Fishery Management Report No. 14-41

2013 Annual Mariculture Status Report

by

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and

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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.

Weights and measures (metric)

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

Weights and measures (English)

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

Time and temperature

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

Physics and chemistry

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

General

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

Mathematics, statistics

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

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The Fishery Management Reports series was established in 1989 by the Division of Sport Fish for the publication of an overview of management activities and goals in a specific geographic area, and became a joint divisional series in 2004 with the Division of Commercial Fisheries. 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.adfg.alaska.gov/sf/publications/. This publication has undergone regional peer review.

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ABSTRACT

With the enactment of the Aquatic Farm Act in 1988, the Alaska Department of Fish and Game (ADF&G) implemented regulations for aquatic farming of shellfish and aquatic plants and established the mariculture program. This document summarizes the year's program and permit activities of aquatic farm, nursery, and hatchery operations, and provides the industry status based on annual reports submitted by operators to ADF&G in 2013. Aquatic farms in the state are mostly small-scale operations, from 1 to 24 acres, and located on state-owned submerged lands and tidelands. During 2013, a total of 68 aquatic farms, 8 shellfish nurseries, and 2 shellfish hatcheries had current permits for their operations. Aquatic farm operations produced over 1.2 million Pacific oysters and close to 9,700 lb of blue mussel, Pacific littleneck clam, and Pacific geoduck combined. The farm gate value for aquatic farm product totaled $769,146, an increase of 37%. Sales per acre for productive oyster farms statewide averaged $6,309 per acre. In-state hatchery and nursery contributions from bivalve seed sales increased by 45.7% and totaled $157,283. Employment in the aquatic farm industry including nurseries and hatcheries has also shown a marked increase in 2013. However, Pacific oyster seed acquisitions by aquatic farmers has declined from 2009 to 2013, which may be related to seed shortages reported by the oyster industry in Alaska and the Pacific Northwest due to hatchery production issues and acidification in Washington and Oregon. Growth of bivalve shellfish aquatic farming in Alaska looks promising for the next year based on increasing trends in aquatic farm sales and production, industry employment, aquatic farm product inventory, and seedstock sales and production from in-state hatcheries and nurseries.

Key words: Aquatic farming, hatchery, nursery, mariculture, managed cultivation, culture, Pacific oyster (*Crassostrea gigas*), Pacific geoduck (*Panopea generosa*), Pacific littleneck clam (*Protothaca staminea*), blue mussel (*Mytilus trossolus*), bivalves, farm gate value, Aquatic Farm Act

INTRODUCTION

The Aquatic Farm Act[1] became law on June 9, 1988, after the Alaska Legislature passed the act to allow aquatic farming of shellfish and aquatic plants. The intent of the legislation was to create an aquatic farming industry in the state that would contribute to its economy by providing jobs and business opportunities, strengthen the competitiveness of Alaska seafood in the world marketplace, broaden the diversity of products, and provide year-round supplies of premium quality seafood. The Act supported responsible growth of the aquatic farm industry while considering established uses and ongoing activities in areas of proposed aquatic farm sites during reviews. This legislation did not support finfish farming and added a moratorium for this type of activity. In 1990, a law passed and codified as Alaska Statutes (AS) 16.40.210 prohibited finfish farming in Alaska.[2]

Statutes authorized the Alaska Department of Fish and Game (ADF&G) commissioner to permit and regulate aquatic farming and protect the state's fish and game resources (AS 16.05.050). Other changes added provisions to (1) construct and operate an aquatic farm or a hatchery, (2) acquire and transport stock to supply an aquatic farm or hatchery and/or for propagation purposes, (3) put restrictions on importing stock, (4) establish disease control protocols, (5) require inspections and reporting, and (6) establish penalties (AS 16.40.100–199). A similar authorization amended existing statutes used by the departments of Natural Resources and Environmental Conservation to allow those departments to permit and regulate use of state tideland and submerged waters for aquatic farming and to oversee food safety of associated aquatic farm products for human consumption, respectively.

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[1] Section 19, Chapter 145, Session Laws of Alaska (SLA), 1988; HCS CSSB 514.

[2] Section 2, Chapter 91, SLA 1990.

To implement the statutes, ADF&G developed regulations (5 AAC 41.100–199) to administer the aquatic farm program. These became effective on April 10, 1988, and were further refined on August 12, 1989. The regulations required a person to obtain an operation permit to construct and operate an aquatic farm or a hatchery for the purposes of supplying shellfish and aquatic plant stock to an aquatic farm. It also provided ADF&G the ability to issue various permits for a person to acquire, purchase, offer to purchase, transfer, possess, sell, and offer to sell stock and aquatic farm products that are grown or reared at the hatchery or aquatic farms.

Allowance for Pacific Oyster Importation

Pacific oysters are not native to Alaska and do not reproduce in the colder waters of Alaska. Although the state prohibits the transport of nonnative species into the state, provisions allowed importation of juvenile Pacific oysters (≤20 mm) for aquaculture purposes only. Transport conditions for imported Pacific oysters specified that only broodstock from oysters commercially cultured on the Pacific Coast of North America be used to produce progeny, accompanied by a disease history indicating that there has been no incidence of diseases exotic to the state or those considered a risk to local stocks, oyster health, and marketability.

To ensure that imported Pacific oysters had no pathogens of transport concern, ADF&G developed shellfish health and disease control protocols for certification of Pacific oyster for out-of-state seed sources (Meyers 2014). Additional requirements for in-state shellfish hatchery and seed distribution facilities for the transport of live oysters and other indigenous species within Alaska were established to further control any disease introductions (Meyers 2014). These evaluation protocols have been essential to preventing the introduction and spread of diseases into Alaska.

On-bottom Culture of Indigenous Species

In the spring of 1999, the state began open enrollment for on-bottom aquatic farm site proposals for culture of littleneck and geoduck, both indigenous species to Alaska. Controversy over on-bottom culture proposals began to emerge—primarily focusing on the extent to which shellfish farmers can sell common property shellfish from an aquatic farm site and what would be allowable under the state's legal provisions.

Site surveys revealed some areas had high enough densities of geoduck wild stock to support a limited-entry commercial fishery. The department denied these permit applications due to high numbers of geoduck wild stock. In February 2000, an applicant filed a lawsuit[3] against ADF&G's decision.

In response to a Superior Court decision, ADF&G had to determine what would constitute a *significant* population of naturally occurring shellfish species. Over the next three years, ADF&G worked with various stakeholders to hear their concerns. Subsequent revisions in 2003 authorized permit holders to remove naturally occurring geoduck clams on farm sites where ADF&G had determined there were insignificant populations of the species intended for culture. The regulation maintained important safeguards for conserving geoduck clam resources while being consistent with the Superior Court decision and the state's objective to expand the industry.

[3] Alaska Trademark Shellfish, LLC v. State, 172 P3d 764 (Alaska 2007).

In April 2004, the Alaska Supreme Court ruled that the constitution prohibited permitting aquatic farm operations culturing geoduck in a site where significant populations of wild stock—in this case, Pacific geoduck—were present. The court defined a significant population as one that would "attract and support a commercial fishery."

With support from ADF&G, aquatic farm operators, and commercial geoduck fishery divers, the Alaska legislators passed legislation[4] in 2005 that codified the ruling of the Supreme Court. This legislation added the court's definition for an insignificant population with authority for the commissioner to determine the threshold. It authorized ADF&G to issue aquatic farm operation permits for sites that had more than an insignificant population of the species intended for culture, and to permit operators to harvest and sell insignificant populations of shellfish wild stock from a permitted aquatic farm site. The legislation also included provisions to deal with existing permitted operations on sites that had geoduck stocks planted on them but no survey completed. It authorized the commissioner to allow an operator with an existing permitted site holding a significant amount of Pacific geoduck the right to harvest with the constraint that permit holders pay reasonable compensation back to the state for wild stock sold that exceeded an insignificant population. As a trustee of the state, ADF&G has an obligation to protect the public trust resource interest for the people of the state and find the harvest to be in the public interest and that harvest by someone other than the permit holder could unreasonably interfere with the aquatic farm operation.

An emergency order approved by the Board of Fisheries passed on March 28, 2005, allowing a commercial geoduck fishery on seven subtidal aquatic farm sites to remove any significant populations of geoduck on those sites and to enable the permit holders to proceed immediately with planting geoduck spat on their farm sites. The commercial fishery excluded nine sites that had reported Pacific geoduck seed planting.

Subsequent regulation revisions in 2005 and from 2010 to 2012 implemented the court ruling, revised statutes, and addressed additional concerns made by the industry. The 2005 regulations established fees for biomass survey costs to ensure aquatic farm sites do not contain significant populations of wild stock of the species proposed to culture, as well as a provision to restore the wild stock populations when the permit terminated. In 2012, revisions simplified the proof of reseeding requirement for a permitted aquatic farm site where geoduck were harvested, simplified the marking requirements for operations, and added a provision whereby an operator culturing Pacific geoduck could request a determination be made by ADF&G to classify all remaining geoduck on the site as aquatic farm product.

The department continues to administer the program to find the right balance for growth of the mariculture industry and sound management of the resources with considerations made for conflicting public interests on shellfish resources and statutory and constitutional provisions.

Designated Aquatic Farm Areas

House Bill (HB) 208[5] passed and was signed on June 21, 2002. The legislation required the Department of Natural Resources (DNR) to find suitable sites for suspended (60 sites), intertidal (20 sites), and subtidal (10 sites) culture. Over 200 nominated areas were assessed by authorizing agencies: DNR, ADF&G, the Department of Environmental Conservation, University of Alaska

[4] Section 1–3, Chapter 13 SLA 2005 (HB 198).
[5] Chapter No. 81, SLA 2002 (HB 208).

Fairbanks Sea Grant Marine Advisory Program, Alaska Growers Association, and the Alutiiq Pride Shellfish Hatchery (formerly Qutekcak). DNR obtained public comments on 140 nominations and 46 closed aquatic farm sites. Evaluations of areas considered existing agency determination criteria. Subtidal and intertidal site surveys determined wild stock population biomass for each Pacific geoduck nominated area.

The process ultimately resulted in preapproved designated areas through the state, with 158 aquatic farm areas suitable for the three culture methods. Offerings made through a public auction process and DNR's over-the-counter program were on a first-come, first-serve basis. The preliminary review and public noticing for the areas designated by HB 208 makes the process for obtaining authorizations much shorter in duration, and the application period for these areas is open year round. In 2004, DNR awarded 25 aquatic farm areas to bidders.

MARICULTURE PROGRAM

The ADF&G Division of Commercial Fisheries mariculture program is responsible for regulating and permitting aquatic farming activities within the state and provides regulatory, technical, and planning services to people interested in aquatic farming. Prior to an operation being permitted, an aquatic farm and hatchery operation plan must demonstrate technical and operational feasibility and improve the productivity of the culture species above what would occur naturally by using applicable managed cultivation techniques. Aquatic farming and hatchery activities must also prevent significant alterations of existing uses of fish and wildlife resources and avoid any adverse effects on fisheries, wildlife, and their habitat. All acquisitions and transports of organisms to aquatic farms and hatcheries must be conducted in a manner that protects the health of Alaska shellfish and genetic integrity of wild stocks.

PROGRAM ACTIVITIES

Operation Permits

Reviews of joint agency permit applications begin after the January 1 and April 30 openings each year. DNR and ADF&G coordinate the review and make determinations based on their applicable regulations. DNR administers public notices on project proposals and distributes comments to appropriate parties and agencies concerned. Typically, decisions on issuance of permits follow as soon as DNR issues a lease.

For 2013, ADF&G staff reviewed eight application requests for three aquatic farm operations, a shellfish nursery operation, and four amendments to existing operations. They issued two new aquatic farm permits and denied no applications. One applicant withdrew during the review process. In comparison, staff reviewed 11 applications in 2012, including one hatchery, two nurseries, and eight aquatic farm proposals, and issued four aquatic farm permits. Staff approved three operation permit renewals and three transfer requests for operations and issued permits for these during the year. An applicant requested an intertidal biomass survey for Pacific littleneck clam, and staff conducted the survey and provided results. Permit holders requested closure of five aquatic farms and a nursery operation. Staff reviewed a request for a site suitability project proposing to experiment with culturing geoduck in Port Graham and issued a fish resource permit for this activity.

