 1986, the season changed to October 1 through May 15 for all areas. The upper GHR was further reduced to 10,000 lb for the 1995/96 season for the Ketchikan area and to 6,000 lb for the Sitka area. These lower GHRs were intended to provide a limited commercial fishery while increasing the potential for recruitment.

## **FISHERY OUTLOOK**

The status of the pinto abalone population in Southeast Alaska is unknown, because no regular monitoring program exists. Based on anecdotal evidence collected from ADF&G dive surveys of red sea urchins, and very small-scale surveys in 2016 and 2018, the population is probably well below a level that existed prior to the commercial fishery, particularly in Districts 3 and 4, where fishery effort was highest, and sea otters have been more prevalent. ADF&G is unsure when, or if, the population will rebuild to a level capable of supporting a sustainable commercial fishery. A

fishery will not be opened until a management plan is developed that addresses the issues and information identified in the 5 AAC 39.210 management plan for high impact emerging fisheries. As part of that process, ADF&G would require a plan for determining productivity and abundance of abalone, and a harvest strategy that would ensure a sustained fishery.

These elements would be difficult to achieve; ADF&G would be very concerned about local and serial depletion under either an open access or limited entry fishery. ADF&G believes that it is highly unlikely stocks will recover sufficiently to allow commercial fishing to resume.

Subsistence and personal use fisheries for abalone remain open in Southeast Alaska. A reduction in bag limit from 50 abalone (20 in the Sitka area) to 5 was approved for both fisheries at the 2013 BOF meeting due to concerns about the apparent low and declining abundance anecdotally observed during ADF&G dive surveys of red sea urchins and other species.

In 2013, the National Marine Fisheries Service (NMFS) received 2 petitions requesting that pinto abalone be listed as endangered or threatened under the Endangered Species Act. After reviewing the status of pinto abalone along the west coast of North America, NMFS made a determination in 2014 that listing was not warranted, because pinto abalone were not currently in danger of extinction throughout all or a significant portion of its range and are not likely to become so within the foreseeable future. Despite not listing the species as endangered or threatened under the Endangered Species Act, the status review conducted by NMFS found that data gaps existed for several areas, including Southeast Alaska. In response, NMFS and ADF&G conducted a survey in 2016 at locations in the vicinities of Ketchikan and Craig to collect data on abalone density, size, and distribution. Follow-up surveys were conducted in these areas in 2018. ADF&G has set up a long-term monitoring project at the site near Ketchikan that was surveyed in 2016 and 2018, and has conducted surveys regularly since that time. The data from these small-scale surveys will be used to evaluate abalone population trends and better understand how populations are affected by sea otter reestablishment in Southeast Alaska.

## **SEA OTTERS**

### **BACKGROUND**

During the first half of the 20th century, sea otters were not present in the Alexander Archipelago due to their near extermination roughly 100 years ago (Kenyon 1969) as a result of the fur trade. It is likely that, because of this absence, prey species of sea otters expanded in abundance due to less predation as 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 then began a period of rapid growth (Pitcher and Imamura 1990). The population was estimated at 13,221 in 2003 and 25,584 in 2011, with a projected carrying capacity of 74,650 otters for Southeast Alaska (Tinker et al. 2019). Based on field work conducted in the summer of 2022, the U.S. Fish and Wildlife Service updated their population growth rate model and population estimate to an abundance of 22,359 individuals with a carrying capacity of 48,083 (Schuette et al. 2023).

## COMMERCIAL FISHERY INTERACTION

The increasing population of sea otters in coastal waters of Southeast Alaska continues to have a substantial and detrimental impact on the economy of the region's dive fisheries by reducing standing stock biomass, which results in lower GHGs and fishery closures (Figures 5–7).

The sea urchin fishery was the first dive fishery in the region to be affected, with the closure of Sitka Sound because of severe population declines. Sea otters moved into the southern Sitka Sound red sea urchin fishing area in 1992 and, over the next year, removed an estimated 16,000,000 urchins or most of the standing stock (Davidson et al. 1993).

Many sea urchin and sea cucumber fishery areas have been greatly impacted by sea otter predation (Figures 5 and 7), and several have been closed due to low abundance to protect the remaining spawning biomass. In an effort to determine if benthic invertebrate populations can recover to commercially viable levels after high levels of sea otter predation, ADF&G has resurveyed some areas that have been recolonized by sea otters and closed to commercial fishing for several years. An example of this is Tebenkof Bay, on the west side of Kuiu Island, which was closed to commercial fishing in 2004 due to a precipitous decline in sea cucumber abundance after a large sea otter population became resident in the area. In 2011, ADF&G conducted another survey in the area and found that no recovery of the sea cucumber populations had occurred and that sea otters were still abundant. Similar results were found in 2013 for Subdistricts 105-41 and 105-42 (Shakan Bay on northwest Prince of Wales Island), in 2014 for Subdistrict 103-70 (near San Fernando Island west of Craig), in Subdistrict 103-90 (on northwest Prince of Wales Island in 2023, and Subdistricts 109-41,42, and 43 (Keku Strait and Port Camden near Kake) in 2024. In all cases, very few sea cucumbers were observed during ADF&G surveys in these areas after more than a decade since the last survey.

Sea otters have also affected many geoduck commercial fishery areas. Many of these areas are on the outer coast, on the west side of Prince of Whales Island, where sea otters are concentrated. About two-thirds of the commercial geoduck fishery areas have been negatively impacted by sea otters, and some areas have been closed after they fell below the threshold necessary to allow a commercial fishery (Figure 6). Since 2006, during geoduck surveys, ADF&G has recorded sea otter observations and signs of their predation. Sea otter impacts are evident by deep craters created by their digging, and empty or broken clam shells. Of the geoduck fishery areas that have been affected by sea otters, the percentage of survey transects with observed signs of sea otter predation range from 4% to 100%. The department surveys 2 control areas (surveyed areas not open to fishing) for the geoduck fishery. One of these is near Craig and is heavily affected by sea otter predation. That area has seen large declines in biomass over the past 2 decades indicating sea otters have a strong negative effect on geoduck biomass even in the absence of fishing pressure.

