Fishery Management Report No. 15-42

2014 Annual Mariculture Status Report

by

Cynthia Pring-Ham

and

Vincent Politano

November 2015

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

Symbols and Abbreviations

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Weights and measures (metric)

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

Weights and measures (English)

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

Time and temperature

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

Physics and chemistry

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

General

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

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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Alaska Department of Fish and Game
Division of Sport Fish, Research and Technical Services
Raspberry Road, Anchorage, Alaska 99518-1565

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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.

Cynthia Pring-Ham
Alaska Department of Fish and Game, Division of Commercial Fisheries,
P.O. Box 115526, Juneau, Alaska 99811-5526, USA

and

Vincent Politano
Alaska Department of Fish and Game, Division of Commercial Fisheries,
P.O. Box 115526, Juneau, Alaska 99811-5526, USA

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ABSTRACT

With the enactment of the Aquatic Farm Act in 1988, the Alaska Department of Fish and Game implemented regulations for aquatic farming of shellfish and aquatic plants and established the mariculture program. This program oversees the permitting of aquatic farm, hatchery, and nursery operations; stock transport and acquisitions; seed source authorizations; and collection of annual operation activity data including production and sales data. Statutes, regulations, and polices for aquatic farm and hatchery activities provide for industry development while still protecting the state's fish and wildlife resources and their habitat. Permitted operations must use managed cultivation practices that are technically and operationally feasible and sustainable, and demonstrate that they are contributing to the economy and well-being of the state.

In 2014, aquatic farm operations sold over 1.2 million Pacific oysters and over 10,000 lb of blue mussels and Pacific littleneck clams. Hatchery and nursery operations sold 6.7 million juvenile Pacific oysters and 408,000 juvenile Pacific geoducks. The farm gate value for aquatic farm products totaled $870,628 while the seedstock sales added $304,174 to the industry value. The overall total sales for all permitted operations totaled $1.2 million, a 27% increase from the previous year. Paid employment at aquatic farms showed a 14% increase from the previous year, while hatchery and nursery operations showed a 15% decrease. New seed acquisitions purchased for use at aquatic farm operations totaled 6.9 million Pacific oyster and 194,000 Pacific geoduck. Growth of shellfish aquatic farming in Alaska looks promising for the next year based on increasing trends in aquatic farm sales, production, workforce, seed acquisitions, and product inventory. Contributions from in-state hatchery and nursery production are anticipated to grow in order to meet demands for seedstock in-state and outside Alaska.

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, aquatic plants, farm gate value, Aquatic Farm Act

INTRODUCTION

The Aquatic Farm Act[1] became law on June 9, 1988, allowing farming of shellfish and aquatic plants in Alaska. The intent of the legislation was to create an aquatic farming industry in the state that would contribute to Alaska's 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 operations. 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]

Statutory authority passed that allowed 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,[3] (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). Similar authorizations were added to existing statutes used by the Department of Natural Resources (DNR) to permit and regulate use of state tideland and submerged waters

[1] Section 19, Chapter 145, Session Laws of Alaska (SLA), 1988; HCS CSSB 514.
[2] Section 2, Chapter 91, SLA 1990.
[3] As defined in AS 16.40.198, means a facility for the artificial propagation of stock, including rearing of juvenile aquatic plants or shellfish.

for aquatic farming, and to allow the Department of Environmental Conservation to oversee food safety of shellfish for human consumption.

To implement the statutes, ADF&G developed regulations (5 AAC 41.100–199) to administer the aquatic farm and hatchery permitting. These became effective on April 10, 1988, and were further refined on August 12, 1989. The regulations (1) required a person to obtain an operation permit to construct and operate an aquatic farm or a hatchery (a hatchery supplies shellfish and aquatic plant stock to an aquatic farm), and (2) provided ADF&G the ability to issue various permits 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

The statutes, AS 16.40.199(8), defined "shellfish" as a species of crustacean, mollusk, or other invertebrate, in any stage of its life cycle, that is indigenous to state water, or that is authorized to be imported in the state under a permit issued by the commissioner. This provided the authority to import Pacific oyster, a species not native to Alaska and that does not reproduce in the waters of Alaska. Although the state prohibits the transport of nonnative species into the state, an exception was made by the Board of Fisheries that allowed for the importation of live commercially cultured Pacific oysters for aquaculture purposes (5 AAC 41.070). The provision provided needed seedstock to aquatic farm operations in the state. Transport conditions for juvenile Pacific oysters into Alaska specify that only oyster broodstock cultured for 3 or more generations on the Pacific Coast of North America be used to produce progeny (or spat) for import. In addition, importating Pacific oyster spat requires that there be an "acceptable disease history," meaning that there has been no incidence of diseases exotic to the state or considered a risk to local stocks (i.e., oyster health or marketability).

To ensure that imported Pacific oysters had no pathogens of transport concern, ADF&G developed shellfish health and disease control protocols to certify Pacific oyster from out-of-state seed sources (Meyers 2014). Only juvenile Pacific oysters (≤20 mm), may be imported into the state. This reduces the risk of the pathogen, *Mytilicola* sp., which is in most Pacific Northwest stocks. Additional requirements for in-state shellfish hatchery and seed distribution facilities that transport live oysters and other indigenous species within Alaska were established to further prevent 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 Pacific littleneck clam and Pacific geoduck, both indigenous 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. ADF&G denied these permit applications. In February 2000, an applicant filed a lawsuit[4] against ADF&G's decision.

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

The Alaska Supreme Court ruled in 2004 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[5] 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. Now, new proposed aquatic farm sites can only have an insignificant population of Pacific geoducks. Once permitted, permit holders can remove these naturally occurring Pacific geoduck clams inside the aquatic farm site boundary as part of their operations; however, they must notify ADF&G and report their harvest of wild stock landings on fish tickets.

For existing permitted operation sites that held a significant amount of Pacific geoduck, provisions allowed 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. Further modifications in regulations allowed operators to request a determination to change the status of the remaining Pacific geoducks on the site from wild stock to aquatic farm product after they meet specific criteria (i.e., harvesting wild stock and reseeding) at the permitted site. These provisions help maintain important safeguards for conserving Pacific geoduck resources while being consistent with previous court decisions and the state's objective to expand the industry.

PROCESS FOR OBTAINING AN AQUATIC FARM OR HATCHERY OPERATION PERMIT

Any person that wants to construct and operate an aquatic farm or a hatchery (a hatchery supplies aquatic plants or shellfish to an aquatic farm), has to have a valid operation permit from the commissioner. An aquatic farm, as defined in AS 16.40.199(1), is a facility that grows, farms, or cultivates aquatic farm products in captivity or under positive control. A hatchery, as defined in AS 16.40.199(5), is a facility for the artificial propagation of stock, including rearing of juvenile aquatic plants or shellfish. Nursery operations, like hatcheries, rear and supply stock for use by aquatic farms, but do not artificially propagate stock. Nursery activities are included in the hatchery definition and can be further delineated as a *remote setting nursery*, which is a facility that rears eyed larvae, or an *in-water nursery*, which is a facility that rears juvenile seedstock in a FLoating UPweller SYstems (FLUPSYs).

Applicants can apply to construct and operate an aquatic farm, hatchery, or nursey by submitting a multi-agency application during the filing period. Reviews of permit applications begin after the January 1 and April 30 openings each year. Most of the lands, including tidelands or submerged lands, are state owned and to utilize these lands requires a state lease. DNR is the lead agency for aquatic farming and coordinates the review of proposed aquatic farm and hatchery operations. Applications are distributed by DNR to the various agencies, including ADF&G and Department of Environmental Conservation. The public and local, state, and federal agencies have an opportunity to comment as part of the public review process before any determination are finalized. DNR administers public notices on project proposals and distributes public comments to appropriate parties and concerned agencies. DNR determines whether a

[5] Section 1–3, Chapter 13 SLA 2005 (HB 198).

lease for the proposed aquatic farming project on state lands is in the best interest of the state. Typically, decisions to issue operation permits follow DNR issuing an aquatic farm lease. Each agency makes a determination based on provisions in their applicable regulations.

Prior to an aquatic farm, nursery, or hatchery operation being permitted by ADF&G, program staff, along with other ADF&G biologists, geneticists, and pathologists, review applications to make sure that operations won't significantly alter existing uses of fish and wildlife resources, or pose significant adverse effects on fish, wildlife, or their habitat. Applicants often choose to participate in pre-application meetings with ADF&G staff to identify potential locations away from existing uses or sensitive habitats—such as anadromous fish streams, eelgrass and kelp beds, herring spawning areas, marine mammal haulouts and rookeries, and seabird colonies. Reviews of the operation's development plan and cultivation techniques are also conducted to determine if the proposed plan is technically and operationally feasible and whether it will improve the productivity (in numbers) of the culture species above what would occur naturally at the site. Once an operation is up and running, all operation activities must be conducted in accordance to operation permit conditions and the approved operation and development plan.

MARICULTURE PROGRAM

PROGRAM ACTIVITIES

The ADF&G Division of Commercial Fisheries mariculture program is responsible for regulating and permitting aquatic farming industry activities within the state and provides regulatory, technical, and planning services to people interested in aquatic farming. Specific authority includes issuing aquatic farm and hatchery operation permits, shellfish/aquatic plant acquisition and stock transport permits; seed source approval (in-state) and certification (out-of-state); and geoduck status determinations. Aquatic farm and hatchery site inspections are conducted jointly with DNR.

2014 Operation Permits

During 2014, the program administered permit oversight of 65 aquatic farms, 7 shellfish nurseries, and 2 shellfish hatcheries (Table 1; Figure 1). Of all permitted operations, 85% had some form of activity during that year (including seed acquisition, inventory, or sales), based on annual reports submitted by permit holders. Ten permitted aquatic farm operations had no activity that year; these included operations that were newly permitted, transferred to a new operator, merged into existing permits, or closed. Mariculture program staff issued 5 aquatic farm operation permits and 5 renewals. One applicant withdrew an application during the review process. Permit holders requested closure of 3 aquatic farms. Prior to getting an aquatic farm permit, some applicants prefer to request a fish resource permit to conduct a site suitability study at a proposed location. Three fish resource permits were issued for these type of projects.

Shellfish/Aquatic Plant Acquisition and Stock Transport Permits

The program issues broodstock acquisition permits for hatcheries, and stock transport permits for approved culture species to, from, and between aquatic farms, nurseries, and hatcheries. Reviews ensure activities are conducted in a manner that protects the health and genetic integrity of Alaska shellfish stocks. To facilitate review and permit issuance, seed sources are *approved* for in-state distribution, or *certified* for out-of-state hatcheries and nurseries for import into Alaska. Disease histories based on pathology examinations of organisms are established for each

location. Acceptable annual shellfish health reports are required for all out-of-state stocks, and the facility must be recertified each year. In-state seed sources also need to establish a disease history and have acceptable pathology examinations.

For 2014, program staff issued 3 acquisition permits to allow shellfish hatchery operations to acquire broodstock for propagative purposes and produce seed for aquatic farms and nurseries. Staff issued approvals for 114 stock transport permits to allow permit holders to transport stock from approved seed supply locations to their permitted operations. This was an increase of 17.5% from the previous year. Of the stock transport permits issued, 70% were for Pacific oyster and 30% were for Pacific geoduck. Four transport permit requests for import from a noncertified out-of-state seed sources were denied. Five noncompliance events occurred where stock transports took place without a valid permit.

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

In-state hatchery or nursery operations which plan on selling and transporting seed are approved as seed distribution facilities once an acceptable disease history is established. Shellfish specimens cultured in the seed source facility are sent to the ADF&G state pathology lab to verify there are no pathogens of concern present. The duration of the approval varies by facility and is dependent on the disease history.

