

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

DIVISION OF FISH AND WILDLIFE
MARINE FISHERIES



2016 Shellfish Sector Management Plan

Authority: R. I. Gen. Laws Chapter 42-17.1, Section 20-1-4, and Section 20-2.1-9, in accordance with Chapter 42-35 of the Rhode Island General Laws of 1956, as amended.

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INTRODUCTION

During the 2002 legislative session, the Rhode Island General Assembly adopted the Commercial Fisheries Management Act, establishing a new commercial fishing license system and ending the moratorium on the issuance of new commercial fishing licenses that had been in place since 1995. One purpose of the act was to enable new entrants into commercial fisheries, while still limiting access to certain fisheries where warranted. As addressed in RIGL §20-2.1-9, fisheries identified for consideration of limited access are those “*for which there is adequate or greater than adequate harvesting capacity currently in the fishery*”, or are managed under a state quota system to prevent over-fishing. To meet the purposes of the act, licensing regulations developed by DEM in 2002 created four endorsement categories for the shellfish fishery: *Bay Quahaug; Soft-shell Clam; Whelk; and Shellfish Other*.

As stated in RIGL §20-2.1-2, the licensing regulations should seek to “*preserve, enhance, and allow for any necessary regeneration of the fisheries of the state, for the benefit of the people of the state, as an ecological asset and as a source of food and recreation*” and to “*provide Rhode Islanders who wish to fish commercially the opportunity to do so, and end the moratorium on issuance of new commercial fishing licenses so that new licenses may be issued..*” and “*respect the interests of residents who fish under licenses issued by the state and wish to continue to fish commercially in a manner that is economically viable.*”

This plan will be updated annually. Exit/entry ratios are reviewed by the Industry Advisory Committee ((IAC) annually in accordance with RIGL§20-2.1-11. Any proposed changes to the currently adopted exit/entry ratios are then presented for public comment and plans are reviewed by the RI Marine Fisheries Council prior to finalization in accordance with RIGL§20-2.1-9

This management plan addresses statutory requirements and duties of the Director to develop sustainable shellfish management plans in accordance with RIGL 20-2-44, and sector fishery management plans in support of commercial licensing (RIGL 20-2.1-9(5)).

The State of Rhode Island, through a collaborative effort between state agencies, industry, and other stakeholders, completed a comprehensive statewide Shellfish Management Plan in 2014. The plan established a number of goals that the DEM hopes to achieve through implementation of proper management.

SMP Goals:

- a. Honor, promote and enhance the existing shellfish resource and uses. Shellfish offer a myriad of ecological services to Rhode Island state waters, jobs and business opportunities to its residents, and recreation for all. As such, actions should strive to maintain healthy populations of shellfish while honoring the current uses of Rhode Island’s natural resources and promoting Rhode Island shellfish as a source of local, sustainable seafood.
- a. Contribute to a properly functioning ecosystem that is both ecologically sound and economically beneficial. The prosperity of the shellfish industry depends on

the health of our marine environment and the quality of the water that shellfish inhabit. It is therefore necessary to evaluate the current status and potential future changes to the natural resources, ecosystem conditions, and anthropogenic impacts on the marine environment and to recommend actions to protect and, where necessary, restore our marine waters.

- b. Manage marine and shellfish resources for equitable and sustainable use. Through both scientific research and practical knowledge, better understand the existing activities taking place in Rhode Island waters. Identify best management practices to support all shellfish activities for long-term sustainability while supporting compatible uses and minimizing user conflicts to ensure the equitable harvest of these marine resources.
- c. Enhance communication and improve upon the established framework for coordinated decision-making between state and federal management agencies, industry, and other interested parties. Engage management agencies, industry and other interested parties in the development of the shellfish management plan and implementation of recommendations to ensure that all concerns and appropriate legal requirements are integrated into the process. Coordination will allow for the sharing of information across all sectors, improve management, clearly establish roles and responsibilities of all parties and streamline the licensing and permitting process where appropriate.