Although sea otter predation on abalone is believed to be relatively high, it is not considered the major factor in the decline of abalone in the 1980s because sea otter expansion occurred after high harvests by commercial fishing (Woodby et al. 2000). However, the increase and expansion of the sea otter population and resulting predation on abalone is thought to be a primary factor preventing abalone from recovering to commercially viable levels.

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## **TABLES AND FIGURES**

Table 1.—Registration Area A (Southeast Alaska) commercial sea cucumber harvest, effort, and value, 1988/89 through 2023/24 seasons.

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	Average pounds per diver	Average earnings per diver <sup>b</sup> (\$)
1988/89	801,405	801,405	0.21	169,096	57	922	14,060	2,967
1989/90	2,318,305	2,318,305	0.42	969,142	205	2,263	11,309	4,728
1990/91	704,491 <sup>c</sup>	804,184	0.59	472,386	143	890	5,624	3,303
1991/92	839,160 <sup>c</sup>	869,988	0.80	697,970	187	704	4,652	3,732
1992/93	1,100,440	1,249,621	0.79	988,628	240	1,003	5,207	4,119
1993/94	799,235	964,343	1.03	995,783	320	949	3,014	3,112
1994/95	1,351,000	1,322,219	1.79	2,361,541	261	1,379	5,066	9,048
1995/96	1,157,500	1,332,095	1.39	1,846,556	424	1,582	3,142	4,355
1996/97	939,300	909,789	1.29	1,169,612	294	1,234	3,095	3,978
1997/98	892,410	894,739	1.63	1,458,425	226	976	3,959	6,453
1998/99	1,026,345	1,055,572	1.55	1,636,137	219	971	4,820	7,471
1999/00	1,580,000	1,569,626	1.95	3,060,771	200	1,378	7,848	15,304
2000/01	1,122,500	1,158,385	2.23	2,583,199	220	913	5,265	11,742
2001/02	1,425,200	1,438,451	1.75	2,517,289	235	1,201	6,121	10,712
2002/03	1,576,700	1,639,440	1.26	2,042,882	201	1,313	8,156	10,164
2003/04	1,637,700	1,698,650	1.42	2,472,456	195	1,296	8,711	12,679
2004/05	1,381,200	1,374,532	2.12	2,769,116	194	1,139	7,085	14,274
2005/06	1,475,800	1,437,731	2.00	2,875,462	198	1,418	14,523	14,523
2006/07	1,598,700	1,597,457	1.97	3,146,990	175	1,237	17,983	17,983
2007/08 <sup>d</sup>	1,384,300	1,449,301	2.43	3,774,428	181	1,290	7,923	21,086
2008/09	1,122,100	1,102,637	2.30	2,536,065	176	1,072	6,301	13,078
2009/10	1,574,700	1,610,826	2.34	3,769,333	169	1,240	9,532	22,304
2010/11	1,262,800	1,274,541	2.52	3,211,843	180	1,109	7,081	17,841
2011/12	999,000	1,023,834	5.06	5,180,600	189	1,043	5,417	27,411
2012/13	1,476,000	1,512,895	4.05	6,127,225	199	1,369	7,602	30,790
2013/14	1,472,600	1,556,983	3.97	6,181,223	198	1,396	7,864	31,218
2014/15	1,084,800	1,073,554	4.00	4,294,216	171	1,022	6,278	25,083
2015/16	1,439,900	1,525,387	3.50	5,338,855	175	1,278	8,716	30,508
2016/17	1,243,200	1,319,798	3.93	5,279,192	169	1,206	7,809	31,238
2017/18	1,233,900	1,294,637	5.25	6,796,844	175	1,211	7,398	38,839
2018/19	1,757,600	1,768,104	5.37	9,510,249	184	1,606	9,625	51,686
2019/20	1,909,000	1,994,991	5.16	10,294,153	184	1,788	10,842	55,946
2020/21	1,745,300	1,721,185	3.58	6,043,721	159	1,412	10,825	38,010
2021/22	1,872,800	1,868,503	6.00	11,195,392	167	1,537	11,189	67,132
2022/23	1,962,300	1,820,895	3.17	5,723,539	160	1,485	11,381	35,772
2023/24	1,673,000	—	—	—	—	—	—	—

Note: En dashes = values not available.

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

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

<sup>c</sup> Guideline harvest level originally calculated in numbers of sea cucumbers.

<sup>d</sup> Does not include data for the Yakutat sea cucumber fishery.

Table 2.—Registration Area A (Southeast Alaska) commercial geoduck clam harvest, effort, and value, 1988/89 through 2023/24 seasons.