In-state seed source approvals for seed source distribution facilities were issued for Blue Starr Oyster Company Nursery in Tokeen Bay, Prince of Wales Island; and OceansAlaska Hatchery in Ketchikan. Other facilities with multiyear approvals were Eagle Shellfish Farm in Simpson Bay near Cordova, Alutiiq Pride Shellfish Hatchery in Seward, Kachemak Mariculture Association Remote Setting Facility in Homer, Kachemak Shellfish Growers' Association Nursery in Halibut Cove, and Naukati Bay, Inc. Shellfish Nursery in Naukati Bay (Table 2).

Out-of-state hatchery and nursery operations may request certification to import Pacific oysters into Alaska. Pacific oysters are the only nonindigenous species allowed to be imported. Certification is more stringent than the approval process for in-state facilities and requires out-of-state operations to provide acceptable pathology examinations of all stocks cultured at the facility. Propagation of Pacific oyster does not currently occur in Alaska hatcheries so in-state seed sources are dependent on getting smaller Pacific oyster eyed larvae and juvenile seed from Pacific Northwest shellfish hatcheries that are certified out-of-state seed sources. Some aquatic farm operators purchased seed directly from these seed sources as well.

Staff issued certifications to 3 out-of-state hatcheries and associated nurseries; this allowed importation of Pacific oyster eyed larvae or juvenile seed into Alaska. Out-of-state seed sources included Hilton's Coast Seafood Quilcene Hatchery (Quilcene Washington), Hawaiian Shellfish Hatchery and Nursery (Kea'au, Hawaii), and Whiskey Creek Shellfish Hatchery (Netarts Bay, Oregon; Table 3). Staff received reports that 2 pathogens of import concern to Alaska, *M. mackini and Haplosporidium* s*pp*., were found in Pacific oysters from Hilton's Coast Seafood Nursery in Humboldt Bay, CA. Pacific oyster imports from that Humboldt Bay location were restricted.

Geoduck Status Determination

ADF&G requires operators of subtidal aquatic farms to keep track of geoduck wild stock harvest at their sites by using fish tickets. Based on provisions in 5 AAC 41.258, a determination can be made, at the request of the permit holder, as to whether the permit holder has met certain aquatic

farm development criteria to change the status of geoduck remaining on a subtidal aquatic farm from wild stock to aquatic farm product. After this determination, if the geoduck are determined to be aquatic farm product, the permit holder is no longer required to report the landing and submit a fish ticket for Pacific geoduck harvested from the site, but will still have to record harvest number and sales information at the end of the calendar year on an aquatic farm annual report submitted to the ADF&G.

In 2014, staff received no requests for a determination to change the status. Eight geoduck status determinations were made by ADF&G between 2012 and 2014 for on-bottom, subtidal, aquatic farm sites with operation permits approved for the culture of Pacific geoduck.

Inspections

Operations are inspected every other year to insure they are adhering to their permit conditions and applicable regulatory requirements. The inspections also give ADF&G staff an opportunity to see operators' shellfish or aquatic plant products, answer technical or regulatory questions, or address issues operators may be having meeting their business goals or operation and development plans. Inspections check whether approved species are being cultured; culture organisms are being managed according to the operation plans; in-water structures have been maintained, adequately secured, and anchored to prevent grounding; and that no exotic organisms are present that may pose a threat to fish and wildlife and their habitat.

ADF&G staff conducted onsite and flyby inspections at 67% of the 49 permitted operations located in Southeast Alaska. Most operators met staff at their sites and showed them their aquatic farm product. Aerial inspections over 3 permitted and 4 closed aquatic farm operations were also completed.

No onsite underwater inspections took place at the 13 subtidal aquatic farm site operations this year due to the cost of diving on the sites. Previous underwater compliance inspections on subtidal aquatic farm sites by ADF&G divers occurred in 2006 (15 sites inspected) and later in 2011 (one site inspected).

STATUS OF THE AQUATIC FARM INDUSTRY[6]

All aquatic farm, nursery, and hatchery operation permit holders are required to provide an annual report to ADF&G summarizing their activities for the calendar year (5 AAC 41.270). The annual report provides details on the sales, production, seed transport and acquisitions, estimated mortality, and inventory. The report also provides details on development activities of the aquatic farm, nursery, or hatchery operations; installation of new culture gear, equipment and support facilities; and a summary of conditions that may affect the operation production.

In 2014, 70 annual reports were received for 61 aquatic farms, 7 shellfish nurseries, and 2 shellfish hatcheries. A summary of the annual report data and changes from the previous year follows below.

SALES VALUE AND PRODUCTION

In 2014, the overall contribution in sales from all permitted operations (including aquatic farms, in-state hatcheries, and nurseries) totaled $1,174,802 based on farm gate value[7] (Table 4; Figure

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

2). This equates to a $248,372 increase (27%) from the previous year's sales. The last 2 years have had the highest sales recorded for all permitted operations since inception of the program. Overall production totaled 8.3 million Pacific oyster and Pacific geoduck combined, and 10,000 lb of blue mussels and littleneck clams combined—an increase of 14% for numbers produced and 3% for pounds produced from the previous year. Of all the permitted operations, 34 contributed to statewide sales this year.

Aquatic Farm Sales Value and Production

For aquatic farm sales alone, the farm gate value totaled $870,628 in 2014, an increase of 13% from the previous year (Table 4; Figure 3). There were 28 aquatic farm operations selling product this year. The principle aquatic farm product cultured in the state continues to be Pacific oysters (95% of the sales statewide) with 1.2 million sold for a total of $824,188 (Table 4; Figures 3 and 4). Total annual sales for Pacific oyster have been increasing since 2010 (Figure 3). Blue mussel and clams[8] made up the remainder of the sales with 10,000 lb produced for a total of $46,440 (Table 4; Figures 3 and 5). Peak production occurred in 2003 and 2004 for clams[9] and 1992 for blue mussels (Figure 5).

In 2014, production and sales from aquatic farms took place year round with a peak during July and August (Figure 6). Many of the farms without production and sales reported inventory, but required more grow-out time before product reached marketable size.

Statewide aquatic farm production dollar value in Alaska is distributed as follows: 36% for Southern Southeast,[10] 9% for Northern Southeast,[11] 13% for Prince William Sound, and 42% for Kachemak Bay. The average statewide price for Pacific oyster from aquatic farms was $9.60 per dozen. The average statewide price was $5.74 per lb for blue mussels and $8.00 per lb for clams.[12]

Hatcheries and Nurseries Sales Value and Production

Overall bivalve shellfish seedstock sales from in-state hatcheries, remote setting facilities, and in-water nursery operations showed a 93% increase from the previous year, totaling $304,174 (Table 4; Figure 7). Sales came primarily from the production of Pacific oyster seed at nurseries, and secondarily from clam seed production at hatchery operations. Approximately 6.7 million Pacific oyster eyed larvae and juvenile seedstock combined (13% increase) and 408,000 clams[13] (148% increase) were produced in 2014 from these operations (Table 4, Figure 8). Peak production for hatchery and nurseries combined occurred in 2005 for Pacific oysters, and in 2001 for clams.[14] In-state hatcheries are the only facilities where aquatic farm operators can purchase

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[7] The farm gate value can be defined as the unprocessed value, excluding the costs of packaging or transport of the product to its first point of sale.

[8] Clams refer to only littleneck clams for this year.

[9] Clams refer to both littleneck clams and Pacific geoduck for these years.

[10] Southern Southeast includes aquatic farms from South of Port Alexander

[11] Northern Southeast includes aquatic farms from Yakutat to Port Alexander

[12] Clams refer to littleneck clams in this year.

[13] Clams refer to Pacific geoducks in this year.

[14] Clams refer to littleneck clams in this year.

and acquire seedstock for indigenous species. However, Pacific oyster seedstock can originate from either approved in-state or certified out-of-state seed sources.

In 2014, hatchery and nursery sales took place between March and November with peaks during July and August (Figure 9). The average statewide sale price for seedstock from hatchery operations was $10.02 per thousand for Pacific oyster and $83.26 per thousand for Pacific geoduck. The average statewide sale price for Pacific oyster seedstock from nursery operations was $42.20 per thousand.

NEW SEED ACQUISITIONS

Pacific Oyster

Propagation of Pacific oyster does not currently occur in Alaska hatcheries; the majority of the Pacific oyster eyed larvae and small juvenile seed (≤ 20 mm) originates from certified Pacific Northwest and Hawaiian shellfish hatcheries.

Pacific oyster eyed larvae imports from out-of-state seed sources during 2014 totaled 12 million, a drop of 51.5 million (81% decrease) from the previous year. Eyed larvae stock went to hatcheries and remote setting nursery facilities. Small juvenile Pacific oysters from these out-of-state sources totaled 10.5 million, a drop of 59,000 (<1%) from 2013. Juveniles went to hatchery and nursery operations, and a few aquatic farm operations.

New Pacific oyster seed acquired for aquatic farm operations totaled 6.9 million, an increase of 3.6 million oysters from the previous year (107%; Figure 10). Peak acquisition by aquatic farm operations of Pacific oyster occurred in 1998. The proportion of new seed made up 48% of the inventory in 2014 compared to 27% of the inventory in 2013. The number of aquatic farms acquiring Pacific oysters in 2014 has remained relatively stable over the last 2 years (n = 28 in 2014 and n = 26 in 2013).

Pacific oyster eyed larvae and juvenile acquisitions by hatchery and nursery operations totaled 23.7 million, a decrease of 52 million (69%) from 2013 (Figure 12). Pacific oyster acquisitions for these operations peaked in 2006 and 2013. Nurseries had an increase (335%) in new seed stock in 2014 from the previous year, whereas hatcheries had a decrease in seedstock.

Geoduck

In-state seed sources shipped 194,000 Pacific geoducks to 9 aquatic farm operations this year (approximately 300% increase; Figure 11). Peak acquisition for Pacific geoducks at aquatic farms was in 2007.

In-state seedstock acquired by both hatchery and nursery operations in 2014 totaled 2.5 million (844% increase). The availability of geoduck seedstock for sale to aquatic farm operations from these operations increased this year.

Other Species

Aquatic farms also acquired 13 million blue mussels on culture gear from natural sets (51% increase). Bull kelp, giant kelp, green sea urchin, purple sea urchin, purple-hinged rock scallop, and sea cucumber were acquired on culture gear from natural sets, but figures are confidential.

Seed shortages

Ninety-nine acquisition shipments of seed stock occurred in 2014. The frequency of seed acquisition by hatchery, remote setting nursery, in-water nursery, and aquatic farm operations in this year is summarized in Figure 13. Acquisitions occurred in all months except January. Hatcheries and remote setting facilities began acquiring seed in February and continued through July. Hatcheries and remote setting facilities reported no acquisitions in the months of May and between August and December. Inwater nurseries began acquiring seed in April and continued through November with peaks in May and August. Aquatic farms began acquiring seed in March and continued through December with peaks in August and September. Thirty-six aquatic farm operations acquired seed in 2014 (20% increase). Eight aquatic farm operations acquired seed directly from hatchery and remote setting nursery operations and the remaining 24 aquatic farm operations acquired seed from in-water nursery operations or other aquatic farm operations.

Seed shortages have plagued the industry since aquatic farming began in Alaska. Aquatic farm operations acquired an average[15] of 62% of Pacific oysters requested, and 47% of Pacific geoduck requested. Hatcheries acquired 20% of the Pacific oyster eyed larvae requested, 38% of Pacific oyster juveniles requested, and 6% of the Pacific geoduck juveniles requested. Nurseries acquired 100% of the Pacific oyster eyed larvae requested, 63% of the Pacific oyster juvenile seed requested, and 40% of the Pacific geoduck juvenile seed requested. Overall mean percent acquired for all species and all operation types was 56% of requested seedstock.