QUAHAUG ENDORSEMENT

Commercial Landings: There are two very distinct peaks in commercial landings of quahaugs in Rhode Island since 1947, the first occurred in 1955 followed by a rapid decline until 1974 and then a second peak in 1985 (Figure 1). Landings reached an all-time low in 2009 but there has been a modest increase in both landings and catch per unit effort since then (Figure 2). In 2014 landings totaled 2,708 metric tons (5.97 million lbs., Table 1), which is a 14% decrease from the most recent high in 2012. According to the Standard Atlantic Fisheries Information System (SAFIS) reporting system, 83% of the landings were harvested from Greenwich Bay, Conditional Areas A & B, and the West Passage of Narragansett Bay (Table 1). Most of the quahaugs landed by count are littlenecks (67%), followed by top-necks (23%), chowders (9%) and cherrystones (1%).

Resource Assessment: DFW conducts a survey of quahaugs in Narragansett Bay on an annual basis that commenced in 1993 (Ganz et al 1999). Both fished and unfished sections of the bay are sampled. The sampling consists of towing a small hydraulic dredge (0.36 meter sweep) for a distance of 30.5 meters (100 ft) at each station. Pressurized water is delivered to the dredge manifold which dislodges shellfish from the substrate. The dredge is designed to retain legal-sized quahaugs (> 25.4mm thickness). All species retained in the dredge when hauled are identified and all shellfish are counted and measured. Based on the survey, the stratified mean density of quahaugs in Narragansett Bay has been

fairly constant through the duration of the survey typically around 2-3 quahogs per square meter.

In short, the Division evaluated the quahog dredge survey design in 2006 and suggested a change from sampling the entire bay in one year to a rotational design that would accommodate additional sampling in each strata. In 2008 the Division started to implement a partially-revised survey design; however, minimal survey work was conducted in 2010-2011 due to vessel age and repair needs. In 2012 the annual survey employed a fully-reconfigured design to increase sampling in specific strata in a given year, ultimately allowing all strata to be sampled over several years rather than in a single year as in years past. In addition, research is being conducted to improve the precision of the survey by relating observed quahaug densities to mapping of submerged sediments. In general, the reconfiguration is designed to increase sampling intensity so that the number of samples per strata is sufficient to produce improved estimates of biomass by size class.

Management Program: Quahaugs are managed entirely by DEM with advice from the Rhode Island Marine Fisheries Council (RIMFC). The DEM, through the DFW, uses a set of management areas and a rotational transplant/harvest system to manage the resource. Permanent and conditional pollution closures restrict the fishery in addition to seasons, possession limits, and management closures.

A 2:1 exit/entry ratio for the quahaug fishery was implemented in 2011. In 2015 DEM issued a total of 189 quahaug endorsements for the CFL license. Twenty-one of these were issued to fishermen who did not have a quahog endorsement the previous year. In 2014, DEM issued a total of 181 quahaug endorsements for the CFL license of which 92 reported landings on at least one day. Of these fishermen reporting landings the average number of days fished was 39 days with an average catch of 811 quahogs per day.

In 2015, the Department issued 340 PEL licenses with quahaug endorsements compared to 347 in 2014, a decrease of seven licenses. Of the 347 PEL licenses issued in 2014, 180 licenses reported landing quahogs on at least one day. Of those reporting landings the average number of days fished was 70 days with an average of 1,040 quahogs landed each day.

In 2015, the Department issued 804 PEL licenses with quahaug endorsements compared to 816 in 2014, a decrease of twelve licenses. Of the 816 MPURP licenses issued in 2014, 214 reported quahog landings on at least one day, with an average number of 57 days fished, and an average of 976 quahogs landed each day.