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> (\$)
1988/89	189,232	143,188	0.49	70,162	9	127	240	15,910	7,796
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	0.66	127,429	20	131	33	9,654	6,371
1992/93	196,000	189,379	1.11	210,211	22	109	19	8,608	9,555
1993/94	219,000	209,322	1.50	313,983	40	115	11	5,233	7,850
1994/95	195,000	197,246	1.85	364,905	64	190	14	3,082	5,702
1995/96	209,000	229,681	2.02	463,956	109	401	10	2,107	4,256
1996/97	196,000	203,017	2.57	521,754	97	359	6	2,093	5,379
1997/98	196,000	180,443	3.89	701,923	110	312	3	1,640	6,381
1998/99	112,500	111,311	2.13	237,092	98	206	66	1,136	2,419
1999/00	250,400	202,260	1.60	323,616	61	240	50	3,316	5,305
2000/01	391,100	438,334	1.06	464,634	74	543	148	5,923	6,279
2001/02	285,322	283,405	0.72	204,052	37	324	78	7,660	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 <sup>d</sup>	477,000	535,516	3.93	2,104,578	60	710	24	8,925	35,076
2005/06 <sup>d</sup>	403,800	436,040	2.04	889,522	64	545	51	6,813	13,899
2006/07 <sup>d</sup>	687,100	726,866	3.88	2,820,240	66	812	42	11,013	42,731
2007/08 <sup>d</sup>	590,800	611,164	3.12	1,906,832	59	675	42	10,359	32,319
2008/09 <sup>d</sup>	868,700	906,685	3.66	3,318,467	56	920	39	16,191	59,258
2009/10 <sup>d</sup>	630,900	658,714	6.74	4,439,732	60	694	28	10,979	73,996
2010/11 <sup>d</sup>	824,800	845,582	6.61	5,589,297	69	953	25	12,255	81,004
2011/12 <sup>d</sup>	557,300	556,210	10.31	5,734,525	69	776	25	8,061	83,109
2012/13 <sup>d</sup>	763,200	800,783	6.88	5,509,387	68	974	30	11,776	81,020
2013/14 <sup>d</sup>	601,400	514,037	7.92	4,071,173	69	763	34	7,450	59,003
2014/15 <sup>d</sup>	770,100	818,766	4.56	3,733,573	59	1017	32	13,877	63,281
2015/16 <sup>d</sup>	543,600	565,761	5.28	2,987,218	55	658	28	10,287	54,313
2016/17 <sup>d</sup>	616,900	605,529	9.87	5,976,571	59	813	28	10,263	101,298
2017/18 <sup>d</sup>	573,700	533,999	8.20	4,378,792	62	730	20	8,613	70,626
2018/19 <sup>d</sup>	716,600	536,379	6.11	3,277,276	64	821	36	8,381	51,207
2019/20 <sup>d</sup>	651,100	551,208	5.68	3,130,861	58	767	52	9,504	53,980
2020/21 <sup>d</sup>	542,400	526,542	5.17	2,722,222	54	855	64	9,751	50,412
2021/22 <sup>d</sup>	537,500	507,415	12.01	6,094,054	61	709	53	8,318	99,903
2022/23 <sup>d</sup>	389,700	393,615	8.44	3,322,111	60	709	57	6,560	55,369
2023/24 <sup>d</sup>	467,100	—	—	—	—	—	—	—	—

Note: En dashes = values not available.

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

<sup>b</sup> Average price data is based entirely on ADF&G fish ticket data. Note: 1985–2000 prices were reported for 90% of total pounds landed, however from 2001–2009 and for the 2010–2014 seasons, prices were reported for only 25–35% of total pounds landed, and for the 2009/10 season, prices were reported for 50% of the total pounds harvested.

<sup>c</sup> Five-year, 300,000 lb guideline harvest level in 3 areas.

<sup>d</sup> Mariculture site fisheries are not included.

Table 3.—Registration Area A (Southeast Alaska) commercial red sea urchin harvest, effort, and value, 1982/83 through 2023/24 seasons.

Season	Guideline harvest level (lb)	Total landed (lb)	Average price per pound <sup>a</sup> (\$)	Estimated exvessel value <sup>b</sup> (\$)	Number of divers	Number of landings	Average pounds per diver	Average earnings per diver <sup>a</sup> (\$)
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	1,024,282	0.31	317,527	17	354	60,252	18,678
2006/07	5,599,500	622,501	0.33	205,425	11	209	56,591	18,675
2007/08	5,599,500	710,718	0.36	283,030	10	266	71,072	23,303
2008/09	5,440,100	354,697	0.34	125,403	9	121	39,411	13,934
2009/10	5,059,800	506,959	0.29	147,150	11	201	46,087	13,377
2010/11	4,950,000	276,745	0.34	93,913	3	103	92,248	31,304
2011/12	3,274,500	160,540	0.41	65,821	3	58	53,513	21,940
2012/13	3,275,300	357,679	0.37	133,082	8	125	44,710	16,635
2013/14 <sup>b</sup>	3,275,300							
Confidential								
2014/15	3,310,700	634,430	0.37	234,739	12	233	52,869	19,562
2015/16	3,838,900	677,202	0.49	331,829	12	314	56,434	27,652
2016/17	3,690,000	265,715	0.61	162,086	9	114	29,524	18,010
2017/18	3,435,100	298,770	0.68	203,164	13	161	22,982	15,628
2018/19	3,453,700	268,306	0.74	198,316	12	137	22,356	16,526
2019/20	3,529,800	194,312	0.98	190,426	18	157	10,795	10,579
2020/21	2,997,800	33,003	0.85	27,930	3	38	11,001	9,351
2021/22	2,909,900	13,841	0.71	9,807	4	16	3,460	2,452
2022/23 <sup>b</sup>	2,600,500							
Confidential								
2023/24	2,318,500	—	—	—	—	—	—	—

Note: En dashes = values not available.

<sup>a</sup> Based on Commercial Fisheries Entry Commission (annual) data prior to the 1998/99 season, then based on ADF&G fish ticket data.

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

<sup>c</sup> Department test fishery. Guideline harvest level is the agreed test fishery maximum poundage taken during spring of 1995 through spring of 1996, in exchange for research funds.

Table 4.—Registration Area A (Southeast Alaska) commercial abalone harvest, effort, value, and season length, 1970/71 through 1996/97 seasons.