INVENTORY

At the end of 2014, 58 of 70 operations (83%) completing annual reports had aquatic farm product inventory. The primary aquatic farm inventory included approximately 14.5 million Pacific oysters, 969,000 geoduck, 425,000 blue mussels, and 238,000 Pacific littleneck clams (Figure 14). Operations also had green sea urchins in smaller quantities, but the data is confidential. Peak inventory for aquatic farms occurred in 2013 and 2000.

Pacific oyster inventory for aquatic farm operations increased by approximately 2 million (16% increase) from the previous year (Figure 15) and made up 90% of the aquatic farm inventory. Inventory for this species peaked in 2001. Pacific geoduck inventory has increased by approximately 131,000 (16%; Figure 16). Inventory has slowly increased every year since 2002. Estimates of blue mussel inventories, originating from natural sets collected on ropes, decreased by 7.8 million (95%).

Between 2013 and 2014, Pacific oyster seed inventory at hatchery and nursery operations, decreased by 784,000 (15%; Figure 17). Peak inventory for Pacific oysters occurred in 2005 for these operations. During the same time period, inventory of Pacific geoduck increased by 2,000; peak inventory was observed in 2001.

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

[15] Mean percent acquired was determined by comparing the maximum numbers of seedstock an operator requested from an approved or certified seed source on their approved stock transport permit and the actual number acquired by an operator from that source,

an aquatic farm to keep labor costs down. Hatcheries and nurseries tend to have more paid full-time and seasonal employees.

Aquatic Farm Operations

Aquatic farm operation positions and number of days worked have steadily increased over the years as more operations are started and grow. The number of all positions working at aquatic farms has increased from 166 to 185 (11%), the highest of all years (Figure 18). Aquatic farm operations increased the number of days worked by 3%, from 11,003 workdays in 2013 to 11,345 workdays in 2014 (Figure 19). Peak days worked at aquatic farms occurred in 2002. Only 22 aquatic farm positions worked more than 150 days. Approximately 64% of the total positions reported were aquatic farm laborers (not the permit holder/owner). Paid aquatic farm workers made up 43% of all workers. Paid positions increased 14%, from 70 paid positions in 2013 to 80 paid positions in 2014. The number of days paid employees worked on aquatic farms increased by 28%, from 3,484 in 2013 to 4,448 days in 2014.

Hatchery and Nursery Operations

The number of positions and days worked at hatchery and nursery operations have also increased steadily over the years, similar to the trend at aquatic farms. However, between 2013 and 2014, the number of all hatchery and nursery positions combined decreased by 15% from 39 positions in 2013 to 34 positions in 2014 (Figure 18). The number of days these positions worked at hatchery and nursery operations decreased by 18%, from 2,559 workdays in 2014 to 3,120 workdays in 2013 (Figure 18). Peak days worked and number of workers at aquatic farms both occurred in 2013. Most of this increase was from nursery operations. Only 6 hatchery and nursery positions worked more than 150 days. Approximately 82% of the total positions reported were laborers (not the permit holder/owner). Paid positions in shellfish hatchery and nursery operations decreased by 15% from 26 positions in 2013 to 22 positions in 2014. The number of days paid employees worked at these operations decreased by 21%, from 2,252 days worked in 2013 to 1,777 days worked in 2014.

Pacific Geoduck Wild Stock Harvest Landings

An interim use permit issued from the Commercial Fisheries Entry Commission is required in order to harvest wild stock Pacific geoducks from an aquatic farm. During 2014, 2 interim use permits were issued by the Commercial Fisheries Entry Commission.[16] According to fish tickets, no wild stock Pacific geoducks have been harvested from aquatic farms in this year. From 2006 to 2014, the cumulative harvest of wild stock Pacific geoduck on 10 permitted subtidal aquatic farms totaled 90,170 lb, equivalent to 40,056 individual Pacific geoduck (Table 5).[17]

INDUSTRY TRENDS AND ISSUES

Seed Availability

The industry continues to be very reliant on Pacific oyster seed from certified out-of-state seed suppliers. Due to the high cost of energy for algae production to feed oysters, and the labor resources and overall effort involved in conditioning and propagating broodstock, both in-state

[16] Data from Commercial Fisheries Entry Commission Public Search Application web page at http://www.cfec.state.ak.us/plook/#permits.

[17] Data from ADF&G Venus database.

hatcheries favored using imported eyed larvae and juvenile seed. However, new interest has stirred in smaller facilities to experiment with producing viable Pacific oyster seed in-state starting with propagating mature oyster broodstock that come from Alaska aquatic farms. There may be some advantage to using offspring from Pacific oysters raised in Alaska as they may have more resilience to Alaska water conditions than the seed coming directly from out-of-state facilities.

Production restrictions at grow-out nursery facilities can—due to water temperature, amount and size of phytoplankton in the water to feed the juveniles, space in the bins at the facility, specific size of seed, and even adequate labor force—influence seed availability. The hatcheries can provide Pacific oyster spat easily up to 4–5 mm, but in-water nurseries are needed to grow them out to the larger sizes desired by growers. The industry has discussed modifying in-water nursery gear to accommodate smaller seed. However, factors such as lower water temperatures and timing of seed availability from seed sources may prevent introduction of smaller seed into FLUPSYs earlier in the year.

With the crisis in the Pacific Northwest and Canada due to early life stage susceptibility and mortalities from acidification and climate changes, the demand for quality, Pacific oyster seed will increase. Hatchery and nursery operations in Alaska may find new opportunities in producing good quality seed needed by the shellfish industry outside of the state.

HATCHERY WATER CONDITION MONITORING AND OCEAN ACIDIFICATION

Hatcheries provide a unique environment for observing impacts of ocean acidification on the early life stages of various species reared at hatcheries for aquatic farming and research projects. This type of controlled environment gives us an inside glimpse at what might be happening out in the marine environment. Baseline ocean acidification measurements of seawater used by Alutiiq Pride Shellfish Hatchery, a land-based facility in Seward (Southcentral Alaska), showed suboptimal saturation rates of aragonite, a form of calcium carbonate especially important in early life stage development of shellfish, during autumn and winter (Evans et al. 2015). Continued monitoring at Alutiiq Pride Shellfish Hatchery and planned baseline studies at OceansAlaska, a hatchery in Ketchikan (Southeast Alaska), should help to understand the extent of current conditions of ocean acidification in Alaska and its potential threat to the shellfish industry.

INDIGENOUS SPECIES CULTURE

With most indigenous species, variability in natural recruitment occurs from year to year. There is a risk in depending solely on standing crops of Pacific littleneck clams within an aquatic farm site boundary, especially if natural reseeding is lower than expected. With the episodic nature of natural sets, it may be necessary for aquatic farm operators to rely on hatchery-produced seed to sustain their production and meet production goals. Propagation of indigenous species, such as Pacific geoduck and Pacific littleneck clams, at in-state hatcheries has not yet reached the large production levels necessary for growers to meet their aquatic farm production goals. However, there have been some improvements in Pacific geoduck seed production in the last year at in-state hatcheries. These improvements are expected to continue—meeting the demand for seed for aquatic farms and enhancement research feasibility projects.

More operators are requesting to culture blue mussel by collecting natural sets on suspended lines and later transferring them to mussel socks. Sale of this species has risen to the highest

levels yet and is expected to continue to grow. Since natural sets of blue mussels are abundant in many areas where aquatic farms are located, this may provide additional opportunities to operators to diversify their aquatic farm products to ensure year-round production.

AQUATIC PLANT CULTURE

New interest in farming aquatic plants, specifically macroalgae, has begun in Alaska. Initial development plans propose to use longline culture gear to grow out seeded strings of common kelp brown algae species such as *Macrocystis pyrifera*, *Laminaria saccharina*, and *Alaria marginata* for seaweed food production. Several aquatic farm operators and University of Alaska Southeast educators with an interest in the study of algae are working cooperatively with enterprising individuals on site suitability studies to outplant seeded strings originating from artificial cultivation and propagation of native, mature macroalgae plants. Unlike natural collection, which may lead to the entangled collection of multiple seaweed species, artificial cultivation produces seed (spores) of only one species desired. The resulting reproductive spores are released on spools of string in tanks at the hatchery facility that can then be transplanted to culture gear at an aquatic farm site. In order to make farming aquatic plants worthwhile, operators will need to find a source of mature wild stock for propagation purposes and perfect culture techniques in a hatchery facility to produce a stable, viable supply of each macroalgae seedstock. No facilities have requested approval to produce macroalgae seedstock yet.

REFERENCES CITED

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Meyers, T. 2014. Policies and guidelines for Alaska fish and shellfish health and disease control. Alaska Department of Fish and Game, Division of commercial Fisheries, Regional Information Report 5J14-04, Anchorage.

TABLES AND FIGURES

Table 1.−List of permit holders with operation permits in 2014.

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	2000-09-AF-SC	Halibut Cove	Bates	Weatherly and Greg	Alaska Shellfish Farms LLC
Aquatic Farm	2009-101-AF-SC	Halibut Cove (oysters)	Bates	Weatherly and Greg	Alaska Shellfish Farms LLC
Aquatic Farm	2012-103-AF-SC	Halibut Cove (mussels)	Bates	Weatherly and Greg	Alaska Shellfish Farms LLC
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	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 and Corinne	New Tokeen Oysters
Aquatic Farm	2007-02-AF-SE	Jinhi Bay	Gladsjo	Ernie	*
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.
Nursery	2003-03-NU-SE	Tuxekan Narrows	Hempel	Candy	Naukati Bay, Inc.
Aquatic Farm	1990-04-AF-SE	Big John Bay and Stedman Cove	Henderson	Tom	Pearl of Alaska
Hatchery	1992-01-HA-SC	Alutiiq Pride Shellfish Hatchery	Hetrick	Jeff	Alutiiq Pride Shellfish Hatchery
Aquatic Farm	2014-101-AF-SE	Port Frederick	Hillman	John	Port Frederick Oysters
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	2004-04-AF-SE	Boca de Quadra	Lentz	Kyle	Seaproducks Inc.
Aquatic Farm	2011-103-AF-SE	Fred Point/Burnt Point/North Bight	Lindoff	Anthony	Kushtaka Farms LLC
Aquatic Farm	1991-113-AF-SC	Peterson Bay	Loflin	Cameron	Otter Rock Oyster Company

-continued-

Table 1.–Page 2 of 2.

Site Type	Permit Number	Site Name	Last Name	First Name	Business Name
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	2011-101-AF-SE	Sunrise Site/Hobart Bay	Mason	Judy	Goldbelt, Incorporated
Aquatic Farm	2011-102-AF-SE	Sand Spit/Hobart Bay	Mason	Judy	Goldbelt, Incorporated
Aquatic Farm	2005-04-AF-SE	Peratrovitch Island	McMillan	Greg	Keta Seafoods
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	Kurt	Alaska Shellfish Nursery
Aquatic Farm	1990-11-AF-SE	Canoe Lagoon/Fools Bay	Nicholson	Sharon Gray and Don	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 and 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 and Linn	Oysters LLC
Aquatic Farm	1990-21B-AF-SE	Kahli Cove	Ryggs	Jerry Larry and 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	2014-102-AF-SE	Zimovia Islets	Sawyer	Timothy	Heaven's Bay Zimovia Shellfish
Aquatic Farm	1991-08A-AF-SC	SW Eaglek Bay	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	2013-103-AF-SC	East Squaw Bay	Shoffner	Justin	Alaska's Best Shellfish
Aquatic Farm	1991-117-AF-SC	Halibut Cove	Sidelinger	Kevin	Sea Farms of Alaska
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 LLC
Aquatic Farm	2002-01B-AF-SE	West Gravina	Zaugg	Gary	Pac Alaska LLC

Table 2.−List of approved in-state shellfish seed providers in 2014.