Two additional license categories are not subject to the 2:1 exit/entry ratio and are restricted to basic harvest levels. *Student shellfish licenses* decreased by 10 (from 47 in 2014 to 37 in 2015) but only 21 of these licenses reported any landings in 2014. The average number of days fished by this license group was 26 days and the daily average

catch was 510 quahogs. Over 65 *shellfish licenses* increased by 20 (289 in 2014 to 309 in 2014). Only 31 of these license holders reported any landings in 2014 and the average number of days fished by this license group was 23 days. The average daily catch was 548 quahogs.

The provision set forth in the RI Marine Fisheries Commercial and Recreational Saltwater Fishing Licensing Regulations Section 6.7-4 (e) allowing an actively fishing CFL license holder with a quahaug endorsement to upgrade to a PEL license with a quahaug endorsement, and an actively fishing student shellfish license holder to upgrade to a CFL with a quahaug endorsement after two years of reporting landings and no violations, was continued in 2015.

DEM needs to continue to work with industry to ensure a healthy quahaug fishery consisting of resource sustainability and a licensing system that will maintain an active group of fishermen and facilitate entry of new participants. Continued improvements in the landings data collection system along with DFW resource surveys will provide for accurate evaluation of standing stock and allow for sound management. Acquisition of fishery landings by market class and tagging areas allow for area specific assessment and management. The ability of DFW to manage the resource would be further increased by improved compliance with reporting tagging areas accurately and by reducing the size of some of the larger tagging areas. In concert with transplanting and spawner sanctuaries, other area specific regulations are already established and could be refined to maximize sustainable harvest. In particular, the western Greenwich Bay Management areas have seen a dramatic reduction in biomass and CPUE in recent years despite the reduced Winter Harvest Schedule. Further reductions in the number of days open for fishing in these areas may be warranted if resource levels do not show signs of improvement.

The Narragansett Bay Commission's combined sewer overflow project combined with more-intensive water quality monitoring by RIDEM Office of Water Resources, has resulted in water quality improvements in the Providence River as well as a decreased number and duration of rainfall-induced closures in Conditionally Closed Areas "A" and "B". The high densities of quahaug broodstock observed in the Providence River combined with prior rainfall-induced closures in the Conditionally Closed Areas have resulted in a significant and sustained level of harvest. In order to sustain this harvest, it is recommended that an area-specific assessment and management plans be developed and implemented for the Providence River, Conditional Area "A", Conditional Area "B" and the recently established "Conimicut Triangle". Alternatives include, but are not limited to, establishing new shellfish management areas, establish area-specific fishing periods, and adopting realistic possession limits.

DFW Recommendations: DFW believes that the number of individuals that are licensed to fish in this fishery and the number of active fishers is more an industry-based economic issue than a resource management issue. As such, the number of people participating in the fishery is becoming less relevant from a resource management perspective. The Division believes that amending the current 2:1 exit/entry ration to a 1:1 ratio as

recommended by the IAC will not impact the fishery to an appreciable degree. If fishing effort levels and active participation levels remain at current levels the additional number of licenses issued at a 1:1 ratio would only result in an increase in landings in 2016 of approximately 0.7%.

RI Marine Fisheries Council: The Industry Advisory Committee (IAC) of the RIMFC met on July 21 and recommended amending the exit/entry ratio for the *quahaug* endorsement in 2015 from 2:1 to 1:1 for all eligible licenses that retired in 2015. This would allow 32 new CFL licenses with a *quahaug* endorsement to be made available for 2015 (versus 18 at the 2:1 ratio). The RIMFC met on October 5, 2015 and concurred with the Division and IAC.

SOFT-SHELL CLAM ENDORSEMENT

Commercial Landings: Commercial landings of soft-shell clams in Rhode Island showed an increasing trend from the early 1980's until 2007 (Figure 4) but in recent years have been in decline (Figure 5). Soft shell clams were down 94% statewide in 2014 when compared to the 2008-2010 average. With the introduction of SAFIS, landings data have been coded by area allowing for evaluation of landings by area (Table 2) and by catch per unit effort (Figure 5). For the past three years the area with the most landings are the Coastal Ponds comprising 53% of the landings statewide. The 2014 harvest in the upper portions of Narragansett Bay was down to only 2.3% of the average landings observed in 2008-2010.