Season	Guideline harvest range (lb x 1,000)	Southern Southeast harvest (lb)	District 13 harvest (lb)	Total Southeast harvest (lb)	Number of divers	Exvessel value <sup>a</sup> (\$)	Season length (days)
1970/71	—	—	—	—	—	—	365
1971/72 <sup>b</sup>			Confidential data				365
1972/73	—	65	2,610	2,675	6	2,675	365
1973/74	—	—	3,000	3,000	3	4,500	365
1974/75	—	—	13,826	13,826	3	20,739	365
1975/76	—	55	8,497	8,552	8	17,104	365
1976/77 <sup>b</sup>			Confidential data				365
1977/78	—	805	10,861	11,666	10	14,816	365
1978/79	—	130,607	49,320	179,927	35	253,697	365
1979/80	—	316,952	61,733	378,685	43	408,980	287
1980/81	250	233,589	18,382	251,971	40	420,792	273
1981/82	100–125	338,305	32,589	370,894	54	445,073	59
1982/83	100–125	100,458	12,826	113,284	41	240,162	36
1983/84	100–125	99,294	8,735	108,029	31	302,481	126
1984/85	100–125	59,237	8,379	67,616	25	165,659	151
1985/86	25–58	32,817	7,720	40,537	18	117,963	71
1986/87	25–58	47,404	13,820	61,224	24	168,366	146
1987/88	25–58	57,209	10,406	67,615	42	208,930	36
1988/89	25–58	65,928	10,172	76,100	45	307,444	33
1989/90	25–58	57,784	4,020	61,804	67	330,651	40
1990/91	25–58	62,779	5,607	68,386	97	374,071	9
1991/92	25–58	35,987	8,095	44,082	96	267,578	35
1992/93	25–58	26,905	9,083	35,988	100	386,151	19
1993/94	25–58	27,680	7,172	34,852	86	487,928	7
1994/95	25–58	15,055	7,824	22,879	102	330,373	8
1995/96	0–16	8,524	5,828	14,352	100	126,526	7
1996/97			Closed indefinitely				

Note: En dashes = values not available.

<sup>a</sup> Based on Commercial Fisheries Entry Commission (annual) data.

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

# ADF&G Sea Cucumber Fisheries in Southeast Alaska

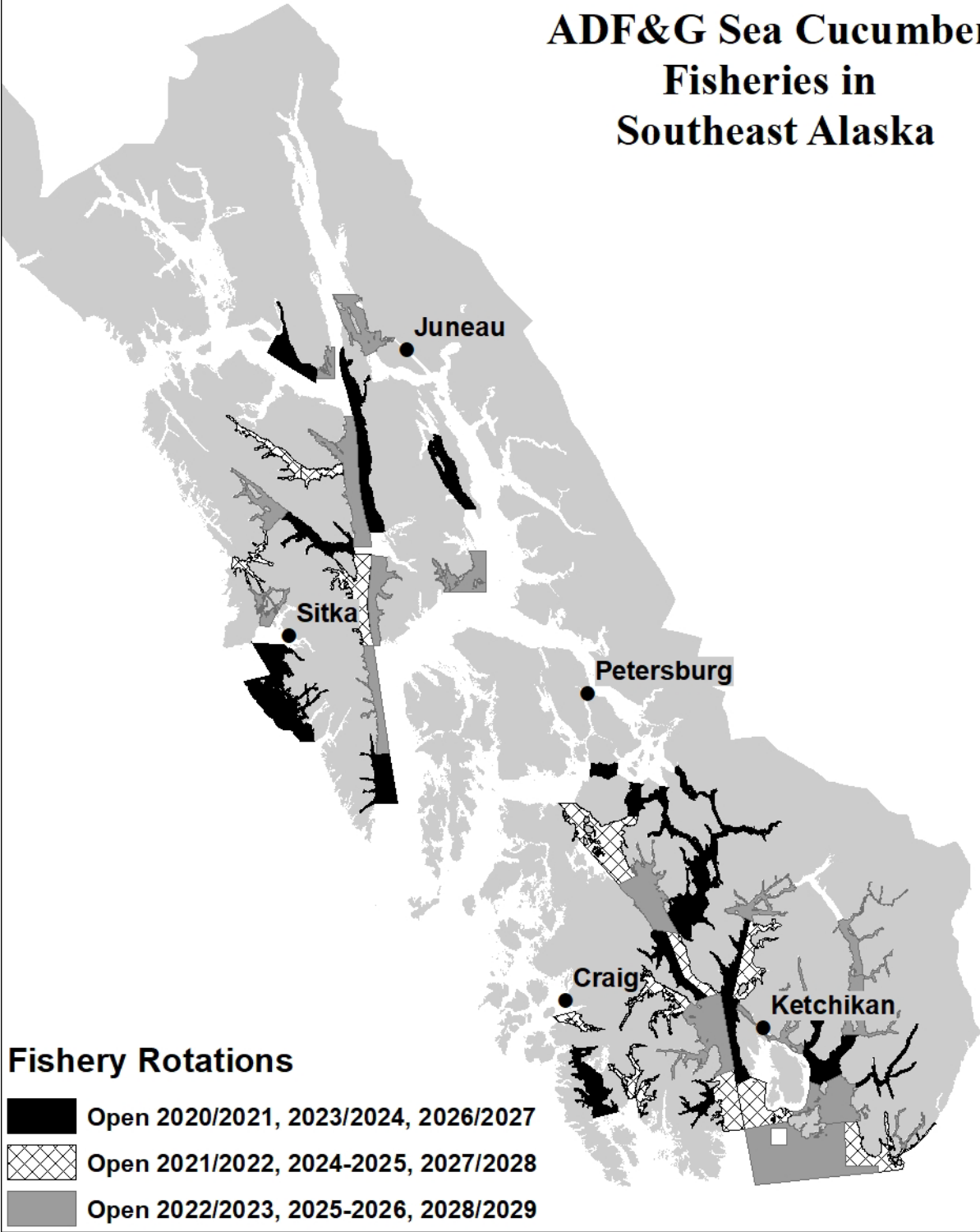


Figure 1.—Sea cucumber commercial harvest areas and rotational seasons.