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*	Mixed West Coast	2/29/2016
		Geoduck Clam	*Panopea generosa*	Betton 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	2/28/2017
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 Crosby/Suzanne Torian 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)	Peter Metcalfe P.O. Box 6383 Ketchikan, AK 99901 metcom@gci.net 907.586.1166 (Peter) 907.225.7900 (phone)	Pacific Oyster	*Crassostrea gigas*	Mixed West Coast	2/28/2015

Table 3.−List of certified out-of-state shellfish seed providers in 2014.

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*	Quilcene Bay, Washington Quilcene Bay, Washington Tillamook Bay, Oregon	2/28/2015 2/28/2015 2/28/2015
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	5/31/2014 Conditional
Hawaiian Shellfish, LLC	David Stick Hatchery and Seed Production Manager P.O. Box 492391 Kea'au HI 96749-2391 stick@goosepoint.com 360.581.3083 (phone)	Pacific Oyster (seed<20 mm only)	*Crassostrea gigas*	Willapa Bay, Washington	2/28/2015

Table 4.–Alaska shellfish production and farm gate value in 2014.

		Oysters	Clams	Mussels	Total Aquatic Farm Product	Total Hatchery and Nursery Shellfish Larvae and Seed	All Shellfish Sales
SE Region	Numbers	626,316	-	-	626,316	4,756,951	
	Pounds	-	416	-	416	-	
	Sales	$409,016	$3,328	-	$412,344	$195,035	$607,379
SC Region	Numbers	577,582	-	-	577,582	2,317,580	
	Pounds	-	-	9,594	9,594	-	
	Sales	$415,172	-	$43,112	$458,284	$109,139	$567,423
Alaska Total	Numbers	1,203,898	-	-	1,203,898	7,074,531	
	Pounds	-	416	9,594	10,010	-	
	Sales	$824,188	$3,328	$43,112	$870,628	$304,174	$1,174,802

Source: 2014 Operator Annual Reports, ADF&G Mariculture Program, confidential data.

Table 5.–Summary of commercial harvest of wild stock geoducks from aquatic farms, 2006–2014.

Year	Operator	Site Name	ADF&G AFOP No.[a]	Acres	Number of Clams	Landed Pounds
2006-2014	Morin	Ape Point	00-18A-AF-SE	5	0	0
2006-2014	Morin	Point Alava	00-18B-AF-SE	6.45	0	0
2006-2014	Morin	Coho Cove	00-18C-AF-SE	3.5	323	806
2006-2014	Zaugg	South Sykes	02-01A-AF-SE	7.5	9,085	20,938
2006-2014	Zaugg	Gravina Island	02-01B-AF-SE	5.1	3,678	10,161
2006-2014	Bakker	Gravina Island	02-02A-AF-SE	1	0	0
2006-2014	Bakker	Slate Island	02-02B-AF-SE	8.6	7,370	17,121
2006-2014	LaCroix	Coho Cove	02-03A-AF-SE	6.48	2,353	5,101
2006-2014	LaCroix	Gravina Island	02-03B-AF-SE	5.42	4,580	11,574
2006-2014	LaCroix	Point Alava	02-03C-AF-SE	3.88	3,989	7,466
2006-2014	LaCroix	Point Alava Ext.	02-03D-AF-SE	4.71	2,943	5,447
2006-2014	LaCroix	Black Island	02-03E-AF-SE	4.93	4,076	8,438
2006-2014	Ethelbah	Cannery Pt	04-02-AF-SE	6.99	0	0
2006-2014	Lentz	Boca de Quadra	04-04-AF-SE	9.9	1,659	3,118
2006-2014	Bakker	Black Island	07-04-AF-SE	2.9	0	0
2006-2014	Marsh	West Pt Alava	07-06-AF-SE	9.89	0	0
Total					40,056	90,170

Note: ADF&G may release records regarding cumulative annual harvests of wild stocks at individual aquatic farm sites as per AS 16.40.155.

[a] ADF&G AFOP = Alaska Department of Fish and Game Aquatic Farm Operation Permit.

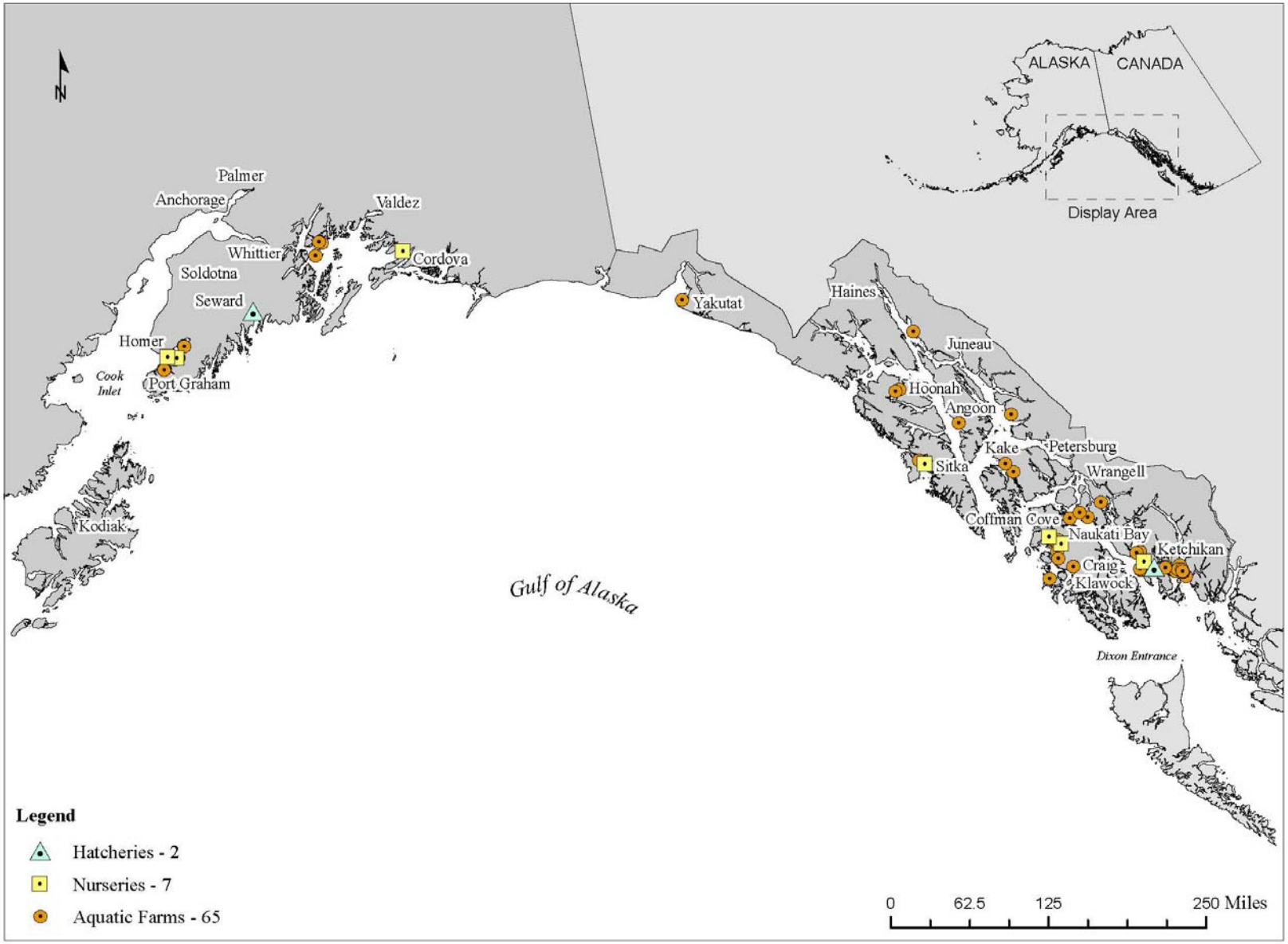

Figure 1.−Aquatic farm, nursery, and hatchery operations permitted to operate in Alaska in 2014.

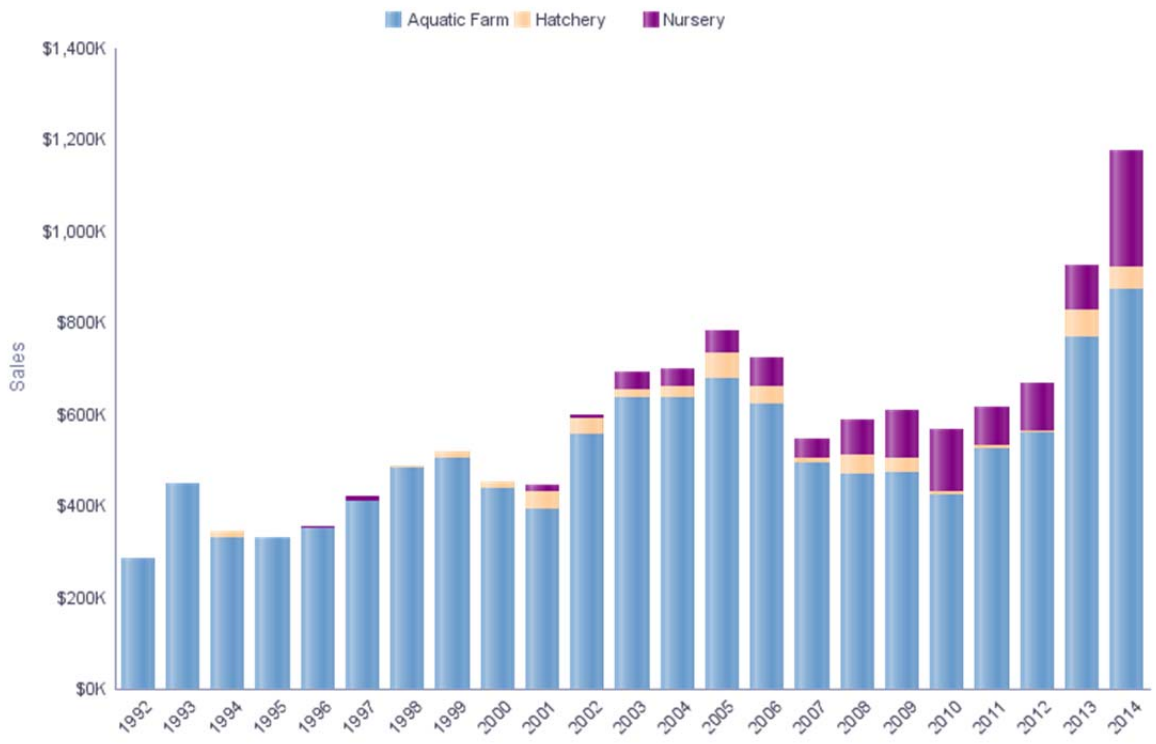

Figure 2.−Sales by operation type, 1992−2014.