Resource Assessment: Soft-shell clam resources are distributed from inter-tidal to sub-tidal zones of Narragansett Bay and the coastal ponds and estuaries. Prior to 2012 the bulk of the biomass was located in the Upper Narragansett Bay, particularly in the Conimicut Point area. In recent years, due to the successful results from the Narragansett Bay Commission's combined sewer overflow project, measurable water quality improvements were recorded in the Providence River resulting in a substantial reduction in the number of rainfall-induced closures in Conditionally Closed Areas "A" and "B" and opening of new areas, such as the new soft-shell clam grounds in the Conimicut Pt Area called the "Conimicut triangle". The Conimicut triangle area opened on June 13th, 2010 with no changes to the existing regulations. Neither the daily catch limit of 12 bushels, nor the 1 ½" minimum size were changed resulting in the biomass being depleted to less than 1/10th its former abundance, and follow up surveys in the fall of 2011 showed astoundingly low densities (Gibson 2012). The Conimicut Shellfish Management Area was established in April of 2011 and the SMA possession limit was set at 3 bushels. The 2-inch statewide minimum size was also established in April 2011.

A dynamic depletion model for open populations based on the work of Restrepo (2001) and Sosa-Cordero (2003) was developed and applied to monthly catch and effort data for the period 2006 to 2011 (Gibson 2012). The preliminary depletion model results suggest that the population declined from 2006 to 2011 with

recruitment failing to replace fishery removals (Gibson 2012). Although the model could benefit from more recent data, present landings suggest that the recent increase in minimum size did not by itself stop overfishing and catch limits may need to be reduced to < 3 bushels per day to bring fishing mortality rates into balance with resource productivity (Gibson 2012).

Management Program: Soft-shell clams are managed entirely within state waters by DEM with advice from the Rhode Island Marine Fisheries Council (RIMFC). Permanent and conditional pollution closures restrict the fishery in addition to seasons, possession limits, and management closures.

DFW Recommendations: DFW recommends remaining the 5:1 exit/entry ratio for the *soft-shell clam endorsement* due to the resource's depleted status as evidenced by landings being at the lowest level since 1982. The current potential fishing effort far exceeds the current resource levels, and effort tends to outpace resource levels in years with higher resource abundance leading to unsustainable harvest levels.

RI Marine Fisheries Council: The Industry Advisory Committee (IAC) of the RIMFC met on July 21 and recommended to amend the exit/entry ratio for the *soft-shell clam endorsement* from the current 5:1 exit/entry ratio to fishery to 1:1 for all eligible licenses that retired in 2015. This recommendation was based on the feeling that people should have the opportunity to participate in the fishery regardless of the current status of the resource, and that the fishing effort would not greatly increase due to the current poor status. With 51 eligible licenses not renewed, this would allow for 51 new CFL licenses with a *soft-shell clam endorsement* available in 2016 versus 12 new licenses at status quo of 1:1. The RIMFC met on October 5, 2015 and recommended maintaining status quo of 1:1.

Future Management Considerations: The Narragansett Bay Commission's combined sewer overflow project combined with more-intensive water quality monitoring by RIDEM OWR, has resulted in further water quality improvements in the Providence River as well as a decrease in the number of rainfall-induced closures in Conditionally Closed Areas "A" and "B". In 2013 RIDEM OWR again modified the boundaries and rainfall thresholds of Conditional Area C (the Conimicut triangle). Landings of soft-shell clams at Conimicut Point area have declined significantly since the overfishing that took place in 2010 and there were no landings reported in the Conimicut Triangle for 2012 or 2013, although it is suspected that some landings did occur and were misreported as Conditional Area B. Stocks could further decline without implementation of more realistic and sustainable management measures. The isolated characteristics of the Conimicut Point fishery make the clams particularly vulnerable to variations in fishing effort. Additionally, a permanent pollution closure line bisecting the bed makes enforcement problematic.