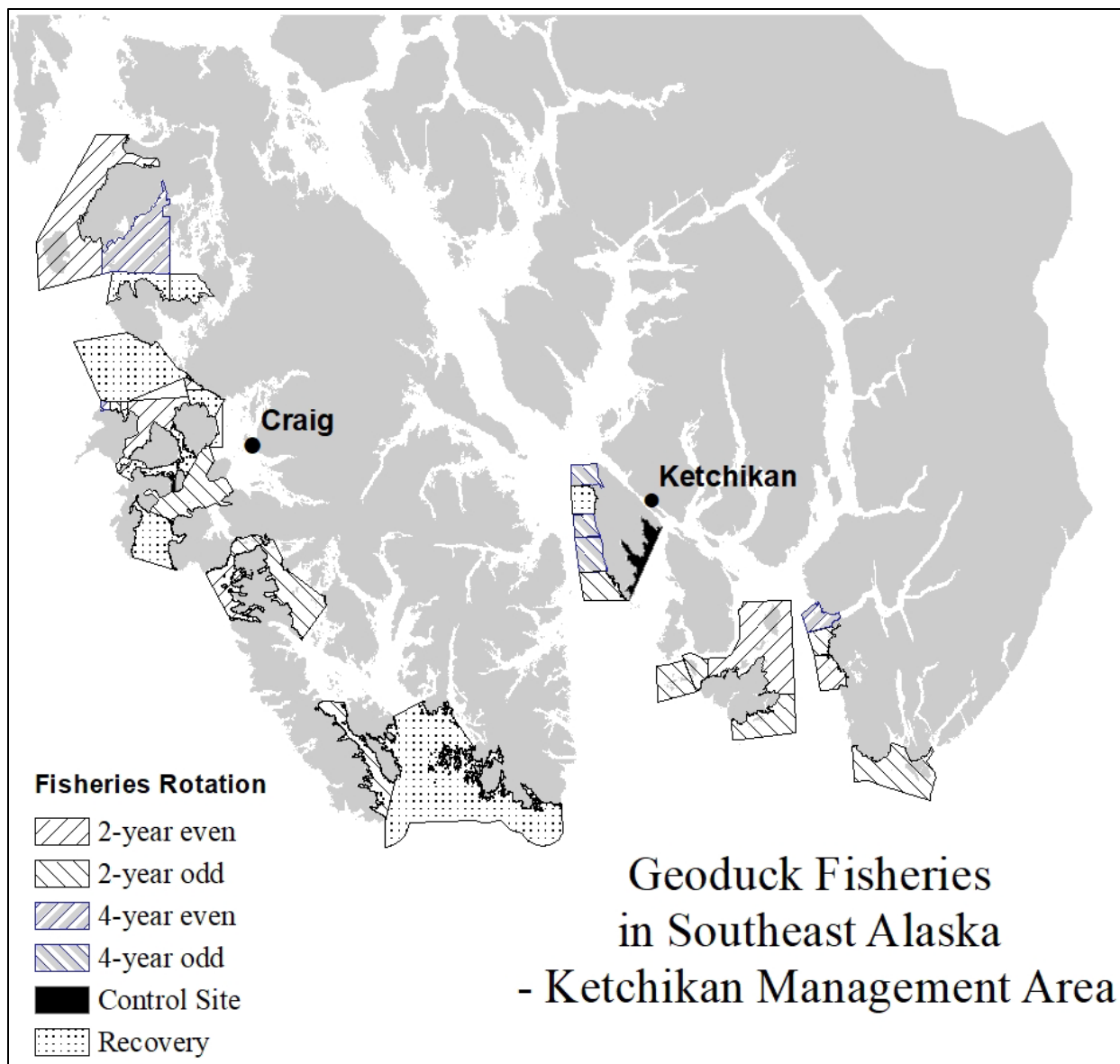


Figure 2.—Geoduck commercial harvest and rotation cycles and control areas in the Ketchikan Management Area.