In 2013, 68 aquatic farms, 8 shellfish nurseries, and 2 shellfish hatcheries had current permits for their operations (Table 1; Figure 1). Of all permitted operations, 93% had some form of activity

in that year (including seed acquisition, inventory, or sales), based on annual reports submitted by permit holders. Six permitted aquatic farm operations, and one nursery operation had no activity in 2013. By the end of 2013, most of these inactive operations closed.

Shellfish/Aquatic Plant Acquisition and Stock Transport Permits

Department staff issued five acquisition permits to permitted shellfish hatchery operations allowing them to acquire broodstock for propagative purposes and produce seed for aquatic farms and nurseries. Approvals for 101 stock transport permits allowed permit holders to transport Pacific oyster (74% of the permits) or Pacific geoduck (26% of the permits) seed from seed suppliers to their aquatic farms, nurseries, and hatcheries. The number of stock transport permits issued increased by 12% from 2012 to 2013.

Compliance Inspections

Department staff conducted aquatic farm compliance inspections at 44% (20 out of 45) of the permitted operations located in Southeast Alaska. Observations from the chartered floatplane took place at eight permitted aquatic farm operations and two decommissioned aquatic farm operations as well. Three aquatic farm operators met staff at the ADF&G office in Ketchikan to discuss their current operations and production goals.

No onsite underwater inspections took place at subtidal aquatic farm site operations (15 in all) this year due to the cost of diving on the sites. The last underwater compliance inspections by department divers for subtidal sites occurred in 2006 (15 sites inspected) and 2011 (one site inspected).

Seed Source Approvals (in state) and Certifications (out of state)

In-state seed source approvals for five seed source distribution facilities were issued by department staff to allow transport of seed to aquatic farms and nurseries within the state. Those permitted were Alutiiq Pride Shellfish Hatchery, Kachemak Mariculture Association Homer Remote Setting Facility, Kachemak Shellfish Growers' Association Halibut Cove Nursery, Naukati Shellfish Nursery, and OceansAlaska Hatchery and Remote Setting Facility (Table 1).

Department staff also issued out-of-state certifications to two out-of-state shellfish hatcheries during the year that allowed for importation of Pacific-oyster eyed larvae or seed into Alaska. Those certified for importation of Pacific oysters include Coast Seafood Quilcene Hatchery, Coast Seafood Humboldt Nursery, and Whiskey Creek Shellfish Hatchery (Table 2).

Supply of Pacific oyster seed improved in 2012 from the previous year, but growers were still concerned about the size of spat and timing from seed providers. In 2013, ADF&G worked with the industry to find solutions for conditionally extending some hatchery annual certifications from February to end of May so they could get eyed larvae to remote setting facilities earlier in the year. Previously, department certifications covered a calendar year from February to February. Outside certification schedules, preferred by the suppliers in Washington, typically took place in the spring to coincide with schedules preferred by Washington pathologists. As a result, there was a gap of two months (March–April) where an out-of-state hatchery lapsed with their recertification until they submitted their examination reports. Only one hatchery accepted the extension offer.

The industry has been very reliant on seed from certified out-of-state seed suppliers. The in-state hatcheries have been reluctant to propagate oysters due to the extra costs involved to heat water.

Propagation of indigenous species, such as Pacific geoduck and Pacific littleneck clam, at the in-state hatcheries has been experimental and has not yet reached large production levels necessary for growers to meet their own aquatic farm production goals.

Pacific Geoduck Wild Stock Harvest Landings

Holders of aquatic farm operation permits for subtidal geoduck aquatic farms are allowed to harvest insignificant amounts of wild stock geoduck from their farm sites under AS 16.40.100(b)(2). Permit holders are required to report their harvest landings on fish tickets to ADF&G. As per AS 16.40.155, ADF&G may release records regarding cumulative annual harvests of wild stocks at individual aquatic farm sites. Reported cumulative harvest based on fish ticket information for 2013 totaled 895 lb of wild stock Pacific geoduck (number = 380) landed from three subtidal aquatic farms. From 2006 to 2013, the total cumulative harvest of wild stock Pacific geoduck harvest landings on 10 permitted subtidal aquatic farms totaled 90,170 lb (number = 40,056).

Geoduck Status Determination

As of 2013, a total of eight geoduck status determinations were made by the department for on-bottom, subtidal aquatic farm sites with operation permits approved for the culture of Pacific geoduck. The determination considers all remaining geoduck on the site to be aquatic farm product based on provisions in 5 AAC 41.258. Permit holders provided information to the department to show that they had met the criteria to allow for this status change on a site-by-site basis. After this determination, a permit holder is no longer required to submit a fish ticket for landings of Pacific geoduck wild stock that are harvested from those sites, but they do have to record harvest number and sales information at the end of the calendar year on an aquatic farm annual report submitted to the department.

STATUS OF THE AQUATIC FARM INDUSTRY[6]

AQUATIC FARM OPERATION SIZES

The majority of the aquatic farm operations are located on state submerged and tidal lands. Only one is located on private tidelands. During 2013, the average size of an aquatic farm in Alaska was 5.09 acres with a range of 0.81 and 23.6 acres. Total acres for all aquatic farm operations permitted encompassed approximately 346 acres. Of those acres, 146 acres made up aquatic farm operations with sales, an increase of 8% since 2012 and 23% since 2009 (Figure 2).

SALES VALUE AND PRODUCTION

In 2013, the overall contribution in sales from all permitted operations (including aquatic farms and in-state hatcheries and nurseries) totaled $926,429 in farm gate value (Table 3), an increase of $258,643 (39%) from 2012. The farm gate value is the unprocessed value, excluding the costs of packaging or transport of the product to its first point of sale.

Statewide Aquatic Farm Sales Value and Production

Farm gate value for all aquatic farms in the state totaled $769,146 in 2013 (Table 3), an increase of 37% from 2012. This is the biggest increase in sales since 2002. The principle aquatic farm

[6] Data obtained from Aquatic Farm, Nursery, and Hatchery Operator Annual Reports. ADF&G mariculture program confidential files.

product cultured in the state continues to be Pacific oysters, making up 93% of the sales statewide and totaling $712,345 (Figure 3). Total annual sales for Pacific oyster have been increasing since 2010. In terms of production numbers in 2013, the dominant species was Pacific oysters, totaling 1,218,851 produced, or 101,571 dozen (Table 3). Blue mussel, Pacific littleneck clam, and Pacific geoduck made up the remainder of the sales ($56,801) and production (9,722 lb).

The average statewide price for Pacific oyster was $9.34 per dozen. The average statewide price was $5.55 per lb for blue mussel. For Pacific littleneck clam or Pacific geoduck, combined average statewide price was $5.96 per lb.

Several factors may have influenced the sudden growth in overall sales and production in 2013. New operations permitted in 2009 and 2010 began harvesting marketable product and reported sales and production in 2013. In addition, the industry has begun to use more productive and effective gear and implement better husbandry practices, leading to increased production.

Regional Aquatic Farm Sales Value and Production

Overall bivalve shellfish sales for the Southcentral Region ($420,578) were 17% higher than the Southeast Region ($348,567; Table 4; Figure 4). Between 2012 and 2013, the Southcentral Region had the highest reported sales increase (51%), compared to the sales increase for the Southeast Region (24%) during that same time period. Both regions showed continued increase in overall sales since 2010.

For Southeast Region, Pacific oyster sales made up 87% of the total aquatic farm sales (Figure 4). The average price for Pacific oyster sold in the Southcentral Region ($10.23 per dozen) was higher than in the Southeast Region ($8.05 per dozen). Pacific oysters made up 98% of the aquatic farm sales in Southcentral Region, and 2% of the sales came from blue mussels (Figure 5).

Southcentral Region was the only region with sales for blue mussel, with an average price of $5.55 per lb. Blue mussel sales dropped 1% from 2012 to 2013 (Figure 6). This region has been responsible for the majority of the blue mussel production in the state since 1990, when almost 60% of the aquatic farm sales in this region came from blue mussel sales. After a peak in 1990, blue mussel production has remained low because it has consisted mostly of opportunistic harvest from Pacific oyster gear. Production is likely to increase in the coming years with new operations starting to focus on culturing blue mussel on a larger scale using lines of mesh socks seeded with juvenile mussel collected at the site and suspended from a raft.

The Southeast Region was the only region that had sales for Pacific geoduck and Pacific littleneck clams. Combined financial sales and production data for all clam species are not available due to confidentiality rules. Pacific littleneck and Pacific geoduck clams combined made up 14% of the sales in this region (Figure 4). The highest percentage of sales occurred in 2001, when 50% of Southeast Region sales came from Pacific littleneck clam sales. Pacific geoduck sales occurred from 2010 to 2013.

Productive Aquatic Farms with Sales

In 2013, 48% (31 out of 65) of permitted aquatic farms had marketable product and subsequent sales, an increase of 11% from 2012 (Figure 7). Many of the farms without production and sales reported inventory but required more grow-out time before product reached marketable size. Of

the aquatic farms without sales, 31% had approval to culture indigenous species such as Pacific geoduck and Pacific littleneck clam that tend to be slower to reach market size.

Grow-out time for aquatic farm stock from seedstock to a marketable size can vary by species. For comparison, the grow-out time from seed to first sale takes approximately 2.5 to 5 years for Pacific oyster, 1 to 3 years for blue mussels, and 3 to 7 years for Pacific littleneck clams. The explicit grow-out time for Pacific geoduck in Alaska is yet to be determined. Many factors may influence the grow-out time, including quality and size of shellfish seed, environmental conditions, husbandry techniques, and the actual size of the shellfish the market will support.

Since 2002, various challenges have delayed production for on-bottom subtidal and intertidal aquatic farm operations. Controversy over a number of issues—including the extent of wild stock harvesting, security, reseeding requirements, the process of acquiring quality and quantity seed from in-state seed sources, lack of effective transport and nursery rearing, high paralytic shellfish toxicity preventing harvest of product, product security and overharvesting issues, and recent sea otter predation—have all had an impact on production for these on-bottom aquatic farms.

Hatcheries and Nurseries Sales Value and Production

Overall bivalve shellfish seedstock sales from in-state hatcheries, remote setting facilities, and inwater nursery operations totaled $157,283 in 2013 (Table 4), an increase of $49,342 (45.7%) from 2012. Sales came primarily from production of Pacific oyster seed and secondarily from Pacific geoduck seed. Acquisition of seedstock for indigenous species has to come from in-state permitted hatchery or nursery operations, whereas acquisitions of Pacific oyster seedstock can originate from approved in-state or certified out-of-state seed sources.

INVENTORY

At the end of 2013, 75% (51 of 65) of the operations reported aquatic farm product inventory. The primary aquatic farm products making up the aquatic farm inventory included 12.5 million Pacific oysters, 8.25 million blue mussels, 837,296 geoduck, and 775,189 Pacific littleneck clams (Figure 8). Operations had purple-hinged rock scallop, green sea urchins, and kelp stock in smaller quantities, but because the number of operations is fewer than three, the data are confidential.

Pacific oyster inventory for aquatic farms increased by 2 million (19%) from 2012 to 2013, primarily from increased inventory in the Southeast Region (Figure 8). Blue mussel inventory, originating from natural sets on ropes, increased substantially from last year by 8.2 million, primarily from increased inventory in the Southcentral Region. From 2012 to 2013, inventory decreased by 2.7 million (78%) for Pacific littleneck clams and by 15,052 (2%) for geoduck clams.

NEW SEED ACQUISITIONS

Propagation of Pacific oyster does not currently occur in Alaska hatcheries due to the high cost of heating the water for conditioning and for inducing spawning in adult oysters. The majority of the smaller Pacific oyster eyed larvae and small juvenile seed cultured in Alaska hatcheries, remote setting facilities, and nurseries originate from Pacific Northwest shellfish hatcheries that are certified out-of-state seed sources (Table 3). Some aquatic farmers purchased seed directly from these seed sources.