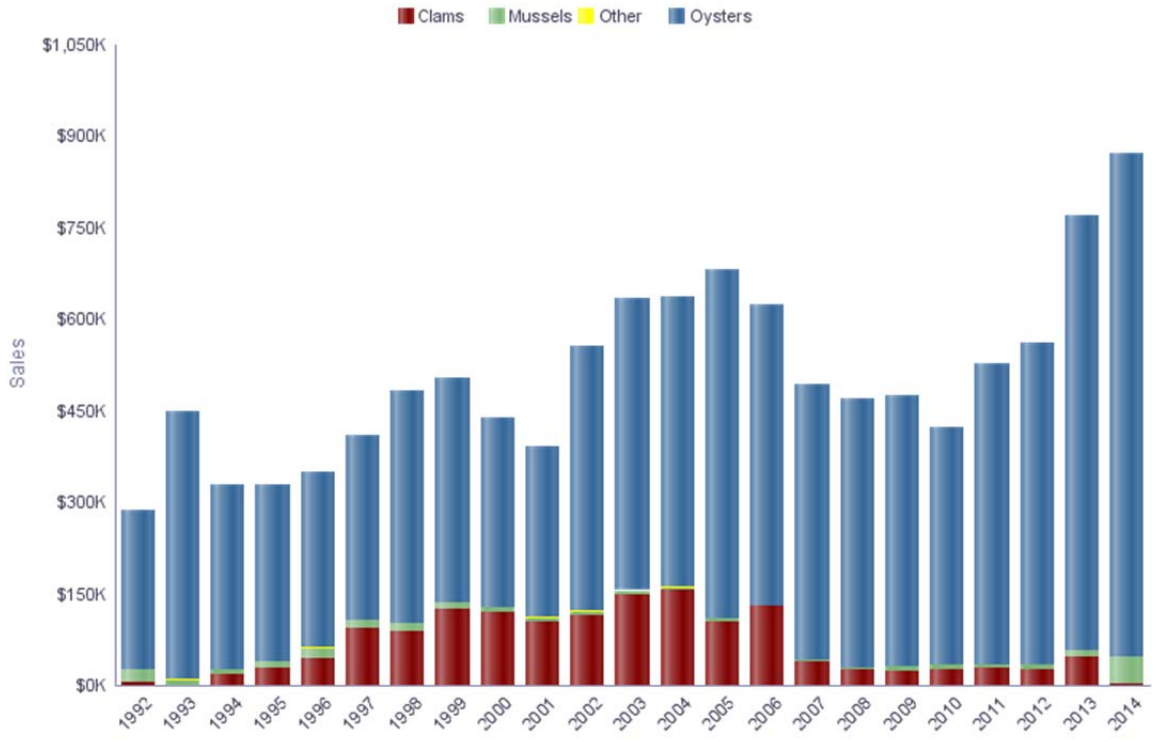

Figure 3.−Aquatic farm operation sales by species, 1992−2014.

Note: All clam sales through 2009 are for Pacific littleneck clams. Beginning in 2010, clam sales includes both Pacific littleneck clams and geoduck clams. Other sales include scallop, seaweed, and sea cucumber.

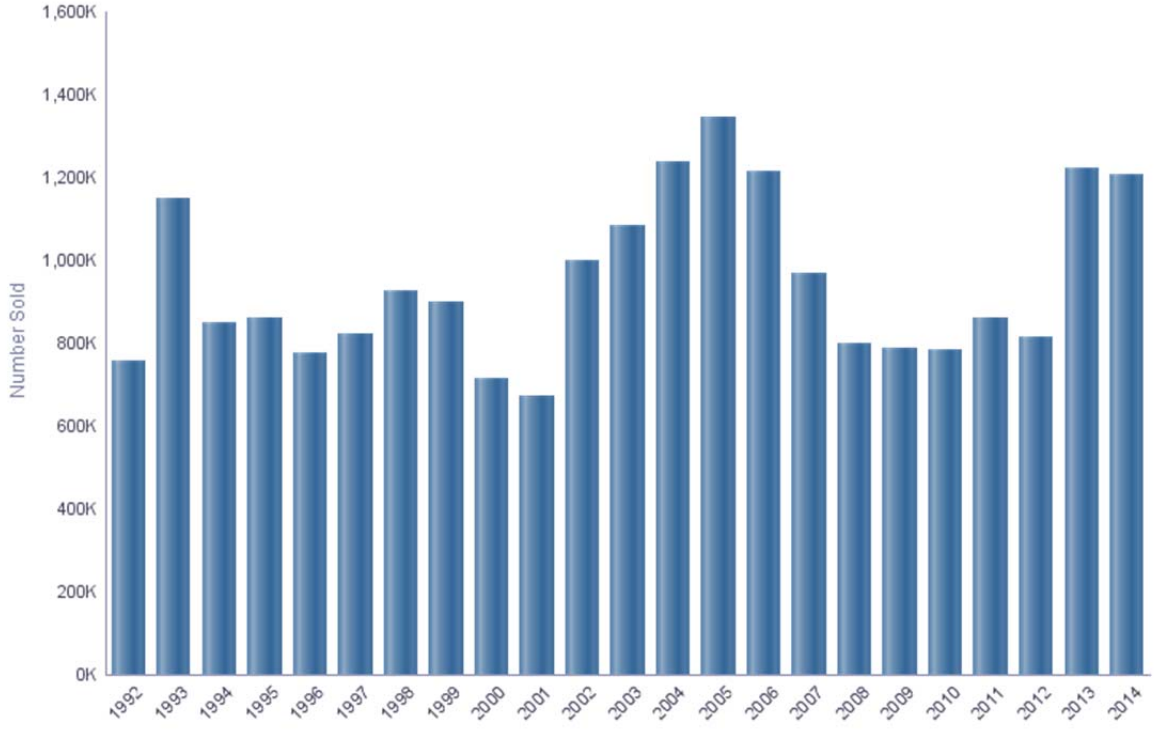

Figure 4.−Aquatic farm operations Pacific oyster production numbers sold, 1992−2014.

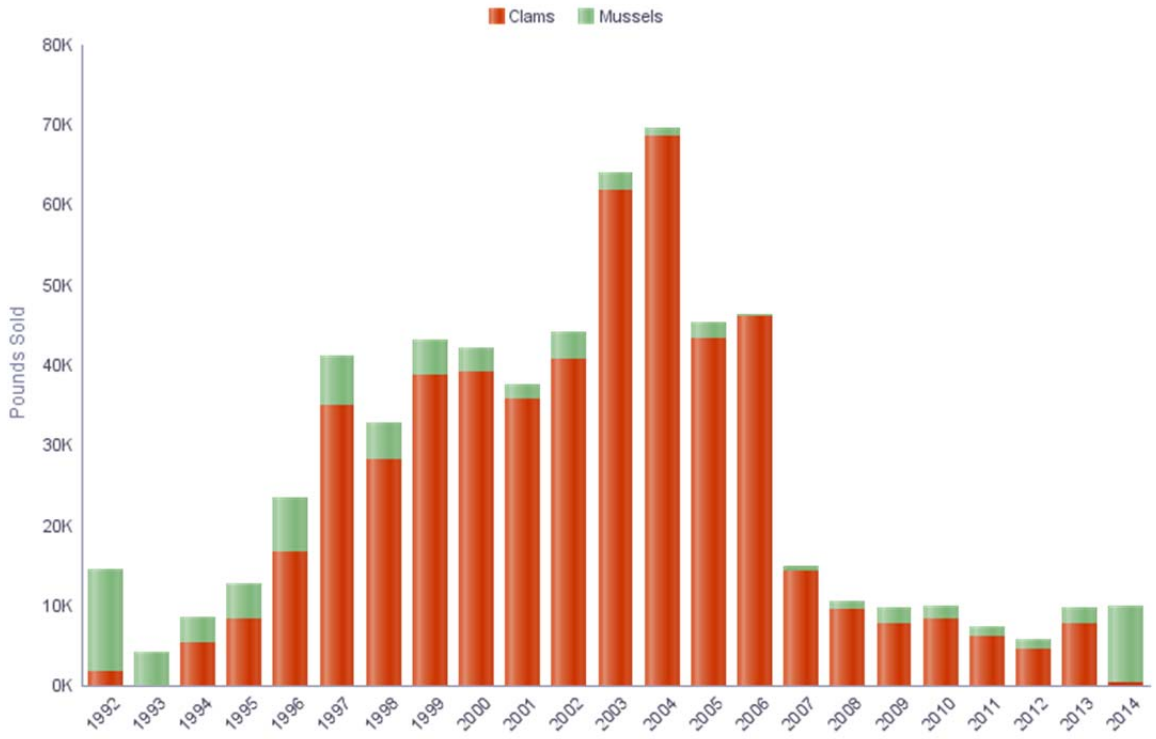

Figure 5.−Aquatic farm operations production pounds sold by species, 1992−2014.

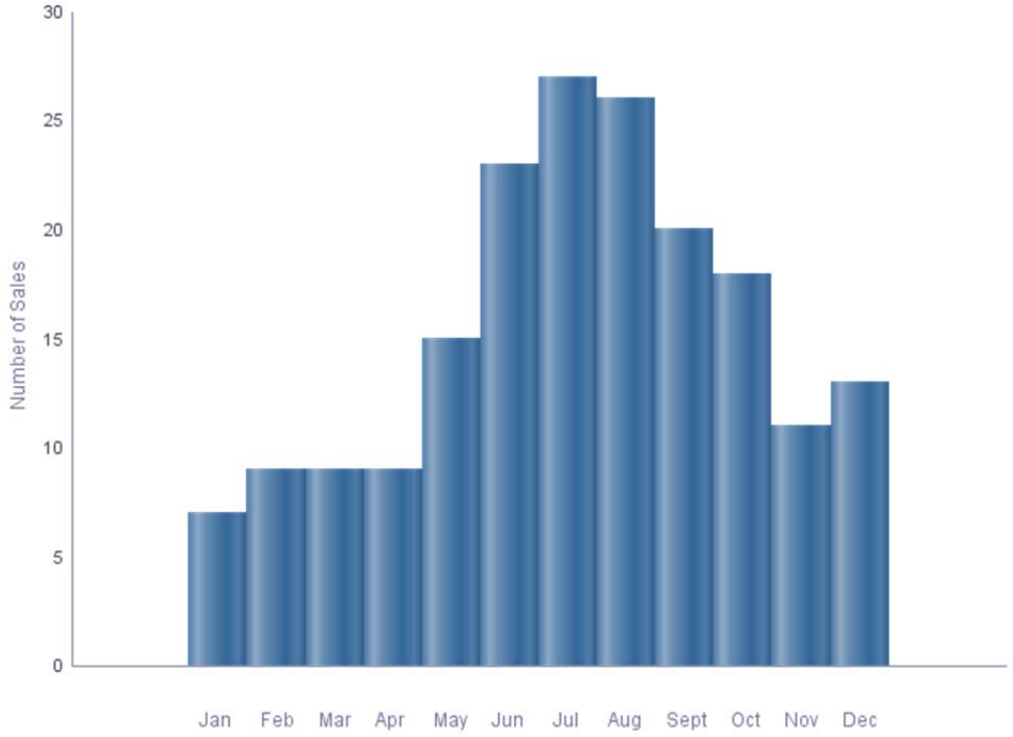

Figure 6.−Months aquatic farm products sold by aquatic farm operations in Alaska during 2014.