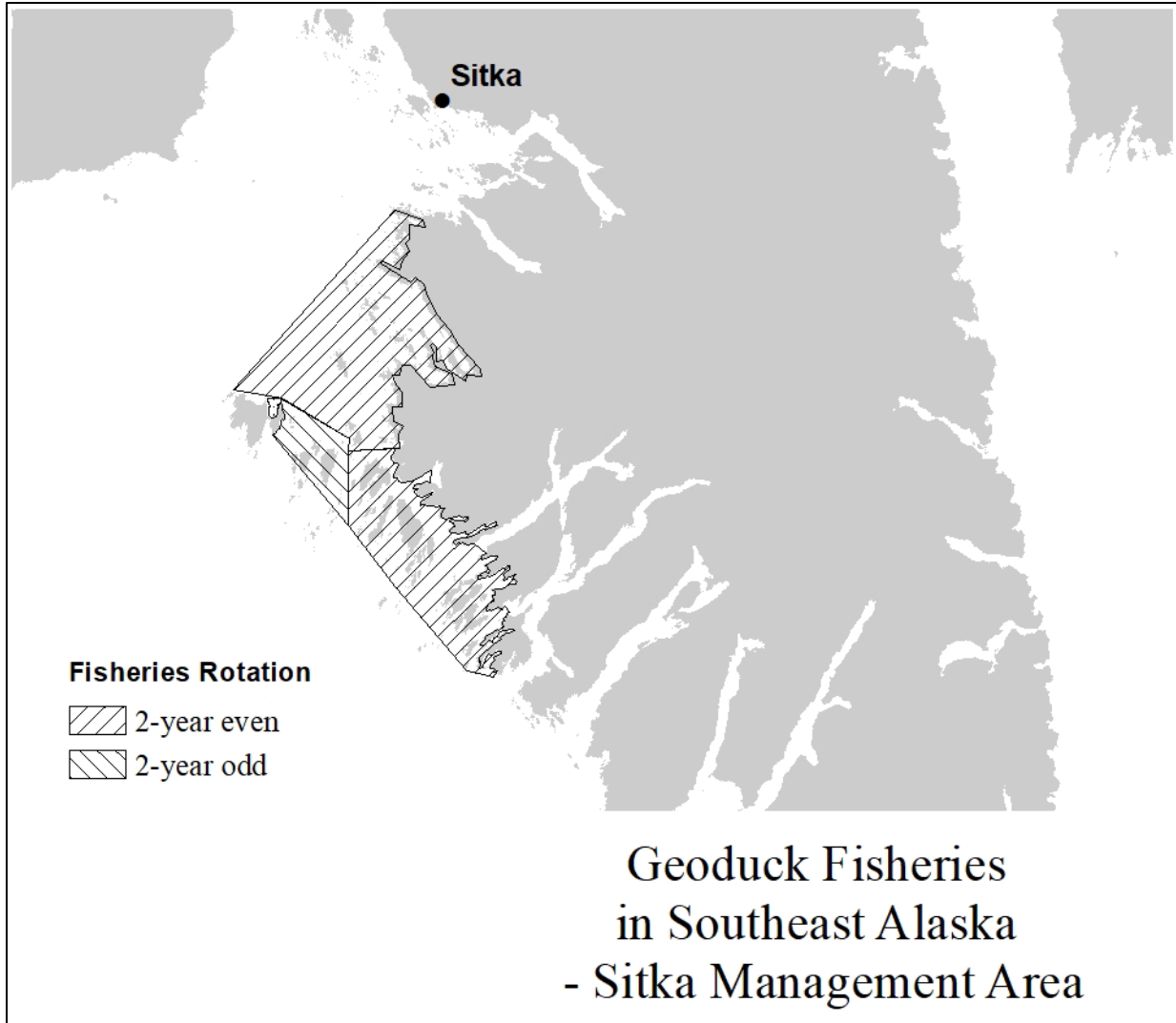


Figure 3.—Geoduck commercial harvest and rotation cycles in the Sitka Management Area.



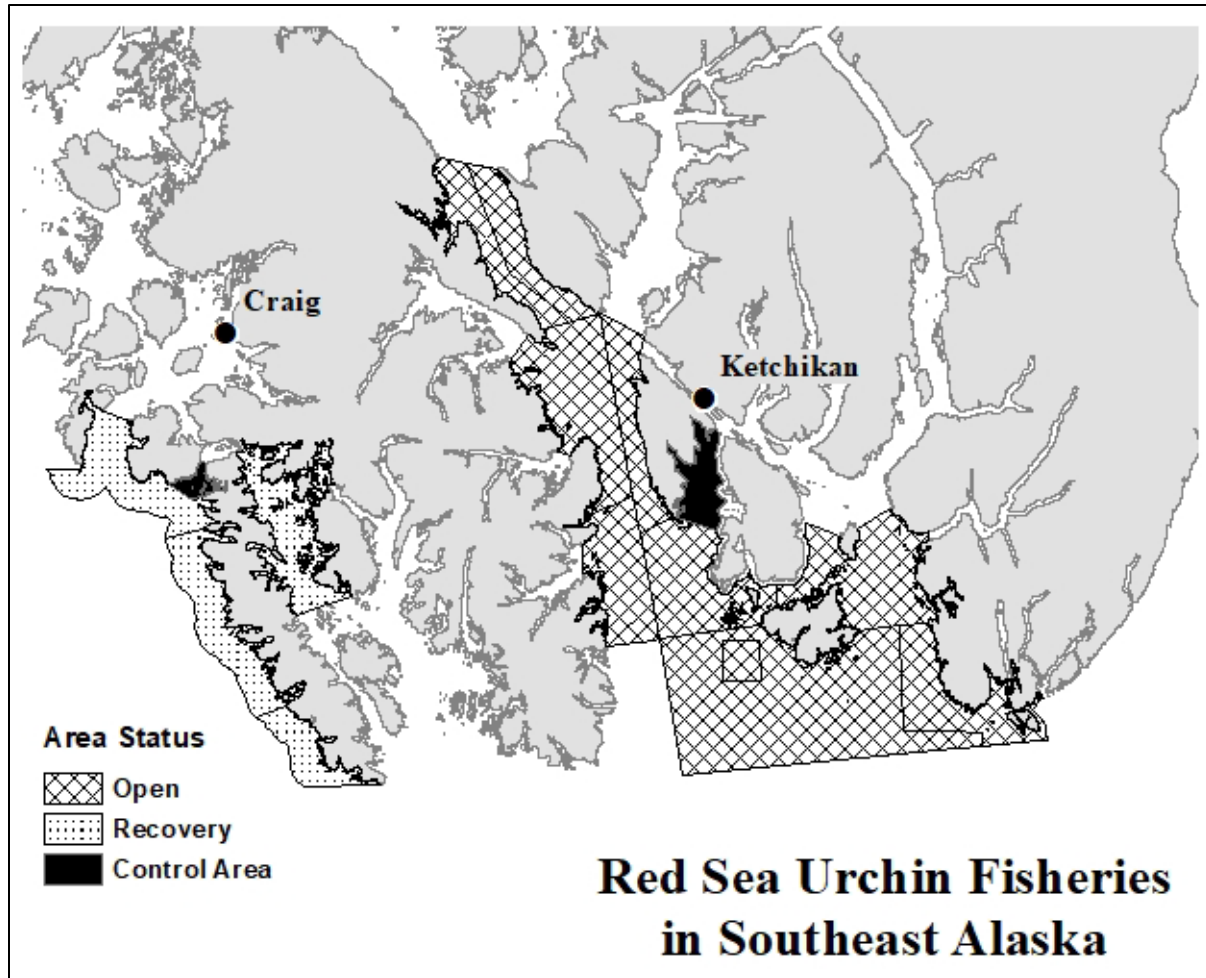


Figure 4.—Red sea urchin commercial harvest areas.