Pacific eyed larvae acquired by hatcheries and remote setting facilities took place between April and August from 2011 to 2013 (Figure 9). In 2013, Pacific oyster eyed larvae imports acquired from out-of-state seed sources totaled 63.5 million, an increase of 16.5 million (35%) from 2012. Small juvenile Pacific oysters from these out-of-state sources totaled 10.6 million in 2013, an increase of 8.5 million (404%) from the previous year.

Inwater nurseries with FLoating UPweller SYstems (FLUPSYs) in Alaska acquired juvenile seed from 2011 to 2013 primarily between May and August (Figure 9). Water temperature, amount and size of phytoplankton in the water to feed the juveniles, space in the bins at the facility, and specific size of seed often restrict production at grow-out nursery facilities. The industry has discussed modifying inwater nursery gear to accommodate smaller seed, but lower water temperatures and timing of seed availability from seed sources may prevent introduction of smaller seed into FLUPSYs earlier in the year.

Aquatic farms acquired new seedstock from certified out-of-state or approved in-state seed sources from 2011 to 2013, primarily between August and September, to replenish their inventory (Figure 9). In 2013, new Pacific oyster seed acquired for aquatic farms totaled 3.3 million, a decrease of 1.8 million (–35%) from 2012 (Figure 10). The proportion of new seed made up 27% of the inventory in 2013 and 41% of the inventory in 2012. The number of aquatic farms acquiring Pacific oysters in 2013 has remained relatively stable over the last two years (n = 29 in 2013 and n = 28 in 2012). Overall, Pacific oyster total seed acquisition by aquatic farmers has declined from 2009 to 2013. This reduction corresponds to seed shortages reported by operators in the state of Alaska and Pacific Northwest areas. Hatchery production issues and acidification (in Pacific Northwest hatcheries) have contributed to the seed shortage.

WORKDAYS AND EMPLOYMENT

Direct employment at aquatic farm operations includes owners, partners, employees, interns, and family. Positions can be paid or unpaid, part time or full time, and seasonal or year round. For most operations, it is very common to have volunteers, family members, or interns working on an aquatic farm to keep labor costs down. Hatcheries and nurseries tend to have more paid full-time and seasonal employees. All positions include both paid and unpaid workers and include owners, partners, family, and laborers unless specified. Full-time employee (FTE) calculations use the formula 1 FTE = 260 workdays.

There has been a steady increase in the number of days worked and positions working at aquatic farms since 2009. Aquatic farm operations have increased the number of days worked by 17% from a total of 9,028 workdays in 2012 to 10,547 workdays in 2013 (Figure 11). The number of all positions working at aquatic farms has also increased from 132 to 161, an increase of 22% since 2012. Of those aquatic farm positions, 25 positions worked more than 150 workdays (Figure 12). Approximately 65% of the total positions reported were aquatic farm laborers. The total workdays for all aquatic farms in the state were equivalent to 40.6 FTE, with an average by aquatic farm operation of 0.77 FTE.

Workdays and positions at hatchery and nursery operations have also increased steadily since 2009, similar to the trend at aquatic farms. The number of workdays at hatchery and nursery operations increased by 82%, with 1,648 workdays in 2012 and 3,005 workdays in 2013 (Figure 13). The number of all hatchery and nursery positions combined also increased by 124% from 17 positions in 2012 to 37 positions in 2013. Of those hatchery and nursery positions, only five worked more than 150 workdays (Figure 12). The total workdays for hatchery and nursery

operations in the state were equivalent to 11.6 FTE, with an average by operation of 0.86 FTE. Over the last few years, one new hatchery and several nurseries have begun operations to grow out and supply seed to aquatic farmers, which has contributed to increased workdays and positions from this sector.

Aquatic farm paid positions increased 30%, from 50 paid positions in 2012 to 65 paid positions in 2013. Of those paid aquatic farm positions, only seven worked more than 150 workdays (Figure 14). The number of days paid employees worked on aquatic farms decreased by –5%, from 3,189 to 3,028 days between 2012 and 2013. The total paid workdays for all aquatic farm positions in the state combined was equivalent to 11.65 FTE, with an average by operation of 0.58 FTE (Figure 15).

Paid positions in shellfish hatcheries and nurseries increased 79% from 14 in 2012 to 25 in 2013. Of those paid hatchery and nursery positions, only three individuals worked more than 150 workdays (Figure 14). The number of days paid employees worked at these facilities increased by 56%, from 1,373 workdays in 2012 to 2,137 workdays in 2013. The total paid workdays for hatchery and nursery positions in the state were equivalent to 8.22 FTE, with an average by operation of 0.33 FTE (Figure 16).

PERFORMANCE BENCHMARKS FOR OYSTER SALES

Benchmarks can be useful to assess overall industry performance (Sherriff 2013). Two indicators selected as benchmarks for aquatic farms that reported sales of Pacific oysters included sales per acre and sales per FTE. Other performance benchmarks calculated included the number of dozen Pacific oysters sold per acre, number of dozen Pacific oysters sold per FTE, and sales per dozen sold. All positions used for the FTE calculations included paid and unpaid workers and owners, partners, family, and laborers.

For 2013, sales per acre for productive oyster farms statewide averaged $6,309 per acre. The sales per FTE for productive sales averaged $30,614 per FTE. The productive oyster farms with sales averaged 781 dozen Pacific oysters sold per acre and averaged 49,721 dozen oyster sold per FTE. The sales per dozen oysters sold in Alaska averaged $9.34 per dozen.

CULTURE EQUIPMENT AND GEAR USAGE

Aquatic farm equipment and gear infrastructure is dependent on the species grown, culture method, site conditions, and the amount of capital a business owner wants to invest in the operations. Various types of predator exclusion devices help contain the aquatic farm product in the water while the organisms grow and keep them away from predators.

Most of the oyster production in the state occurs in deeper waters of the subtidal zone, where lantern nets or trays of oysters are suspended from longlines, rafts, or logs. Some farmers use flip-flop bags strung along support lines in the intertidal zone and take advantage of the tidal movement of the water to move the bags up and down and tumble the oysters. Culture of mussels has been mostly opportunistic with the harvest of mussels growing on oyster gear. Recent experiments show promise for large-scale production of mussel using spat collector lines and mussel sock lines suspended from rafts in the subtidal zone. Gear used for on-bottom, intertidal culture of Pacific geoduck clam is primarily PVC tubes inserted in the substrate and predator netting coverings. On-bottom culture of Pacific geoduck in the subtidal zone uses various grades of predator netting for a certain time to protect planted juvenile geoduck until they reach market

size. Pacific littleneck clam culture may use predator netting over the substrate in the intertidal zone to improve production and protect stock from predators. Recent research conducted by ADF&G suggests that predator exclusion netting can enhance Pacific littleneck clam survival and growth in Southeast Alaska.

Of the equipment and gear culture systems used in 2013 at aquatic farms statewide, 32% of the systems consisted of longline and lantern nets, and 30% consisted of raft and trays/cages culture systems (Figure 17). Since 2011, there has been an 8% increase in the use of raft and tray/cage systems. Other secondary culture systems used include raft and lantern nets, longline and trays/cages, longline and a combination of lantern nets and trays, log and lantern nets, floating vexar bags, flip-flop vexar bags, and shark fin vexar bags.

DESIGNATED HB 208 AREA USAGE

By the end of 2013, eight aquatic farm operations were located on areas designated by HB 208. Of the 158 preapproved aquatic farm designated areas, 28 aquatic farms had aquatic farm operation permits issued between 2004 and 2013. A large percentage of the remaining areas are in rural locations too distant from coastal communities, available markets, and a labor force to be attractive to industry entrants. Increases in fuel costs have also made them less appealing.

INDUSTRY OUTLOOK

Based on increasing trends in bivalve shellfish sales and production, seedstock sales from hatcheries and nurseries, aquatic farm product inventory, and number of aquatic farm workers, the outlook is promising for growth in the mariculture industry next year. Support continues for expansion of the industry through legislative and federal funding, University of Alaska Sea Grant Marine Advisory Program outreach and training, and new focus by industry associations.

Halibut Cove Community Organization received $300,000 in funding from the 2012 Legislature for an Alaska mussel farming demonstration project. Alaska Shellfish Growers Association, the Marine Advisory Program, and Alaska Sea Farms, LLC, have worked closely together to develop a model farm—constructing rafts and suspending lines to collect natural sets and mussel socks to culture mussels for the marketplace. The group will collect biological and scientific data and plans to develop a user manual on mussel farming and conduct workshops to share results of the project. Production from the mussel demonstration project and new aquatic farmers interested in actively culturing mussels should result in growth of mussel production and sales in the coming years.

The Alaska Fisheries Development Foundation received a NOAA Soltenstall-Kennedy grant for $216,812 to coordinate the Alaska Mariculture Initiative, intended to broaden the support and development of the mariculture industry by including restoration and enhancement of invertebrate wild fisheries. Other objectives of the initiative include convening a conference of stakeholders to build partnerships and create strategic plans to optimize economic benefits of shellfish resources for coastal communities, restore and enhance shellfish fisheries that are threatened or affected, and grow shellfish farming businesses.

Alaska Shellfish Growers Association looked to the Pacific Coast Shellfish Growers Association to help revitalize and restructure the organization. The Alaska Shellfish Growers Association represents the interests of shellfish growers in Alaska. Their board has recently been

reestablished and is actively working on addressing current industry issues and getting more participation and direction from aquatic farmers and partnerships.

RESEARCH AND DEVELOPMENT

PACIFIC LITTLENECK CLAM RESEARCH PROJECT

In collaboration with the University of Alaska Fairbanks Sea Grant Marine Advisory Program and Eric Wyatt of Blue Starr Fisheries, LLC, the ADF&G mariculture program funded and completed a study to determine the effects of predator exclusion netting on the survival and growth of Pacific littleneck clams in Southeast Alaska (Politano and Pring-Ham *In prep*). The project, which took place in Tokeen Bay, Prince of Wales Island, involved sampling three sites and three treatment plots (use of predator netting plus clam seed, netting only, and control) to determine whether there were any differences in densities between treatments. Of the three sites sampled, populations of Pacific littleneck clams that had constant protection by netting maintained average densities double that of exposed populations and showed greater average sizes. The data suggest that predator exclusion netting can enhance Pacific littleneck clam survival and growth in Southeast Alaska. This project is one of a small number of empirical studies that have substantiated the use of this culture gear in Alaska. It provides valuable support for use of this managed cultivation method and may contribute to the improved performance and optimization of intertidal clam culture.

REFERENCES CITED

Meyers, T. 2014. Policies and guidelines for Alaska fish and shellfish health and disease control. Alaska Department of Fish and Game, Regional Information Report No. 5J14-04, Juneau.

Politano, V., and C. Pring-Ham. *In prep*. The effects of predator exclusion netting on the survival and growth of Pacific littleneck clams in Tokeen Bay Alaska. Alaska Department of Fish and Game, Regional Information Report, Juneau.

Sherriff, C. 2013. Oyster industry benchmarking snapshot, 2013 summary version. Rural Directions Pty. Ltd, Australia.

TABLES AND FIGURES

Table 1.−List of permit holders with operation permits in 2013.