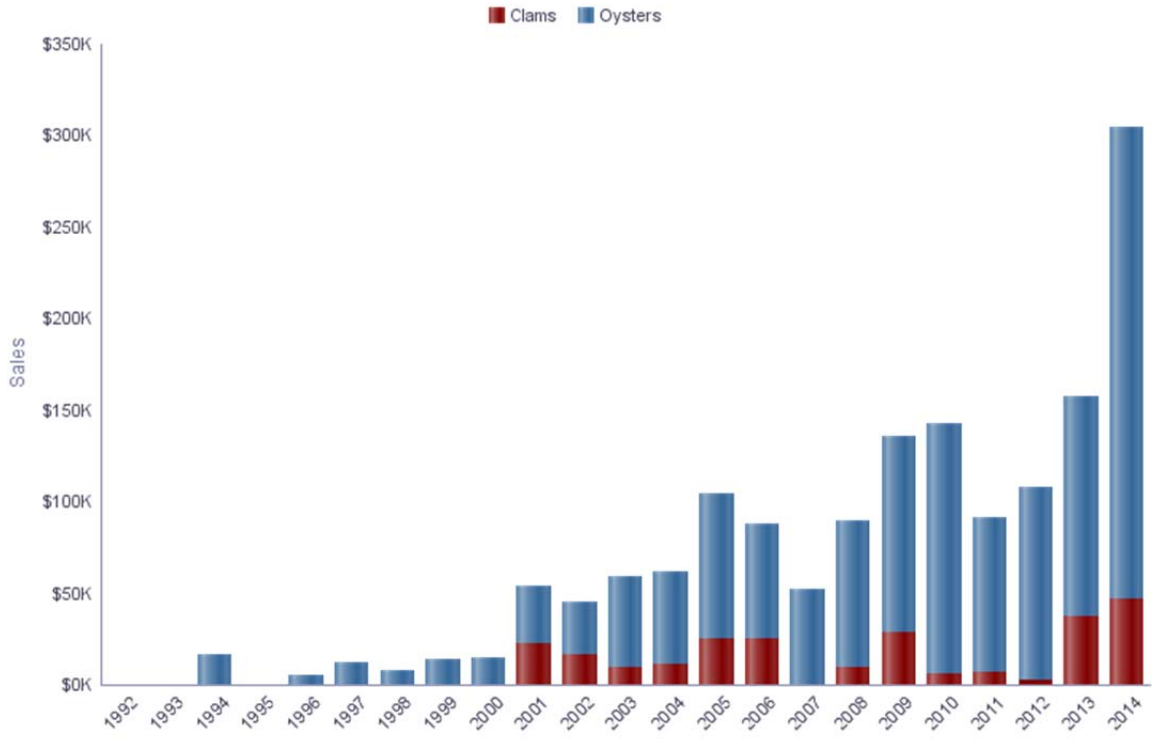

Figure 7.−Hatchery and nursery operation sales by species, 1992−2014.

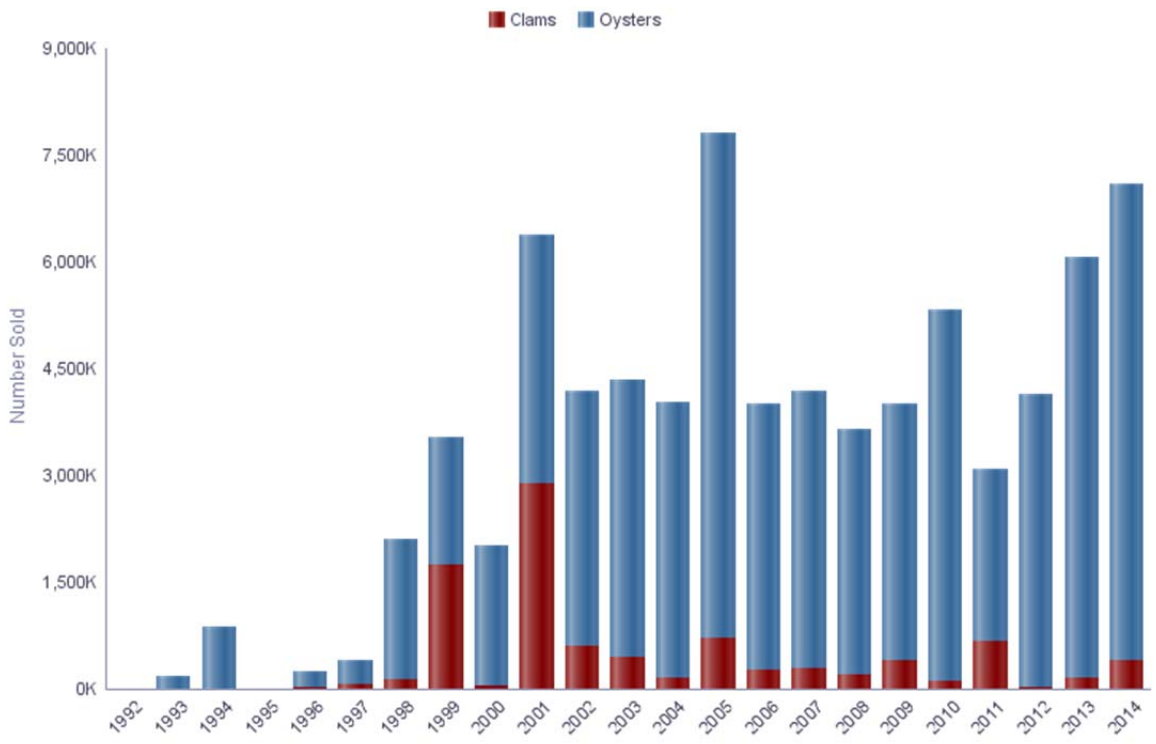

Figure 8.−Hatchery and nursery operations production number sold by species, 1992−2014.

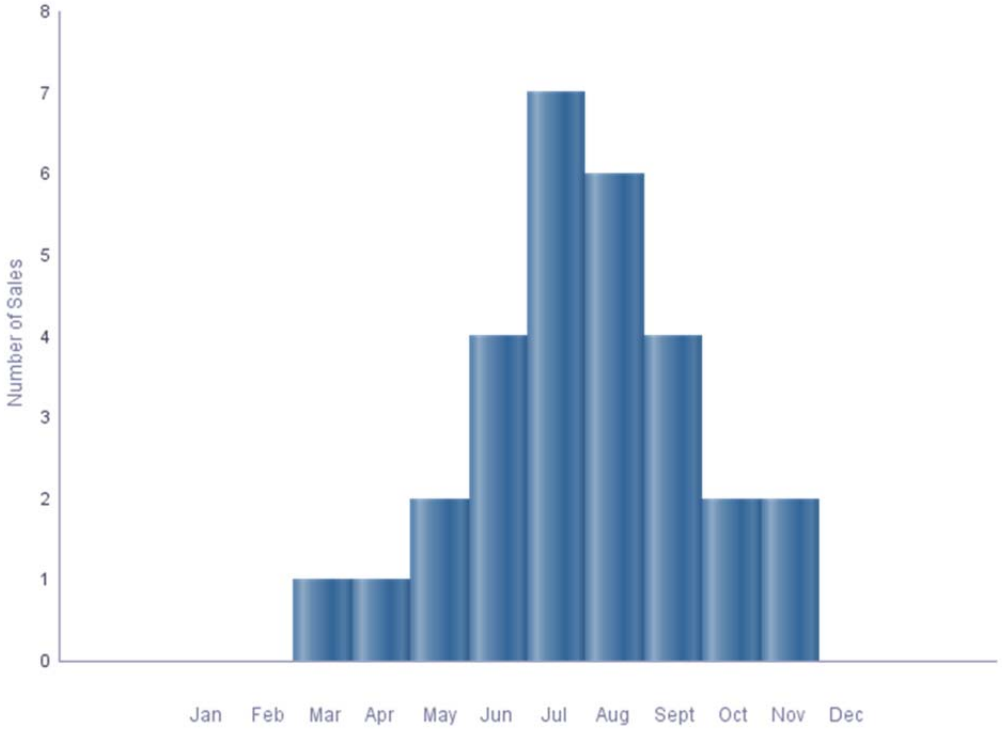

Figure 9.−Months seedstock sold by hatchery and nursery operations in Alaska during 2014.

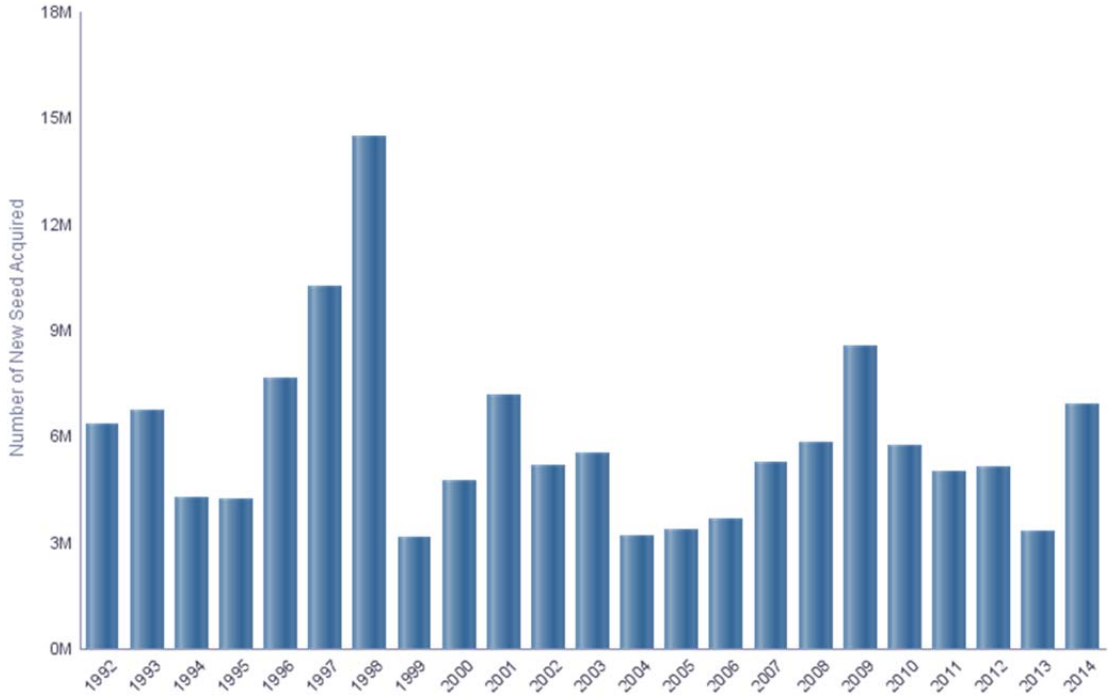

Figure 10.−New Pacific oyster seed acquired by aquatic farm operations, 1992−2014.

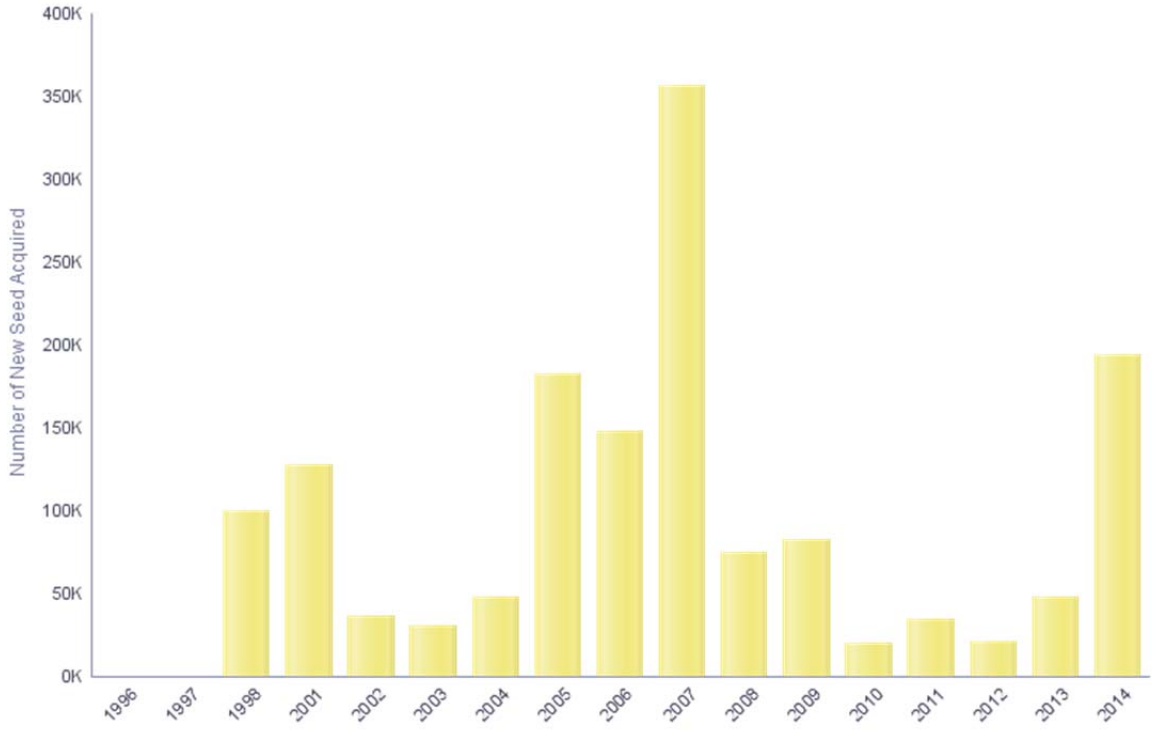

Figure 11.−Pacific geoduck seed acquired by aquatic farm operations, 1996−2014.