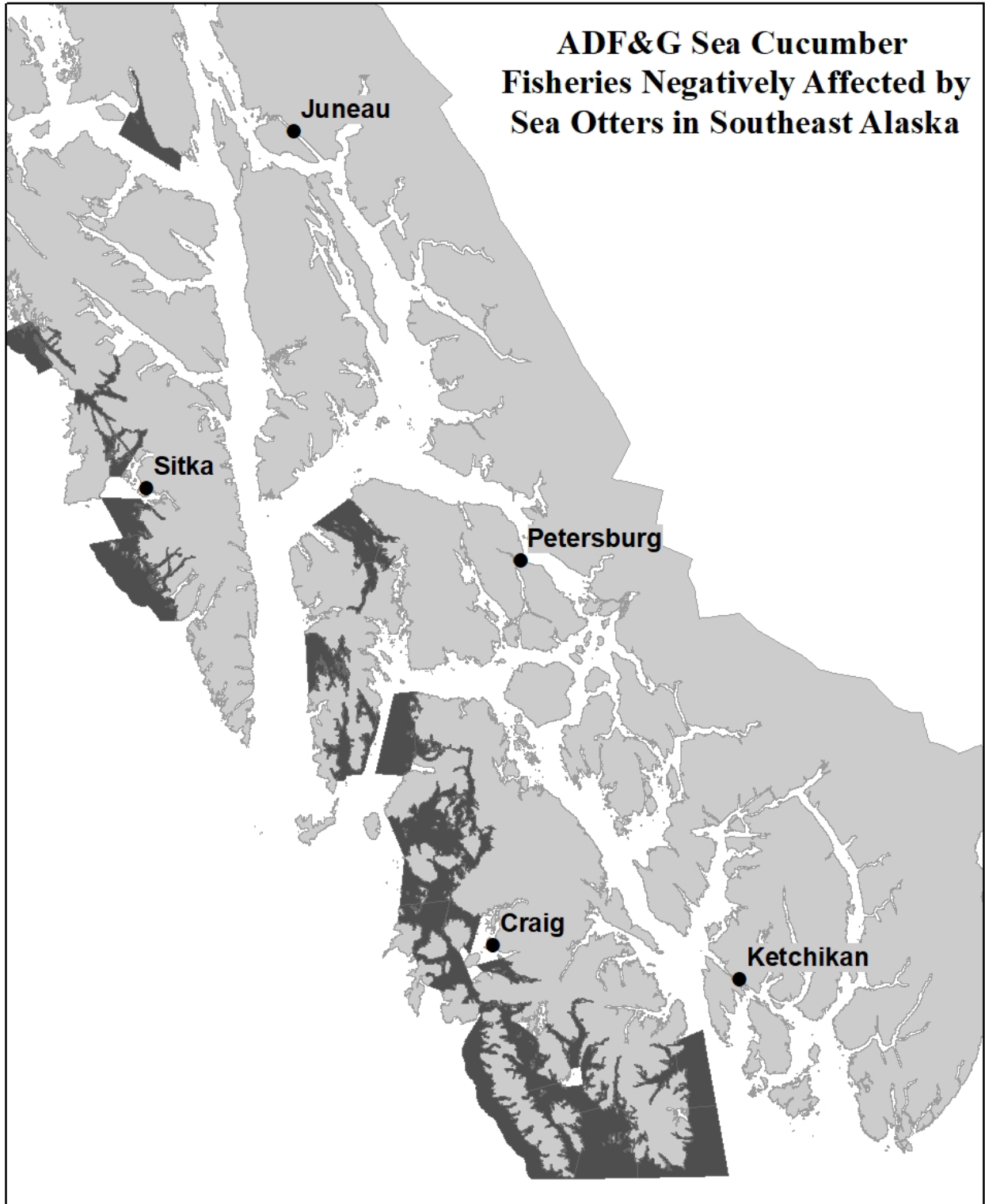


Figure 5.—Sea cucumber commercial harvest areas negatively affected (either closed or substantially reduced guideline harvest level) by sea otters.