Site Type	Permit Number	Site Name	Last Name	First Name	Business Name
Aquatic Farm	1996-18-AF-SC	Simpson Bay	Aguiar	James	Eagle Shellfish Farm
Nursery	1996-18-NU-SC	Simpson Bay	Aguiar	James	Eagle Shellfish Farm
Aquatic Farm	1993-12A-AF-SE	Unnamed Bay/Cap-Tuxekan Islands	Ausec	Gary	Harmony Seafoods
Aquatic Farm	1993-12B-AF-SE	Cap/Tuxekan Islands	Ausec	Gary	Harmony Seafoods
Aquatic Farm	1991-101-AF-SC	Peterson Bay	Bader	Ronald	Moss Island Oyster Farm
Aquatic Farm	2002-02B-AF-SE	Slate Island	Bakker	Cornelis	Cornelis Bakker Inc.
Aquatic Farm	2007-04-AF-SE	Black Island	Bakker	Cornelis	Cornelis Bakker Inc.
Aquatic Farm	2009-101-AF-SC	Halibut Cove (oysters)	Bates	Weatherly/Greg	Alaska Shellfish Farms LLC
Aquatic Farm	2012-103-AF-SC	Halibut Cove (mussels)	Bates	Weatherly/Greg	Alaska Shellfish Farms LLC
Aquatic Farm	1996-03-AF-SE	Unnamed Bay/Marble Island	Belk	Doris	Tokeen Bay Seafoods
Aquatic Farm	2010-101-AF-SE	Kootznahoo Inlet	Booth III	William (Jay)	Boo Koo Oysters
Aquatic Farm	2008-02-AF-SE	Nossuk Bay	Carl	Joseph	Nossuk Seafood Adventures
Nursery	1996-14-NU-SC	Halibut Cove KSGC Nursery	Crosby	Sean	Kachemak Shellfish Mariculture Association
Nursery	2012-101-NU-SC	KSMA Remote Setting Nursery	Crosby	Sean	Kachemak Shellfish Mariculture Association
Aquatic Farm	2011-113-AF-SE	Steamboat Bay	Cunningham	Brian	Steamboat Bay Alaska Seafoods
Aquatic Farm	1991-104-AF-SC	Halibut Cove	Dale	Brenda	Snug Harbor Seafoods Inc
Aquatic Farm	2011-101-AF-SE	Sunrise Site/Hobart Bay	Duncan	Derek	Goldbelt Inc
Aquatic Farm	2011-102-AF-SE	Sand Spit/Hobart Bay	Duncan	Derek	Goldbelt Inc
Aquatic Farm	2004-02-AF-SE	Cannery Point	Ethelbah	Harley	Fresh Start Fisheries
Aquatic Farm	2005-01-AF-SE	Etolin Island	Ethelbah	Harley	Fresh Start Fisheries
Aquatic Farm	1991-109-AF-SC	Little Jakolof Bay	Fell	Donald	Oyster Cove Seafarms
Aquatic Farm	2011-107-AF-SE	South portion of San Island in El Capitan Passage	Fitzgerald	Mike	New Tokeen Oysters
Aquatic Farm	2007-02-AF-SE	Jinhi Bay	Gladsjo	Ernie	None
Aquatic Farm	2009-104-AF-SE	Shikat Bay	Greeley	James	Tomaso Shellfish Farms
Aquatic Farm	2009-112-AF-SE	Gonakadetseat Bay	Harris	Tom	Yak-Tat Kwaan Inc.
Aquatic Farm	1990-04-AF-SE	Big John Bay and Stedman Cove	Henderson	Tom	Pearl of Alaska
Nursery	1990-04-NU-SE	Pearl of Alaska Coho Properties Nursery	Henderson	Tom	Pearl of Alaska
Hatchery	1992-01-HA-SC	Alutiiq Pride Shellfish Hatchery	Hetrick	Jeff	Alutiiq Pride Shellfish Hatchery
Aquatic Farm	1990-03-AF-SE	Unnamed Bay/Mosman Island	Kiser	John	Rocky Bay Oysters LLC
Aquatic Farm	2009-105-AF-SE	Tatoosh Island	Kiser	John	Rocky Bay Oysters LLC
Aquatic Farm	2002-03A-AF-SE	Coho Cove	LaCroix	Stephen	Sea Farms Alaska
Aquatic Farm	2002-03B-AF-SE	West Gravina	LaCroix	Stephen	Sea Farms Alaska
Aquatic Farm	2002-03C-AF-SE	Point Alava	LaCroix	Stephen	Sea Farms Alaska
Aquatic Farm	2002-03D-AF-SE	Point Alava Extension	LaCroix	Stephen	Sea Farms Alaska
Aquatic Farm	2002-03E-AF-SE	Black Island	LaCroix	Stephen	Sea Farms Alaska
Aquatic Farm	1996-15-AF-SC	Bear Cove	Lambe	Sarah	Old Gregg Oyster Co.
Aquatic Farm	2000-08-AF-SC	Halibut Cove	LaRue	Blake	K-Bay Oysters
Aquatic Farm	2004-04-AF-SE	Boca de Quadra	Lentz	Kyle	SeaProducks Inc

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Table 1.–Page 2 of 2.

Site Type	Permit Number	Site Name	Last Name	First Name	Business Name
Aquatic Farm	2011-103-AF-SE	Fred Point/Burnt Point/North Bight	Lindoff	Anthony	Coho Properties LLC
Aquatic Farm	1991-113-AF-SC	Peterson Bay	Loflin	Cameron	Otter Rock Oyster Company
Aquatic Farm	2001-25A-AF-SE	Krestof Sound	Manning	Thomas	Krestof Clam Company
Aquatic Farm	2001-25B-AF-SE	Bridget Cove	Manning	Thomas	Krestof Clam Company
Nursery	2011-105-NU-SE	Siginaka Islands	Manning	Thomas	Krestof Clam Company
Hatchery	2011-110-HA-SE	OceansAlaska	Marsh	Tomi	OceansAlaska
Aquatic Farm	2007-05-AF-SE	Keku Strait (Kuiu & Kupreanof)	Metcalfe	Peter	Clam Gardens of Alaska
Aquatic Farm	1992-15-AF-SC	Halibut Cove	Miller	Melisa	Halibut Cove Seafoods
Aquatic Farm	2000-18A-AF-SE	Ape Point	Morin	Kurt	Alaska Shellfish
Aquatic Farm	2000-18B-AF-SE	Pt Alava	Morin	Kurt	Alaska Shellfish
Aquatic Farm	2000-18C-AF-SE	Coho Cove	Morin	Kurt	Alaska Shellfish
Aquatic Farm	2006-01-AF-SE	Point Sykes	Morin	Kurt	Alaska Shellfish
Nursery	2006-02-NU-SE	Alaska Shellfish Nursery	Morin (nursery)	Kurt	Alaska Shellfish Nursery
Aquatic Farm	1991-22A-AF-SC	Jakolof Bay	Nakada	Mike	Northern Lights Oyster Company
Nursery	2003-03-NU-SE	Tuxekan Narrows	Inc.	Naukati Bay	Naukati Bay Shellfish Nursery
Aquatic Farm	1990-11-AF-SE	Canoe Lagoon/Fools Bay	Nicholson	Don/Sharon Gray	Canoe Lagoon Oyster Co.
Aquatic Farm	1991-21A-AF-SC	Jakolof Bay	Olsen	Eric	Sunset Cove Oyster Farm
Aquatic Farm	2009-107-AF-SE	Shikat Bay	Parsley	Gregg	Shikat Bay Osyters Inc.
Aquatic Farm	2000-08-AF-SC	Halibut Cove	Pierce	Rick/Therese	K-Bay Oyster Company
Aquatic Farm	1991-22A-AF-SC	Jakolof Bay	Reveil	Margo	Jakolof Bay Oyster Company
Aquatic Farm	2000-09-AF-SC	Halibut Cove	Ruddy	Susan	Lighthouse Point Oysters LLC
Aquatic Farm	1990-21A-AF-SE	Kahli Cove	Ryggs	Jerry Larry/Linn	Oysters LLC
Aquatic Farm	1990-21B-AF-SE	Kahli Cove	Ryggs	Jerry Larry/Linn	Oysters LLC
Aquatic Farm	2000-10-AF-SC	Bear Cove	Rykaczewski	Steven	Early Tide Seafarms
Aquatic Farm	2011-106-AF-SE	Clover Passage	Sande	Trevor	DBA Marble Seafoods
Aquatic Farm	1991-08A-AF-SC	Ragged Point	Sczawinski	Dave	Pristine Products
Aquatic Farm	1991-116-AF-SC	Peterson Bay	Seims	Gary	Seims Sea Farms
Aquatic Farm	2009-109-AF-SE	Heceta Island	Sheets Jr	Michael	Alaskan Half Shell Oysters LLC
Aquatic Farm	1991-117-AF-SC	Halibut Cove	Sidelinger	Kevin	Sea Farms of Alaska
Aquatic Farm	1992-24-AF-SC	Jakolof Bay	Steele	Jeffrey	Northern Pride Seafoods LLC
Aquatic Farm	2004-01-AF-SE	Jakolof Bay	Steele	Jeffrey	Northern Pride Seafoods LLC
Aquatic Farm	2005-04-AF-SE	Peratrovitch Island	Tew	Todd	none
Aquatic Farm	1991-26A-AF-SC	South Bay/Perry Island	Van Hyning	Jon	Aquabionics Inc.
Aquatic Farm	2009-113-AF-SE	Steamer Bay Intertidal Site	Weltzin	Jeff	Alaska Wilderness Gourmet
Aquatic Farm	1992-24-AF-SC	Jakolof Bay	Wheeler	James	Clam Gulch Seafoods LLC
Aquatic Farm	2011-104-AF-SE	Hamilton Bay	Williams	Gary	Organized Village of Kake
Aquatic Farm	2003-01-AF-SE	Tokeen Bay	Wyatt	Eric	Blue Starr Oyster Co
Nursery	2003-01-NU-SE	Tokeen Bay	Wyatt	Eric	Blue Starr Oyster Co
Aquatic Farm	2002-01A-AF-SE	South Sykes	Zaugg	Gary	Pac Alaska
Aquatic Farm	2002-01B-AF-SE	West Gravina	Zaugg	Gary	Pac Alaska

Table 2.−List of approved in-state shellfish seed providers.

Business Name (Waterbody Location)	Contact Information	Available Seed	Scientific Name	Broodstock Origin	Good through
Alutiiq Pride Shellfish Hatchery (Land-based—Seward)	Jeff Hetrick P.O. Box 369 Seward, AK 99664 jjeffhetrick@gmail.com 907.224.5181 (phone) 907.224.5282 (fax)	Pacific Oyster	*Crassostrea gigas*	Whiskey Creek Shellfish Hatchery, Oregon	2/29/2016
		Geoduck Clam	*Panopea generosa*	Outside the eastern border of Vallenar Bay, Gravina Island, Alaska	2/29/2016
Blue Starr Oyster Co. Nursery (Tokeen Bay) (Note: Nursery FLUPSY owned by Sealaska Corporation subsidiary, Haa Aani, LLC)	Eric Wyatt Blue Starr Oyster Co P.O. Box 369 Craig, AK 99921 alaskan@bluestarroysters.com 406.235.6059 (phone) 907.401.1372 (cell)	Pacific Oyster	*Crassostrea gigas*	Mixed West Coast	Approved only 12/31/2013
Eagle Shellfish Farm (Simpson Bay)	James Aguiar P.O. Box 2211 Cordova, AK 99574 jaguiar@yahoo.com 907.253.3481 (phone)	Pacific Oyster	*Crassostrea gigas*	Mixed West Coast	2/29/2016
Kachemak Growers Shellfish Cooperative Nursery (Halibut Cove)	Sean Ruddy/Sean Crosby Kachemak Shellfish Mariculture Association P.O. Box 416 Homer, AK 99603 Info@alaskaoyster.com 907.399.1595 (phone) 907.299.1932 (cell)	Pacific oyster	*Crassostrea gigas*	Mixed West Coast	2/29/2016
Naukati Bay, Inc. Shellfish Nursery (Naukati Bay)	Candy Hempel Naukati Bay, Inc. – NKI Box 1 Naukati, AK 99950 igrow2010@gmail.com 907.629.4142 (phone)	Pacific Oyster	*Crassostrea gigas*	Mixed West Coast	2/28/2016
OceansAlaska Hatchery and Remote Setting Nursery (Georges Inlet)	Tom Henderson P.O. Box 6383 Ketchikan, AK 99901 TomHenderson@OceansAlaska.org 907.225.7900 (phone) 907.247.7900 (fax)	Pacific Oyster	*Crassostrea gigas*	Coast Quilcene Hatchery, Washington	2/28/2014

Table 3.−List of certified out-of-state shellfish seed providers.