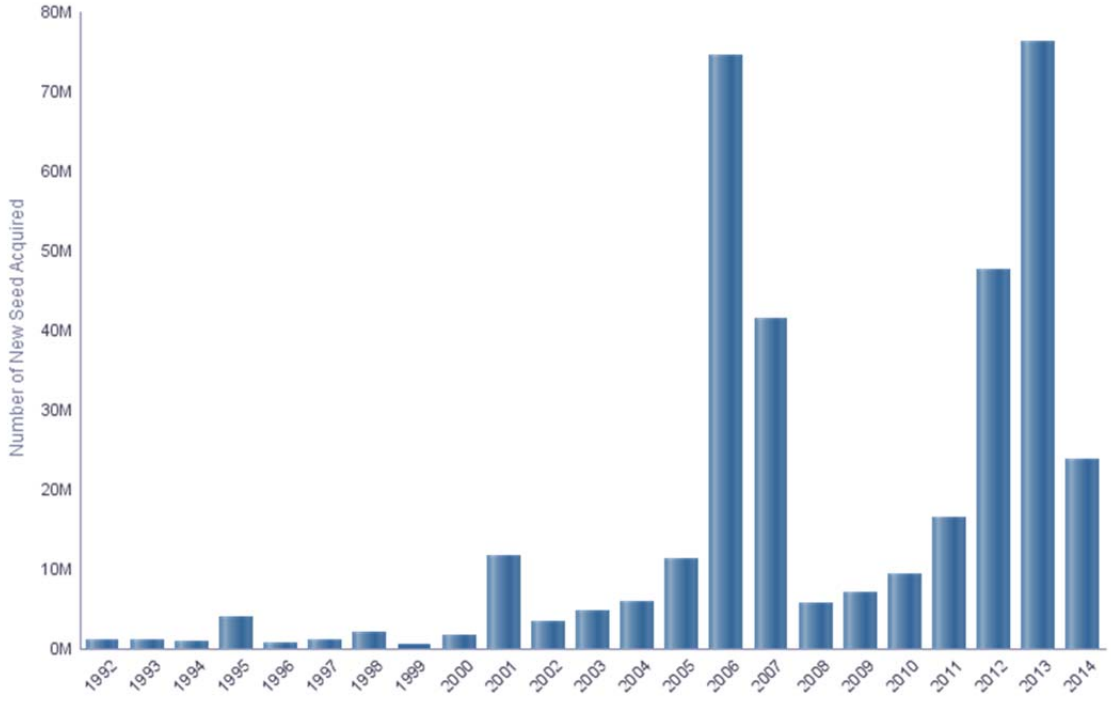

Figure 12.−New Pacific oyster eyed larvae and seed acquired by hatchery and nursery operations, 1992−2014.

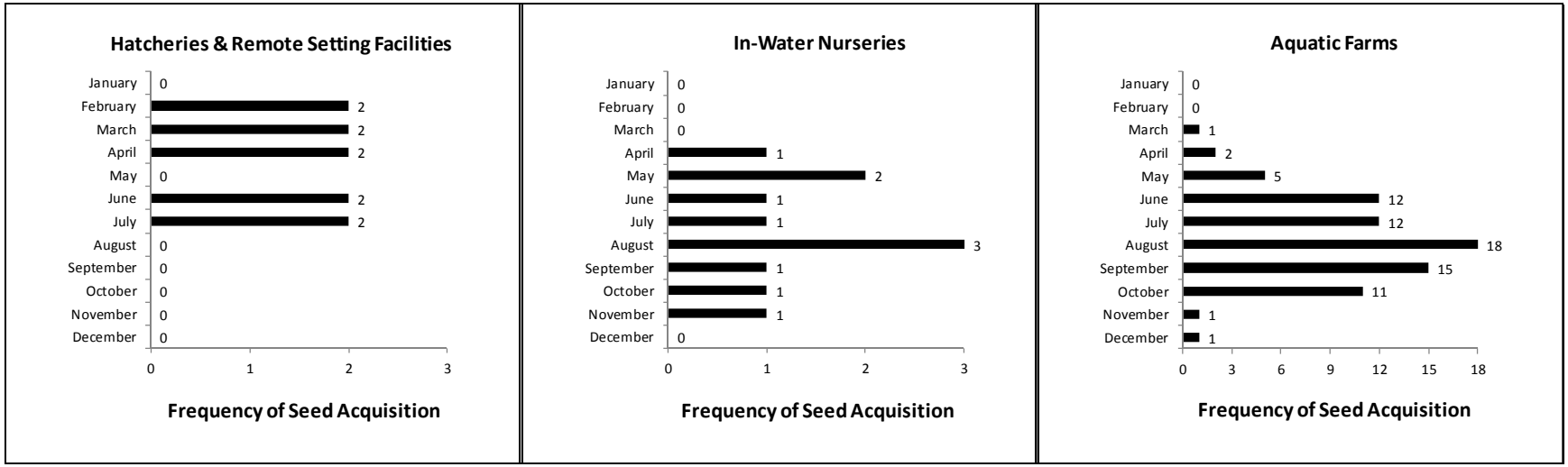

Figure 13.−Frequency of seed acquisitions by hatchery, and remote setting, in-water nursery, and aquatic farm operations in 2014.

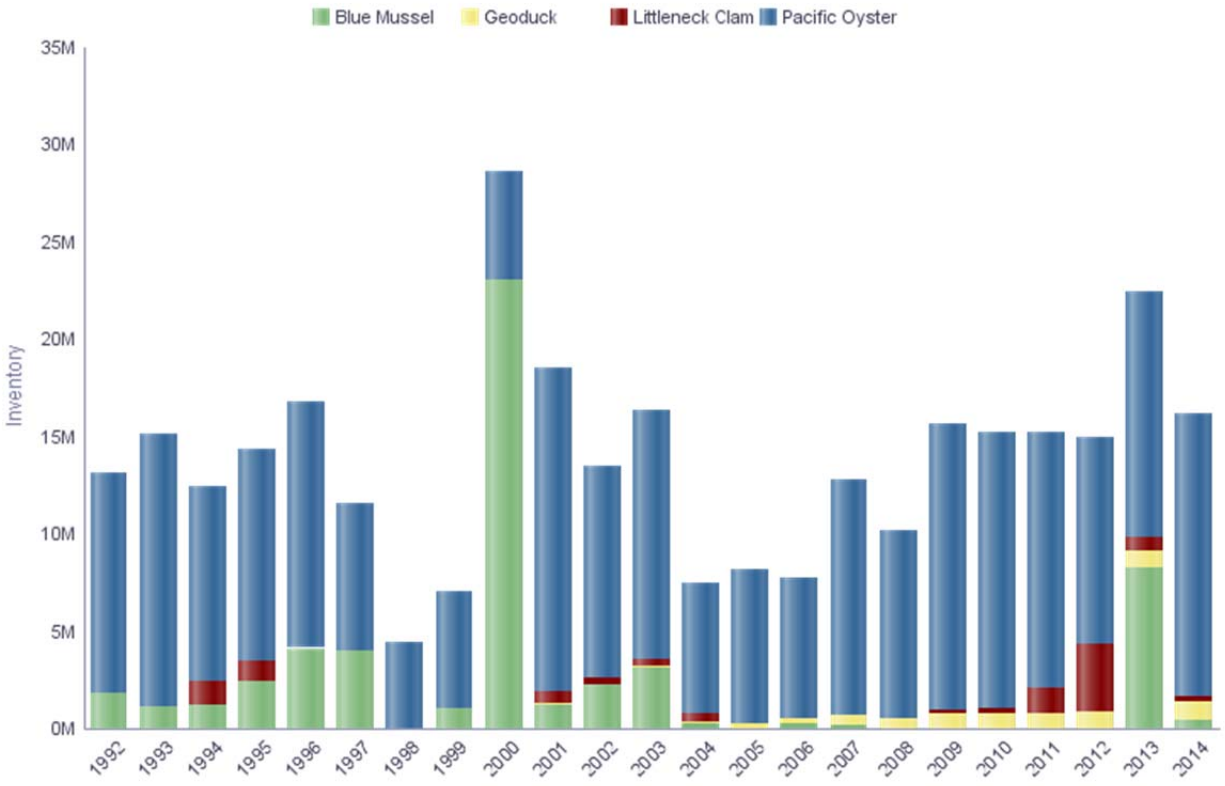

Figure 14.−Inventory of principle aquatic farm products at aquatic farm operations, 1992−2014.

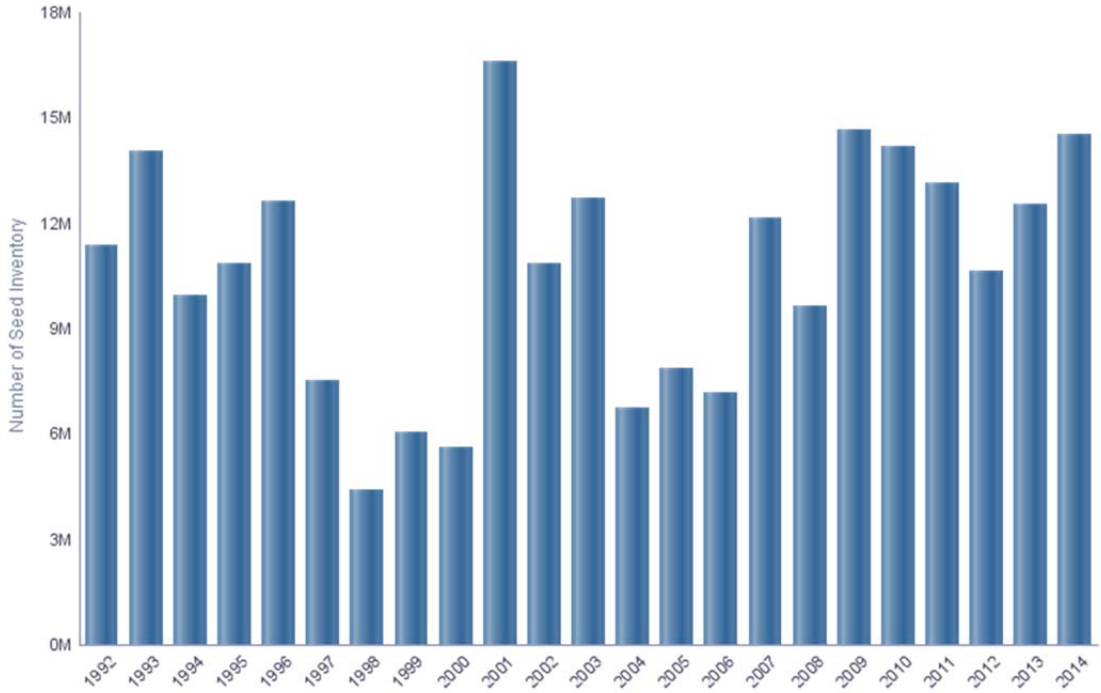

Figure 15.−Aquatic farm operations Pacific oyster inventory, 1992−2014.