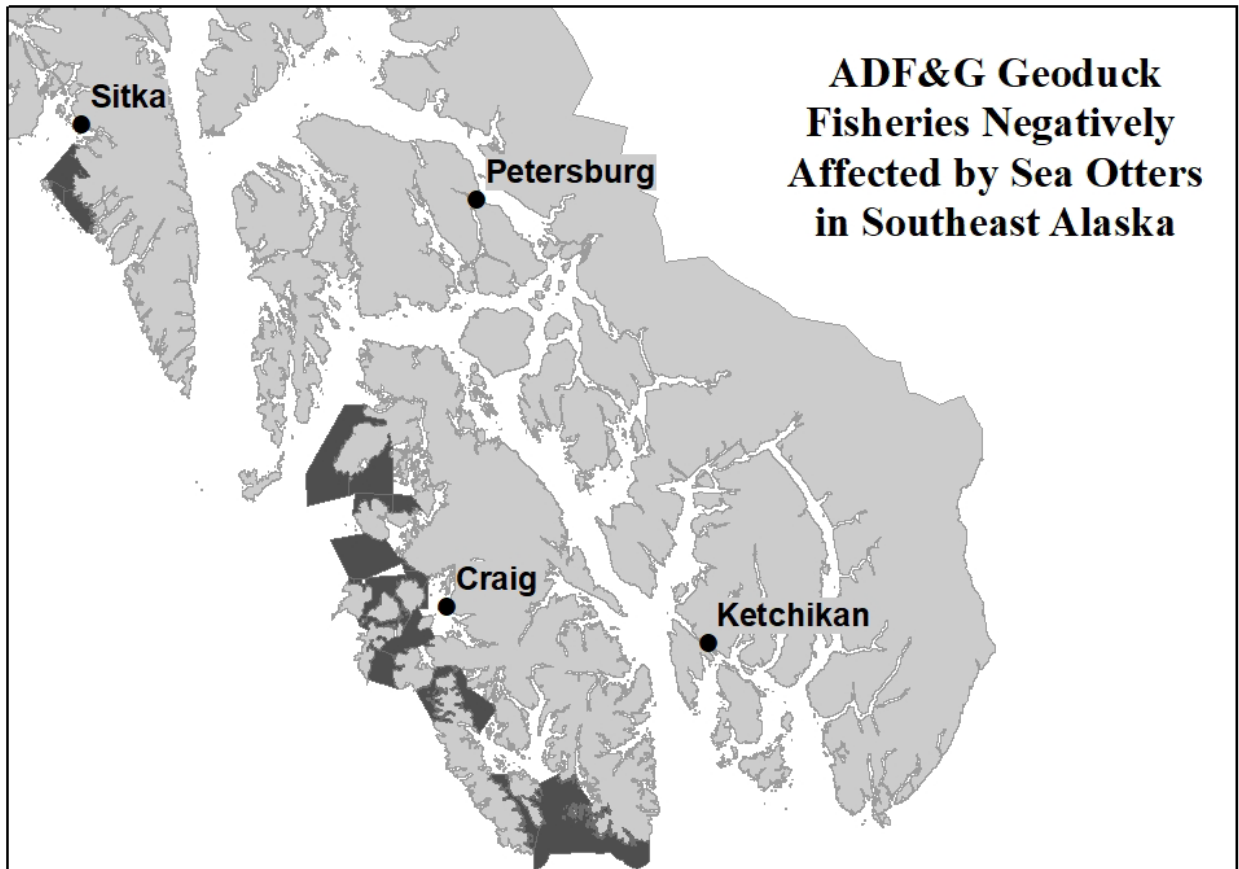


Figure 6.—Geoduck commercial harvest areas negatively affected (either closed or substantially reduced guideline harvest level) by sea otters.

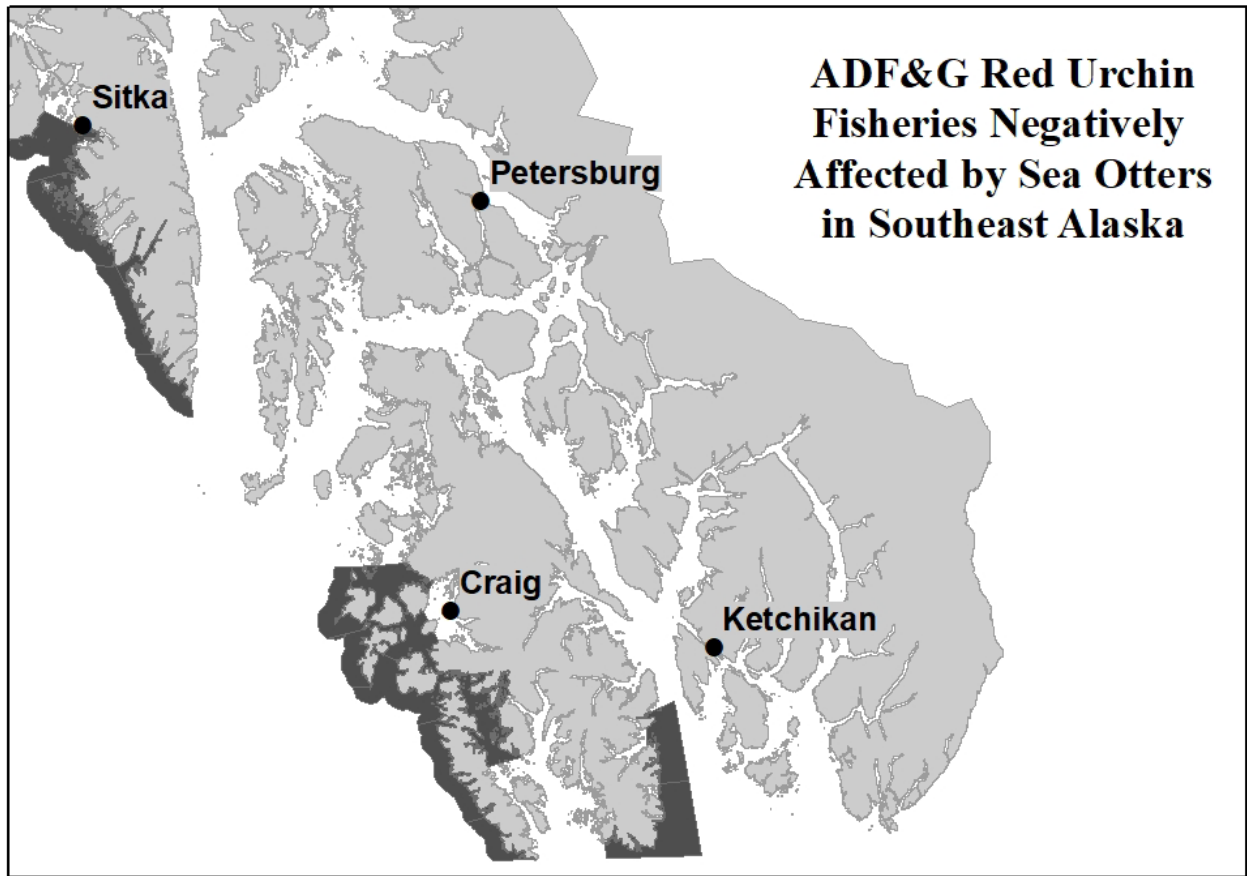


Figure 7.—Red sea urchin commercial harvest areas negatively affected (either closed or substantially reduced guideline harvest level) by sea otters.