Business Name	Contact Information	Available Seed	Scientific Name	Broodstock Origin	Good thru
Coast Seafoods Company (Land-based facility, Quilcene, WA)	Sherry Kilmer Site Manager Quilcene Office P.O. Box 327 Quilcene, WA 98376-0327 jedwards@coastseafoods.com 800.423.2303 (toll-free) 360.765.3345 (phone) 360.765.3045 (fax)	Pacific Oyster (eyed larvae only) Pacific Oyster (seed < 20 mm only) Pacific Oyster (seed < 20 mm only)	*Crassostrea gigas* *Crassostrea gigas* *Crassostrea gigas*	Coast Quilcene Hatchery, Washington Coast Quilcene Hatchery, Washington Coast Humboldt Nursery, California	2/28/2014 2/28/2014 2/28/2014
Whiskey Creek Shellfish Hatchery (Land-based facility, OR)	Sue Cudd Owner/Manager 2975 Netarts Bay Road W. Tillamook, OR 97141 whiskeycreek1@mac.com 503.815.8323 (phone) 503.842.6426 (cell)	Pacific Oyster (eyed larvae only)	*Crassostrea gigas*	Netarts Bay, Oregon Willapa Bay, Washington	2/28/2014 2/28/2014

Table 4.–2013 Shellfish production and farm gate value in Alaska.

		Oysters	Clams	Mussels	Total Aquatic Farm Product	Total Hatchery and Nursery Shellfish Larvae and Seed	All Shellfish Sales
SE Region	*Numbers*	612,108	-	-	612,108	2,416,987	
	Pounds	-	7,834	-	7,834	-	
	Sales	$301,603	$46,964	$0	$348,567	$84,463	$433,030
SC Region	*Numbers*	606,743	-	-	606,743	2,601,000	
	Pounds	-	-	1,889	1,889	-	
	Sales	$410,742	$0	$9,837	$420,579	$72,820	$493,399
Alaska Total	*Numbers*	1,218,851	-	-	1,218,851	5,017,987	
	Pounds	-	7,834	1,889	9,723	-	
	Sales	$712,345	$46,964	$9,837	$769,146	$157,283	$926,429

Note: Data obtained from 2013 Operator Annual Reports, ADF&G mariculture program confidential files.

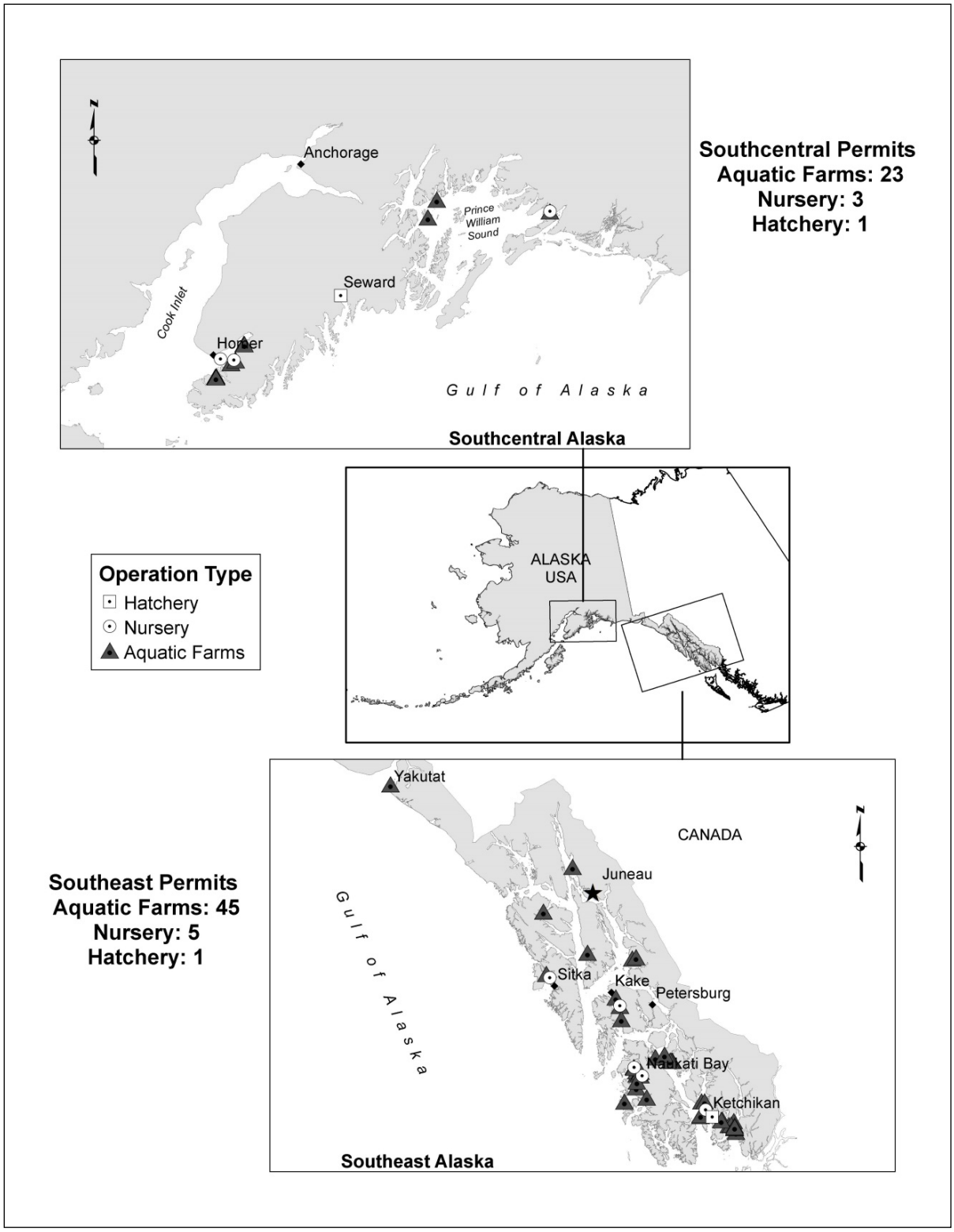

Figure 1.−Aquatic farms, nurseries, and hatcheries permitted to operate in Alaska in 2013.

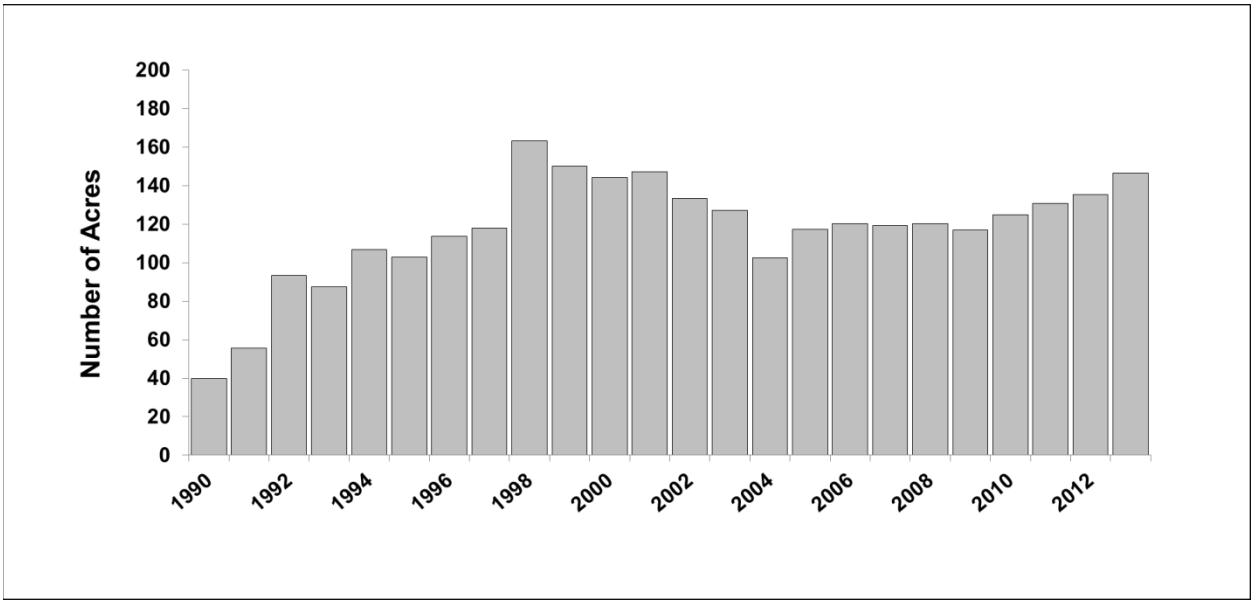

Figure 2.−Number of developed acres of aquatic farms with sales, 1990−2013.

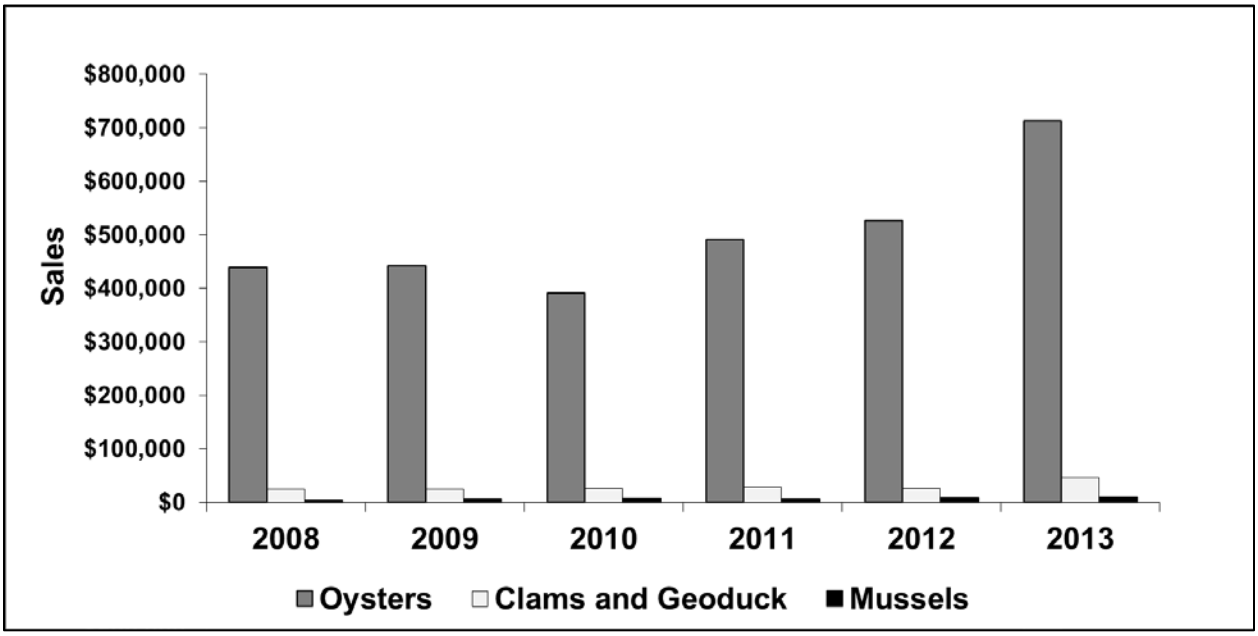

Figure 3.−Aquatic farm sales by species, 2008−2013.