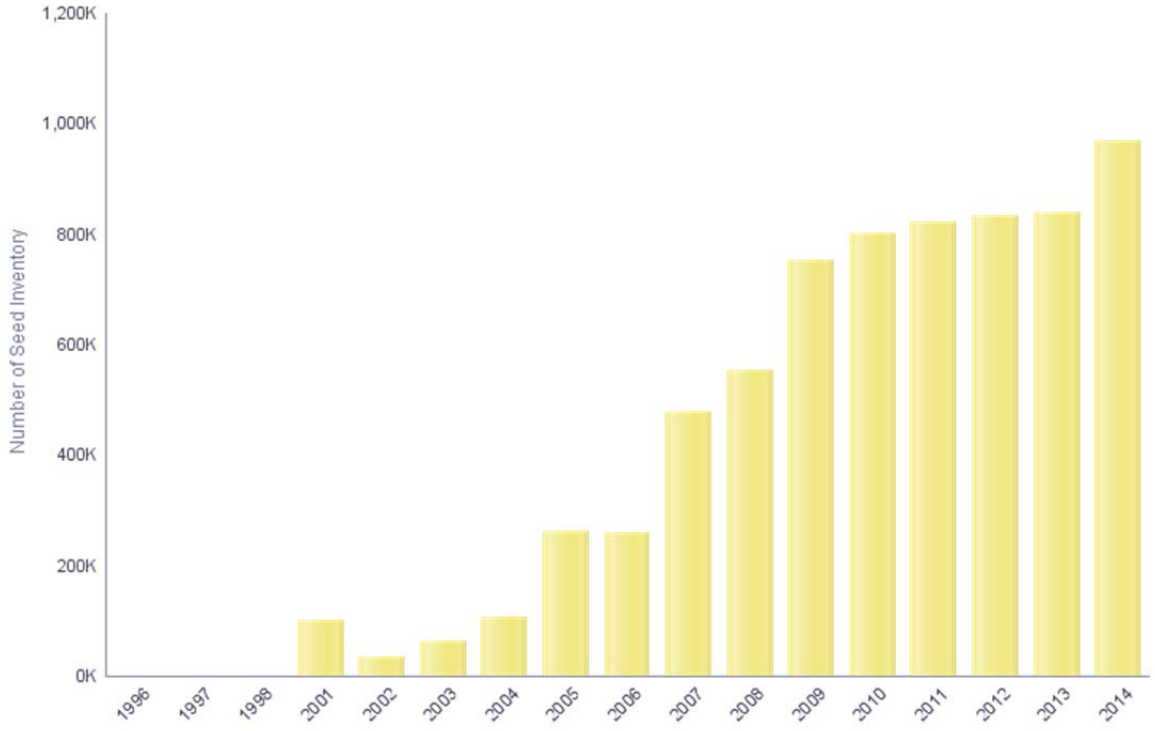

Figure 16.−Aquatic farm operations Pacific geoduck inventory, 1996−2014.

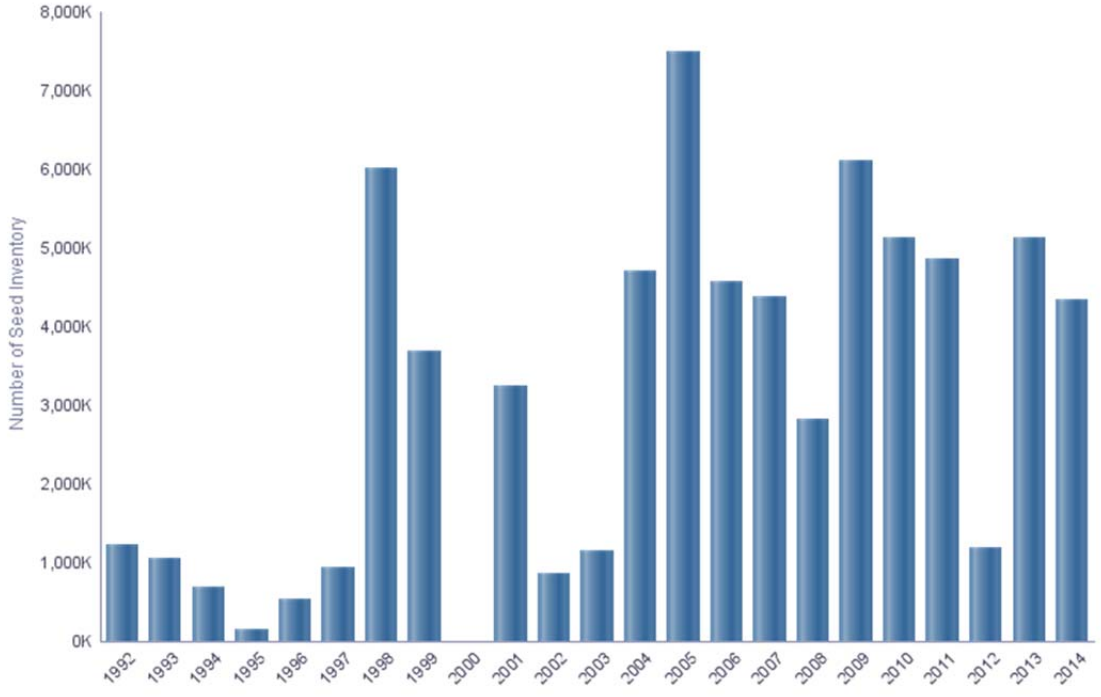

Figure 17.−Hatchery and nursery operations Pacific geoduck inventory, 1999−2014.

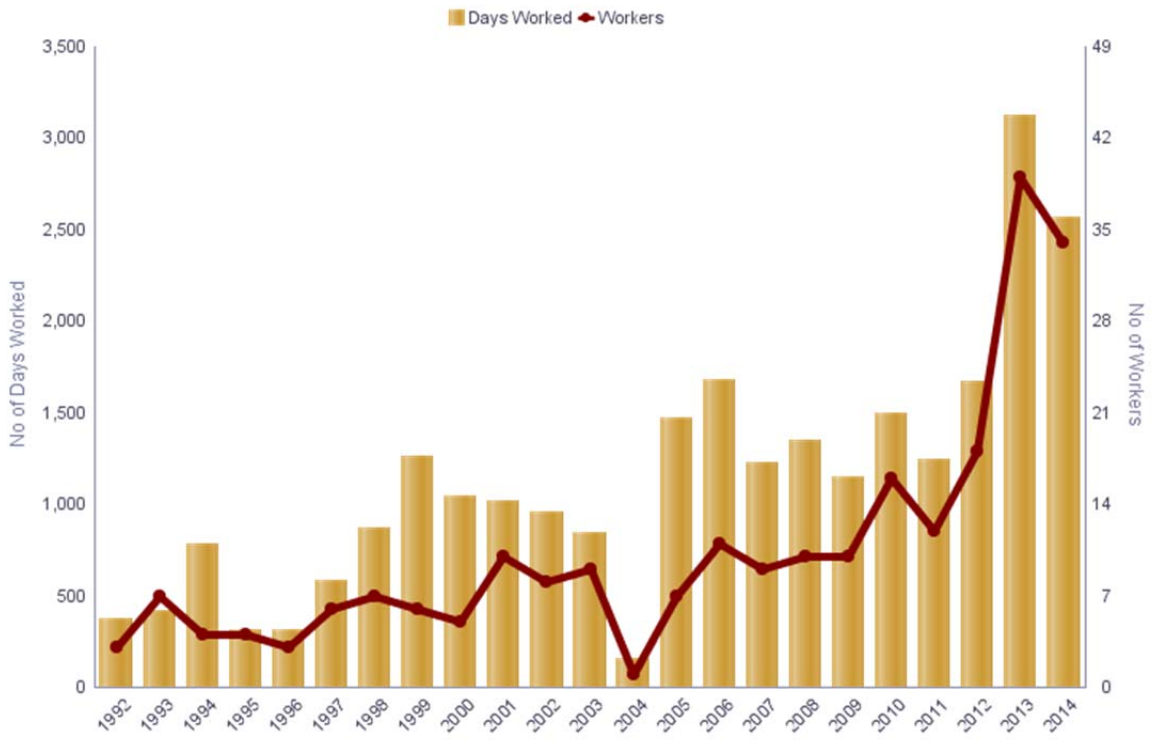

Figure 18.−Number of workers and days worked for hatchery and nursery operations, 1992−2014.

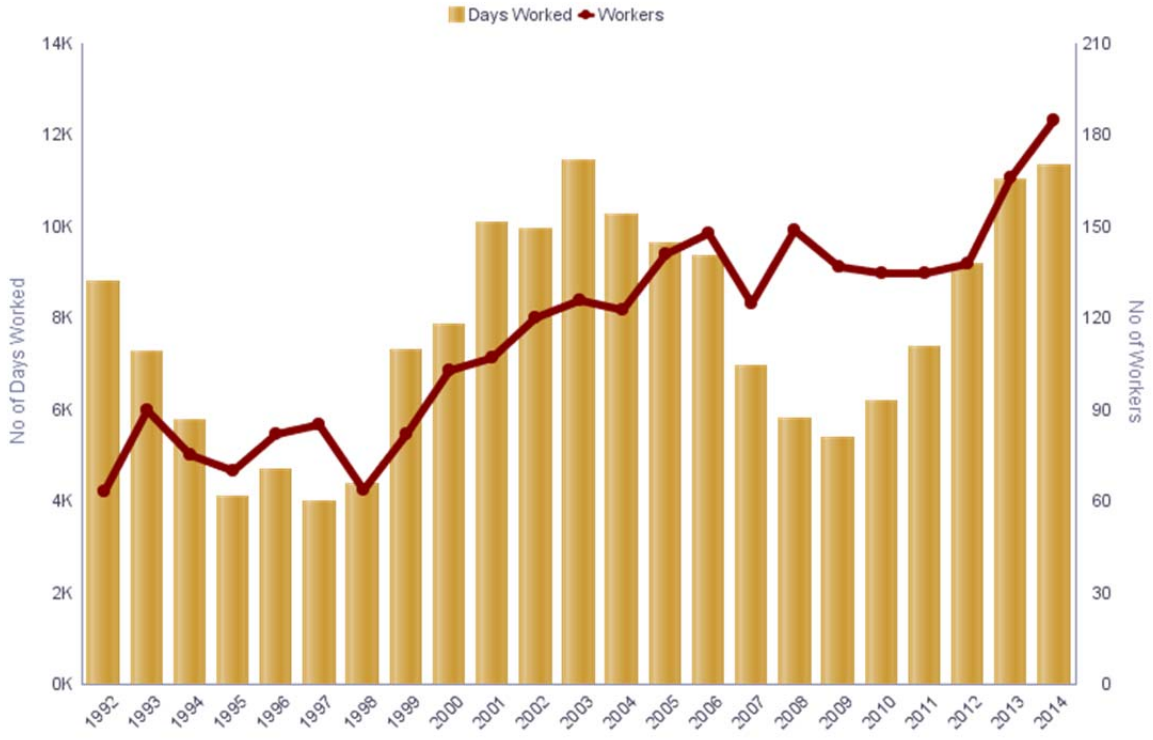

Figure 19.–Number of workers and days worked for aquatic farm operations, 1992−2014.