Current harvesting regulations were developed and implemented to facilitate harvest of specific shellfish species of economic interest to the commercially fishing community. Allowable harvest methods were implemented with the intent of minimizing habitat

impacts and protecting juvenile stocks while providing for commercial harvest. Species-specific regulatory language has resulted in commercial fishing activities targeting unregulated (or under-regulated) species by fishing methods considered too intrusive or unsuitable by DEM. An example is the use of mechanical harvest methods (including air-assisted and water-assisted methods) in pursuit of razor clams and mantis shrimp in direct proximity to regulated species and inside established pollution closures. The insufficiencies also make proper resource management and habitat protection problematic. Establishment of comprehensive restrictions against the use of mechanical harvest, and/or air-assisted, and water-assisted harvest methods for all species in Narragansett Bay and the salt ponds with provisions for certain fisheries would aid in protecting soft-shell clam stocks.

Alternatives to protect this fishery include, but are not limited to, establishing new shellfish management areas, establishment of area-specific fishing periods, and adoption of reduced possession limits statewide. Measures should be implemented for the Providence River while the aforementioned pollution-closure boundary at Conimicut Point is in effect.

WHELK ENDORSEMENT

Recently, DFW conducted a new comprehensive analytical assessment on whelk resources in RI (Gibson 2010). This work constitutes the first attempt to assess the status of whelk and their fishery in Rhode Island waters.

Commercial Landings: A commercial fishery for whelks has existed in Rhode Island for many years; however, until September 2009 it was not regulated or the subject of a stock assessment. There are two species commonly landed in RI, the channeled (*Busycotypus canaliculatus*) and knobbed (*Busycon carica*) whelk. According to National Marine Fisheries Service (NMFS) statistics, RI whelk landings were 85,000 pounds of meat weight in 1950 and increased over time to a peak in 1986 at 347,000 pounds. After several years of high landings, the fishery declined rapidly and from 1994 to 2003, when reported landings were less than 2,200 pounds. Since 2006, whelk landings by species have been monitored through the SAFIS reporting system, which captures landings from both state and federally permitted fishers. A sharp increase in whelk landings occurred from 2008 to 2009, with years 2006-2008 averaging 384,489 pounds annually and years 2009-2014 averaging 654,502 pounds annually (Figure 6). The average whelk landings per fisher show a decreasing trend from 2010 onward (Figure 7). Ex-vessel value of whelks from 1950 to 1976 was steady at about \$1.25 per pound of meat. It then increased sharply from \$1.27 to \$3.24 from 1976 to 1983. From 2004 to 2008, value has fluctuated around \$3.00 per pound (Gibson 2010) but has fallen to around \$2.25 in 2013.

Resource Assessment: An initial stock assessment of the RI whelk and fishery was performed by Gibson (2010) using a biomass dynamic model (BDM) and an overfishing reference point of $F_{msy}=0.33$ was calculated. The BDM clearly showed that whelk

abundance is strongly influenced by fishing mortality rate (F). High F rates above the $F_{msy}=0.33$ level result in low biomass; high whelk abundance occurs when the F is less than F_{msy} (Figure 8). Based on the available data at that time, it was concluded that $F_{msy}=0.33$ was an appropriate overfishing reference point and a fishing mortality rate target equal to 75% of F_{msy} ($F=0.25$) would provide a buffer between the overfishing threshold. Based on this initial stock assessment, F rate was at or below this level, indicating that overfishing was not occurring. Also, biomass was estimated to be near the B_{msy} reference level, so an overfished condition was not likely (Gibson 2010).