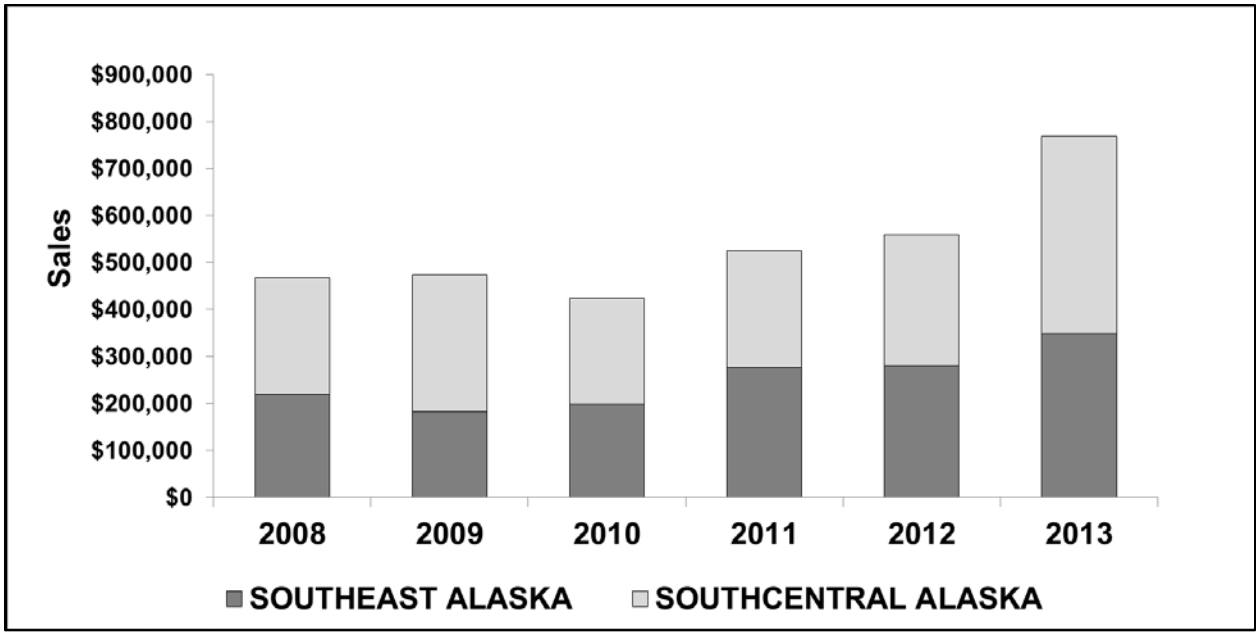

Figure 4.−Aquatic farm sales by region, 2008−2013.

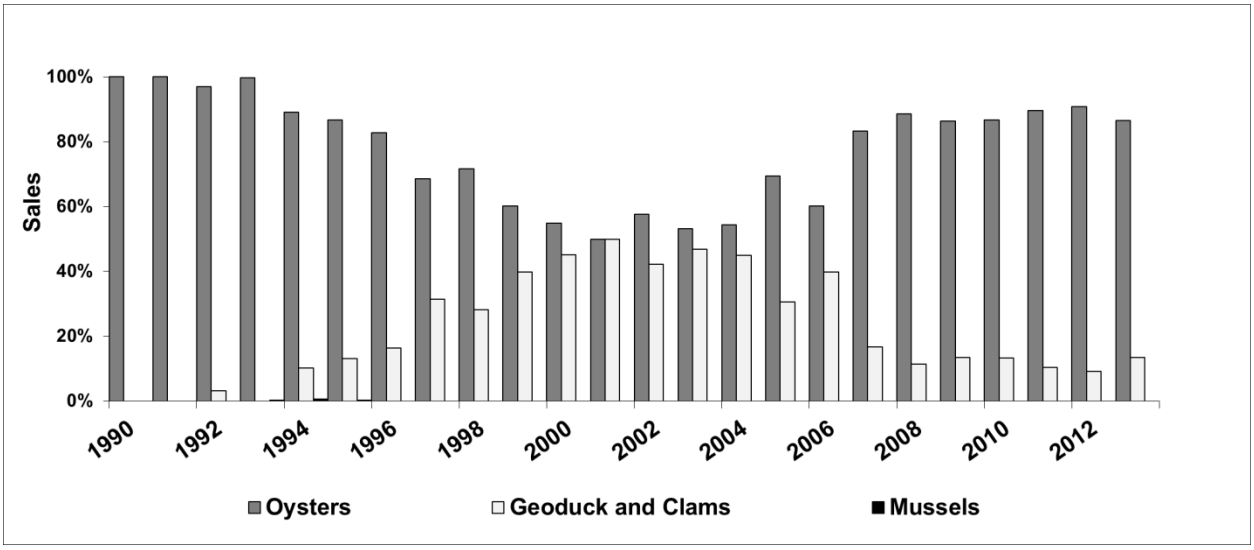

Figure 5.−Percentage of aquatic farm sales by species for Southeast Region, 1990−2013.

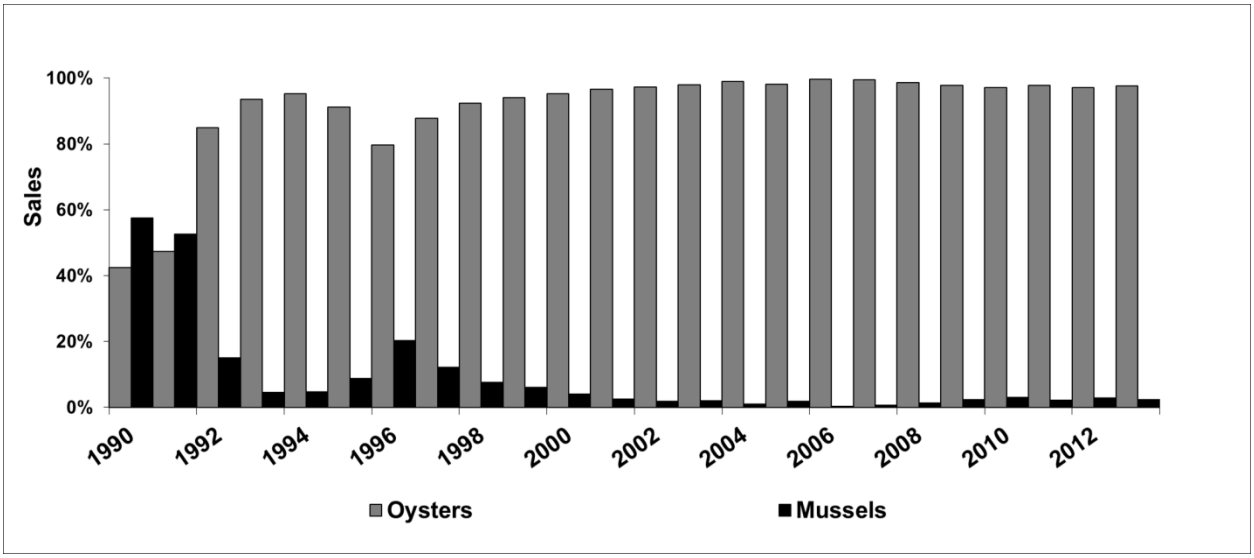

Figure 6.−Percentage of aquatic farm sales by species for Southcentral Region, 1990−2013.

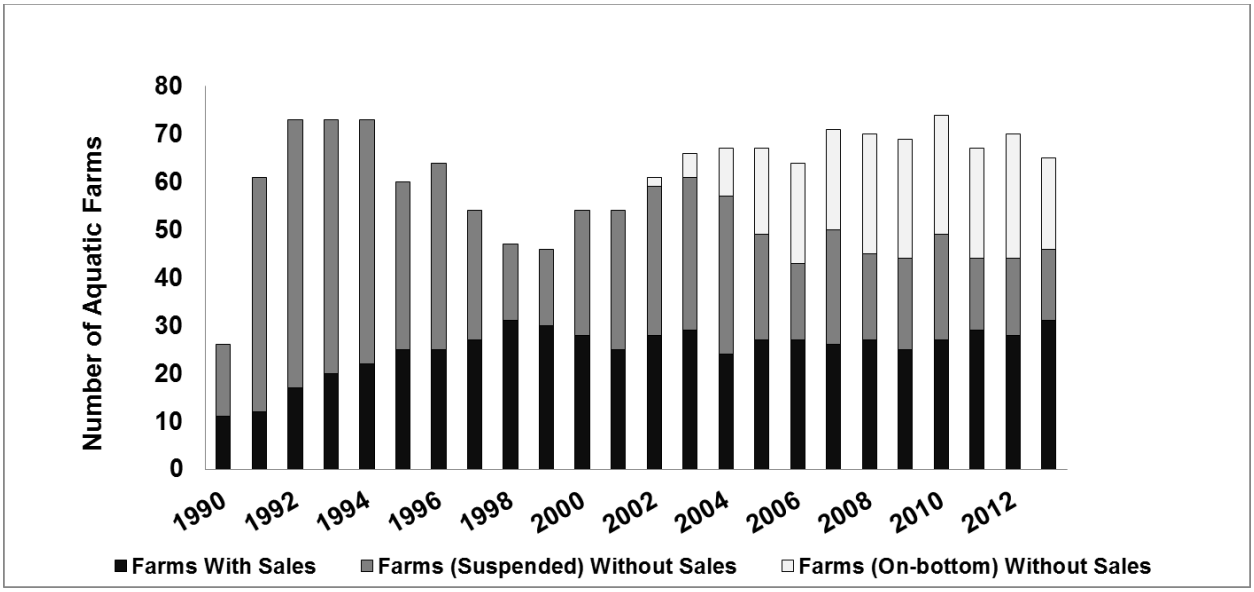

Figure 7.−Permitted aquatic farms with and without sales, 1990−2013.

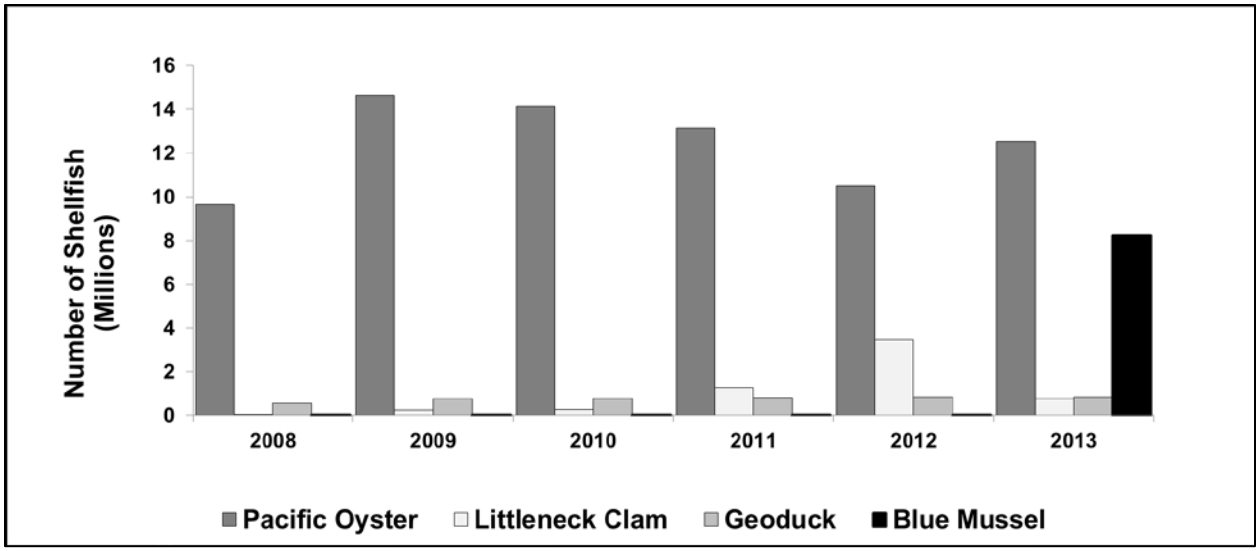

Figure 8.−Principal aquatic farm product end-of-year inventory, 2008−2013.

Note: Inventory includes acquired seed each year.

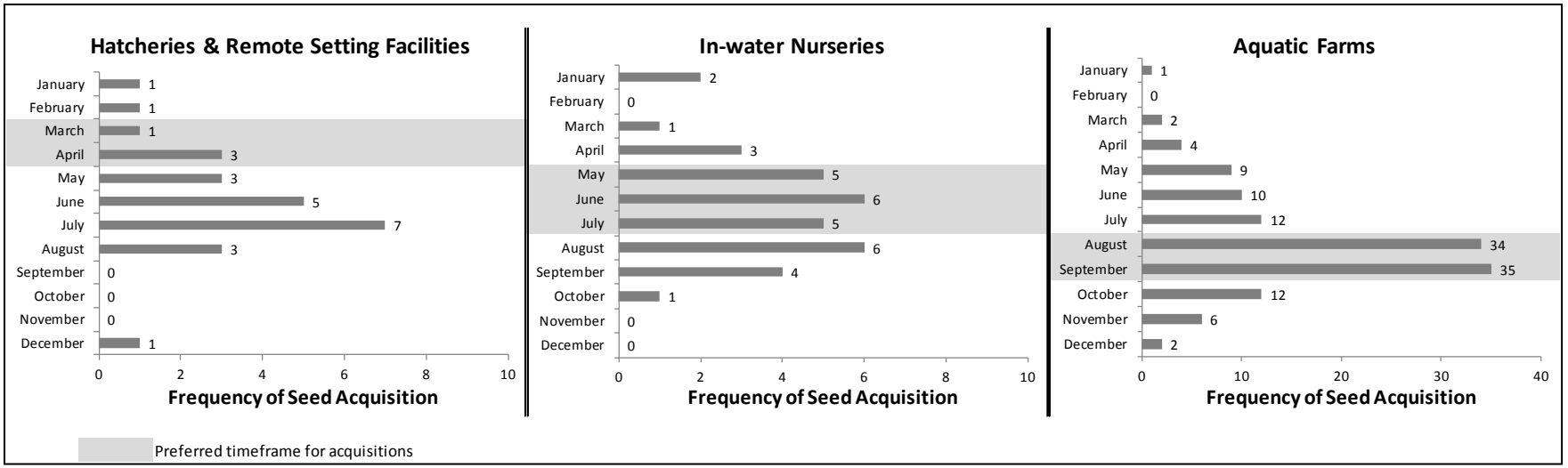

Figure 9.−Timing and frequency of seed acquisitions by hatcheries and remote setting facilities, inwater nurseries, and aquatic farms in Alaska.

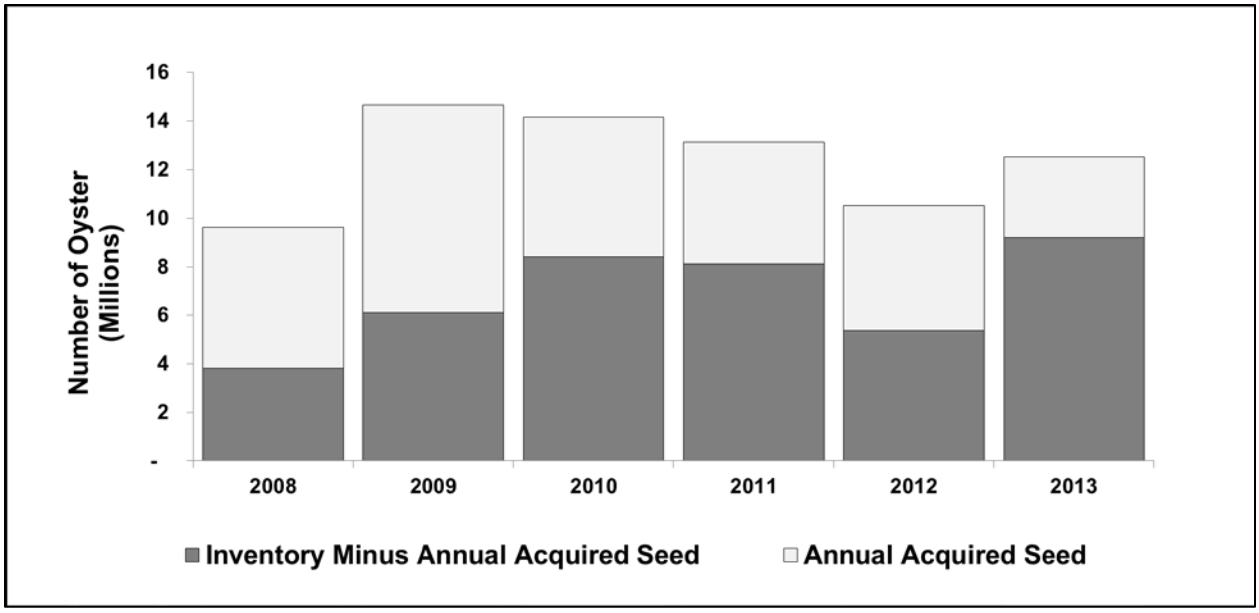

Figure 10.−Pacific oyster inventory and annual acquired seed, 2008−2013.

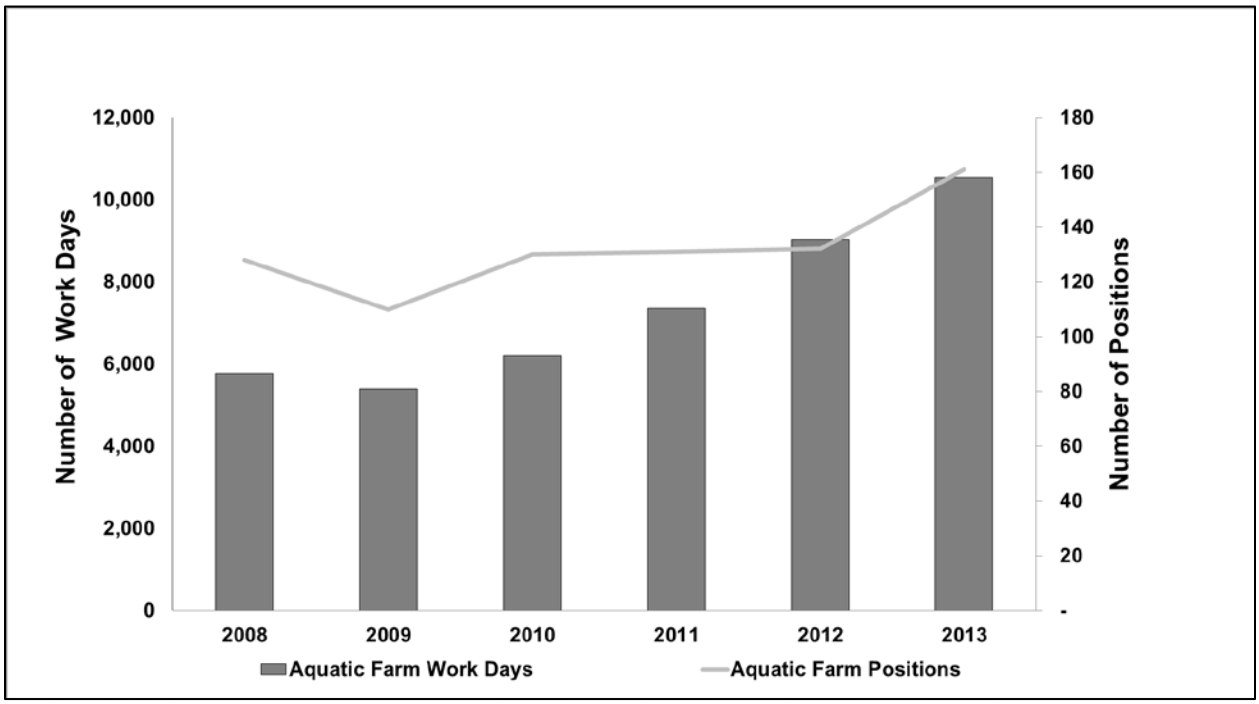

Figure 11.−Number of positions and days worked on aquatic farms, 2008−2013.

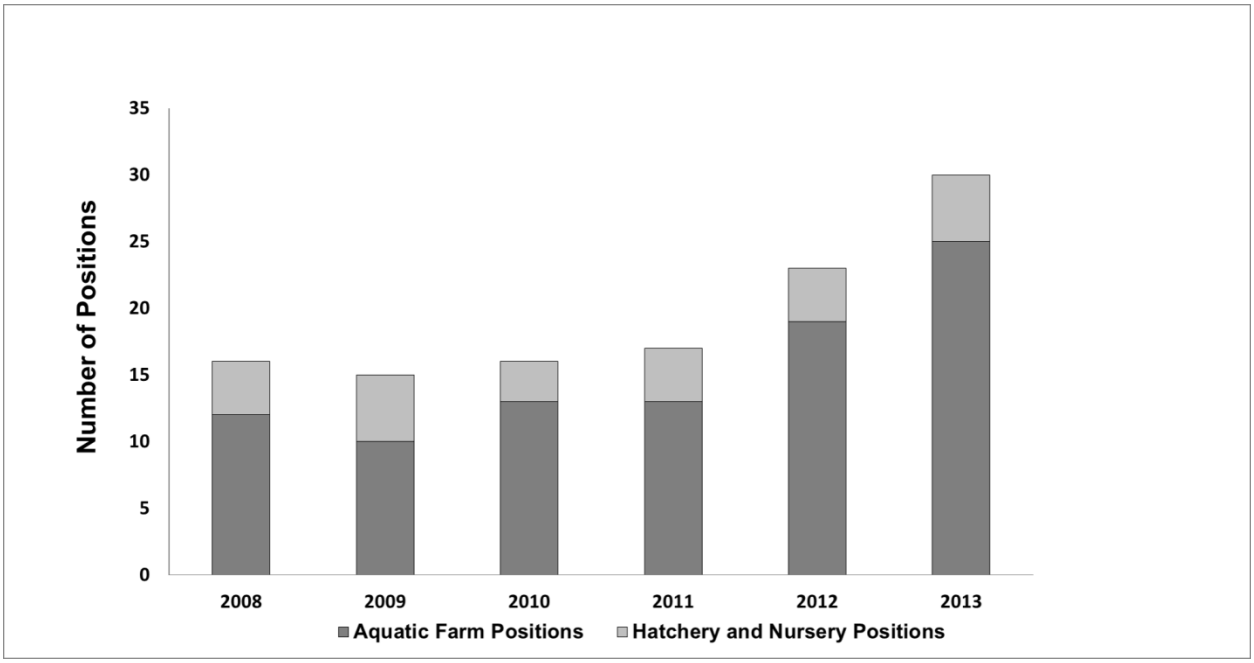

Figure 12.−Number of positions working more than 150 days at aquatic farms, hatcheries, and nurseries, 2008−2013.

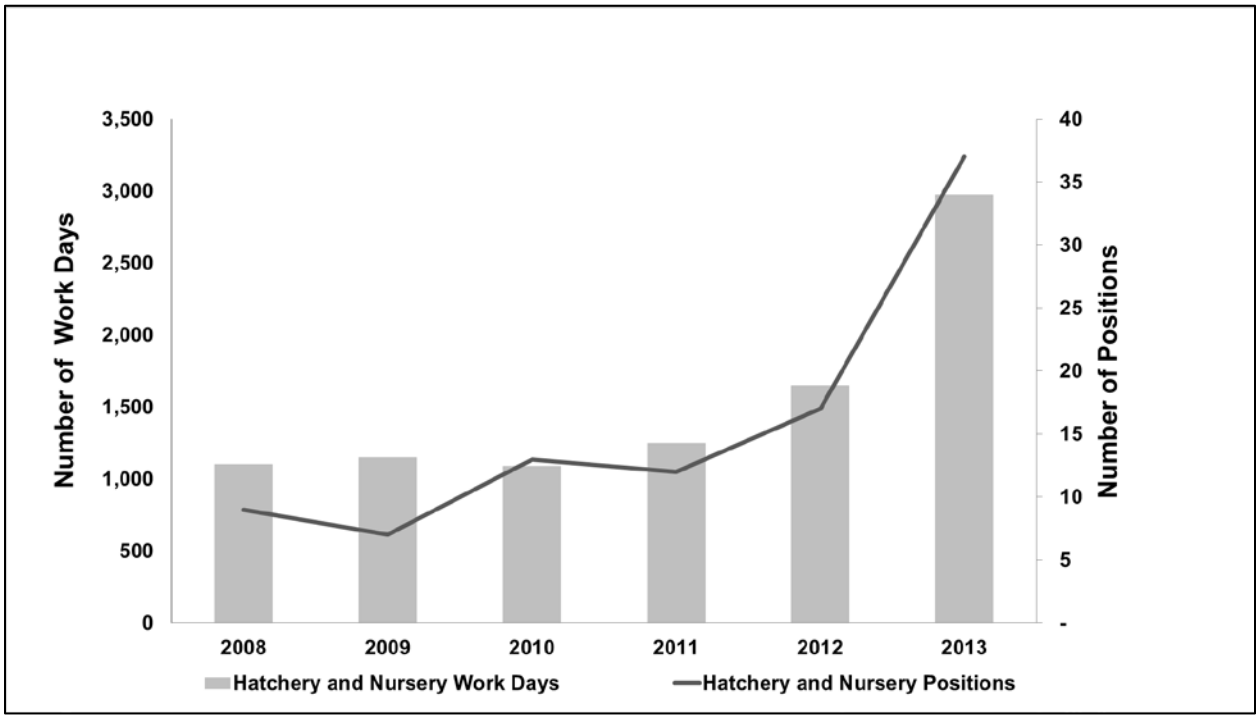

Figure 13.−Number of positions and days worked on hatcheries and nurseries, 2008−2013.

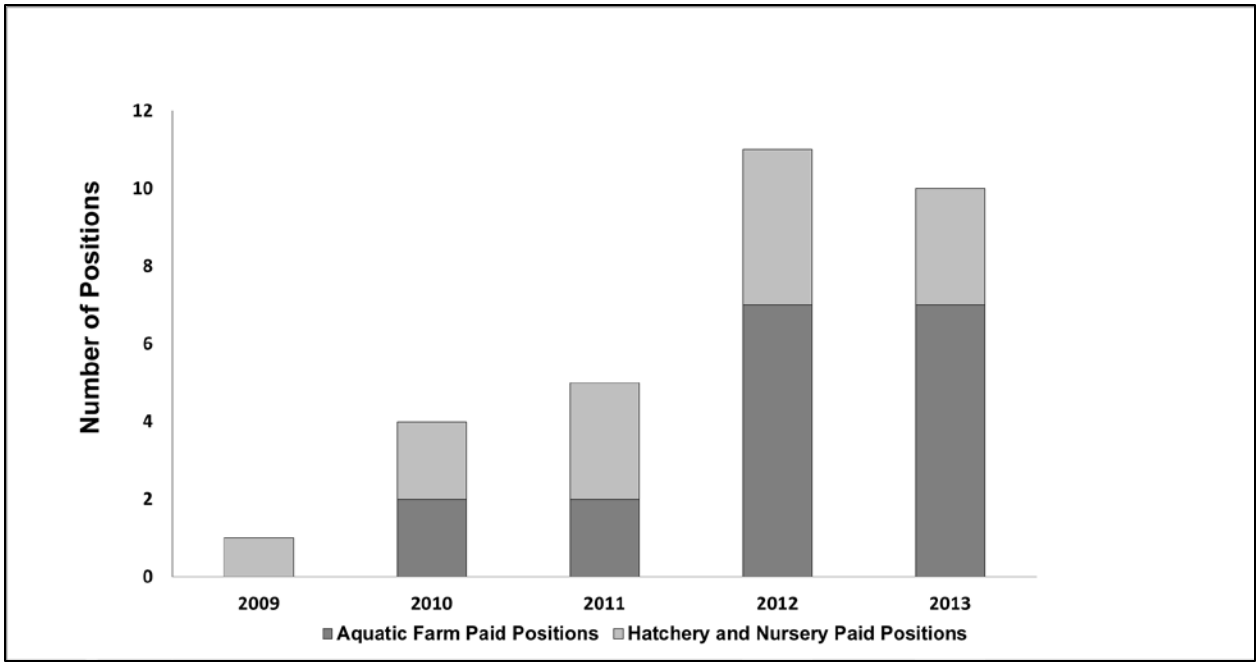

Figure 14.−Number of paid positions working more than 150 days at aquatic farms, hatcheries, and nurseries, 2009−2013.

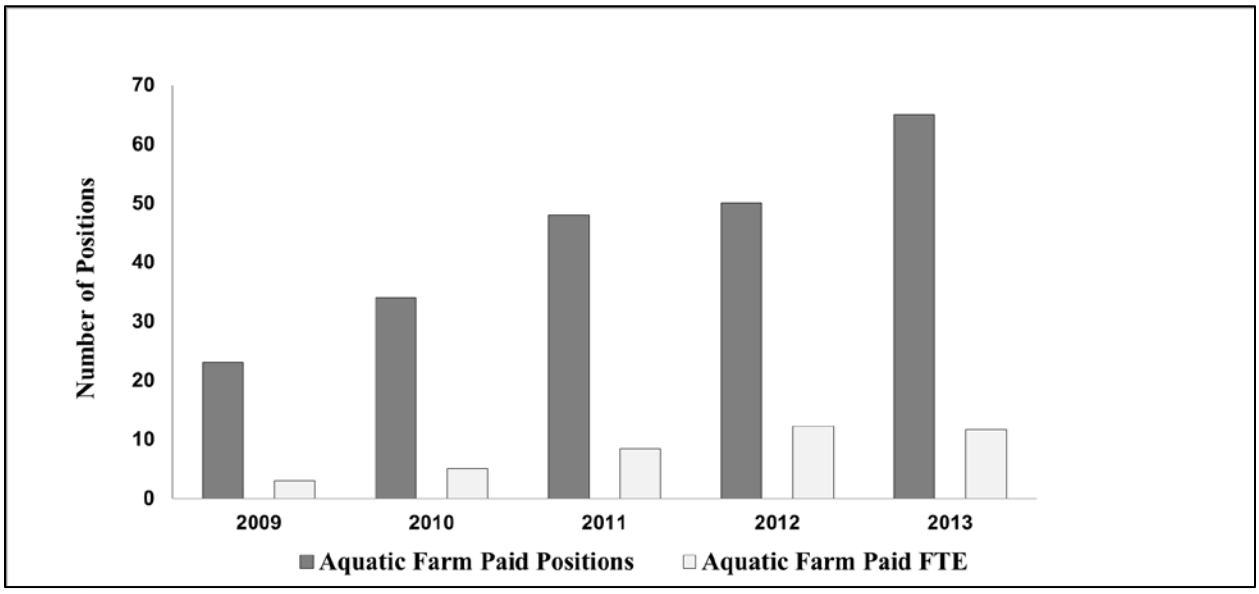

Figure 15.−Number of paid positions (full- and part-time combined) and calculated total full-time employees (FTE) working at aquatic farms.

Note: One FTE = 260 days.

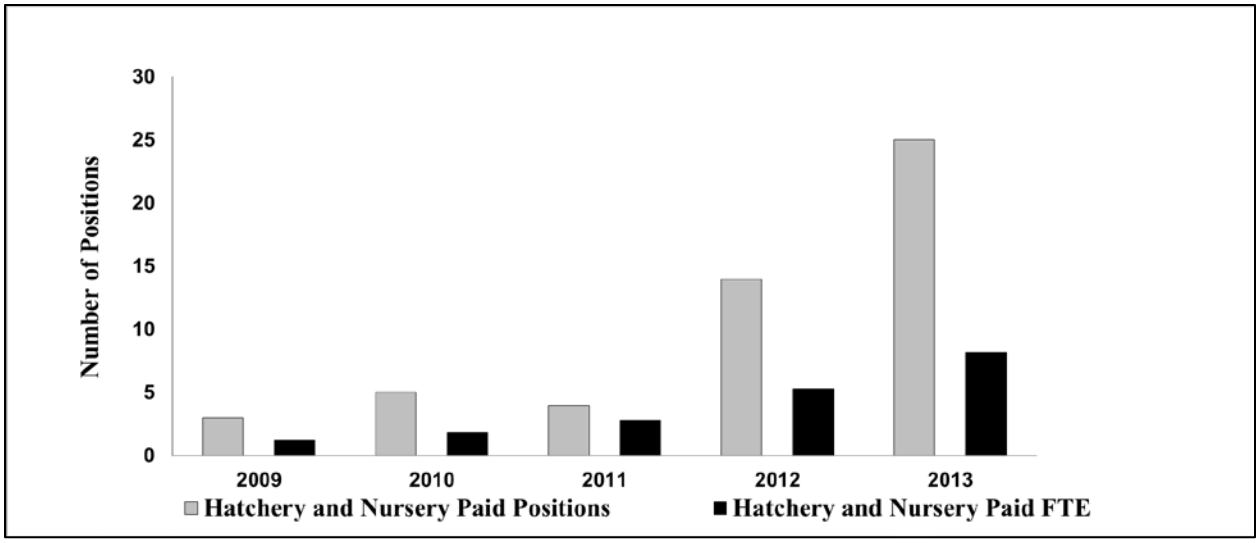

Figure 16.−Number of paid positions (full- and part-time combined) and calculated total full time employees (FTE) working at hatcheries and nurseries.

Note: One FTE = 260 days.

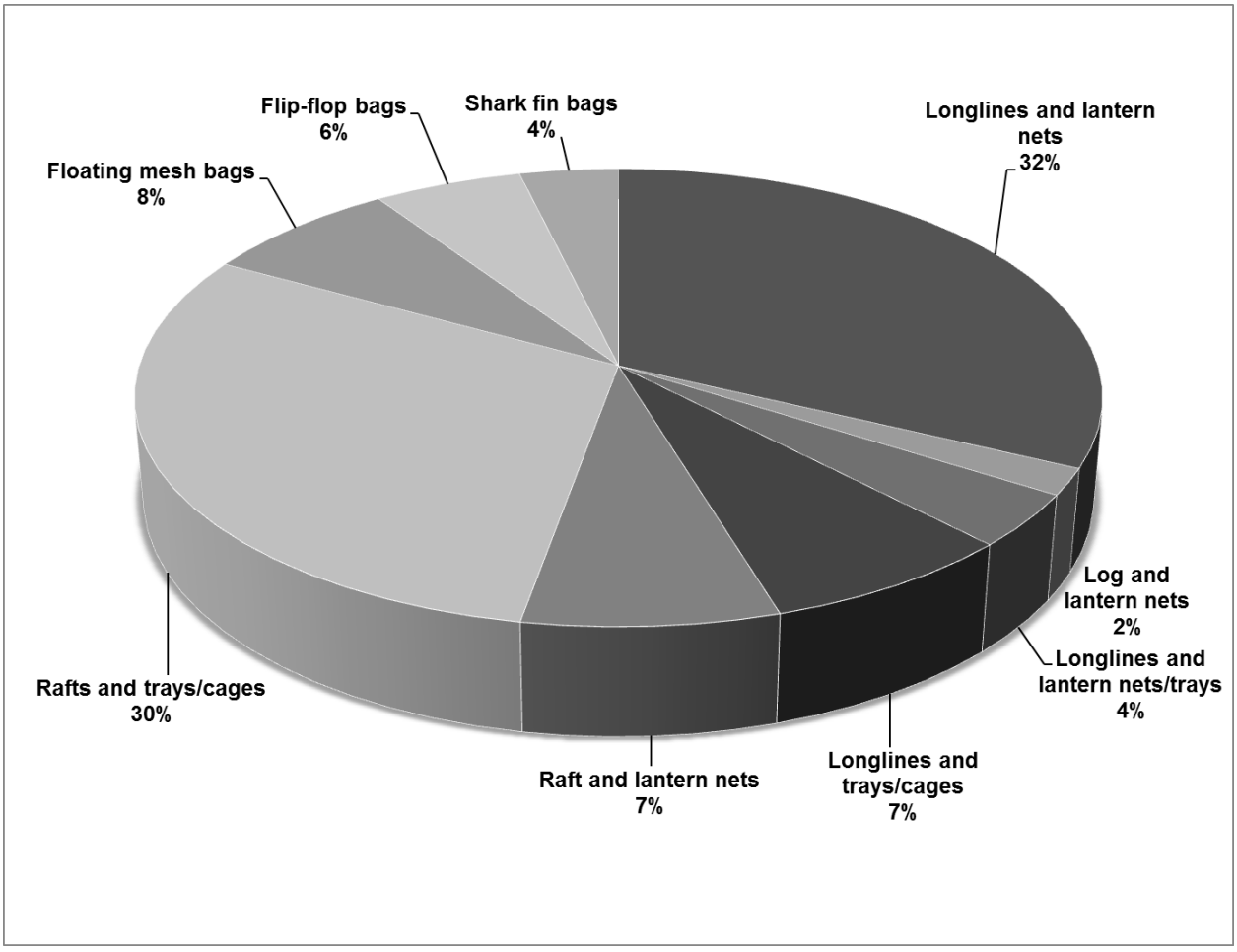

Figure 17.–Percentage of culture gear types used to grow Pacific oyster.