The whelk stock assessment was updated to include data through 2013 and resulted in re-estimation of $F_{msy}=0.40$. As with the previous stock assessment, high fishing mortality rates above $F_{msy}=0.40$ result in low biomass; high whelk abundance occurs when the F is less than F_{msy} . The updated target F rate is 0.30. F has risen and is now estimated to be at or above F_{msy} (Figure 9), so overfishing is likely. Biomass remains at or above B_{msy} (Figure 10). Projections indicate however that biomass will fall below B_{msy} if overfishing continues.

The fishery seems to have operated in a pulse fishing mode with periodic increases in abundance that attracted fishing effort. High fishing mortality rates ensued (1960's, 1980's), the stock declined, effort dissipated, and a biomass recovery followed. A minimum size limit alone cannot prevent reoccurrence of these fishing pulses. To avoid opportunistic expansions in effort, consideration will need to be given to effort limitation via license/permitting or through output controls such as catch limits and quotas (Gibson 2010).

Management Program: Whelks are managed entirely within state waters by DEM with advice from the Rhode Island Marine Fisheries Council (RIMFC). Minimum sizes and possession limits restrict the fishery. To avoid opportunistic expansions in effort, a new endorsement directed at whelk fishing was added to the licensing system for 2012. The goal of the new endorsement is to cap and monitor effort through the use of the endorsement category and avoid future boom and bust cycles that were observed over recent years (Gibson 2010). Other management measures should be considered to control output to limit fishing mortality such as quotas, daily possession limits, closed seasons, and a minimum size based upon sexual maturity. A comprehensive whelk fishery sampling program was conducted by DFW during 2012 and the results of data analyses may be considered for future whelk fishery management plan strategies.

DFW Recommendation: Maintain status quo: to allow holders of a valid CFL or PEL license with a Quahaug and/or Soft-Shell Clam endorsement as of the immediately preceding year to be eligible to obtain a *Whelk endorsement* in 2016.

RI Marine Fisheries Council: The RIMFC's Industry Advisory Committee (IAC) met on July 21 and supported status quo. The RIMFC met on October 5, 2015 and concurred with the Division and the IAC.

SHELLFISH OTHER ENDORSEMENT

Other species of shellfish commercially harvested within Rhode Island waters include oysters, blue mussels, scallops and razor clams. While these species are not routinely assessed by RI DFW and little data is available to conduct comprehensive analytical assessments, landings data and anecdotal evidence from the commercial fishing industry are useful pieces of information in identifying populations that warrant further research.

Commercial Landings: Regarding the oyster stock, landings have decreased since the late 1990's. In 2014, 191,249 wild oysters (33,271 pounds) were landed in RI. To put this number in perspective, the aquaculture industry in Rhode Island (55 farms) sold 7.55 million oysters in 2014. Therefore only 2.5% of the oysters landed in Rhode Island are from wild harvest. According to local researchers studying oyster populations within Narragansett Bay, the effects of disease, environmental conditions, poor sets of new recruits, and fishing pressure are all responsible for the sharp decline in abundance levels (Oviatt et Al. 1998). It is a reasonable assumption that given such high rates of natural mortality, fishing pressure can lead to local depletions of the resource. Recently dead oysters (open shells) are visual evidence of the effects of oyster disease. This occurs in both fished and unfished RI waters. Further investigation into the effects of fishing effort is certainly warranted; however, until the extent of the influence that fishing effort and poor recruitment has on abundance is ascertained DFW recommends reducing the daily possession limit accordingly. Establishment of new spawner sanctuaries and harvest moratoria are considered important components of the collaborative oyster-restoration efforts that are underway. Initiating further research and monitoring to track abundance and recruitment success is needed.

Management Program: Oysters, blue mussels and scallops are managed in state waters by the DEM with advice from the RIMFC. Additional federal regulations apply to surf clams and ocean quahaugs in federal waters. DEM uses seasons and possession limits to manage the state waters fishery. Permanent and conditional pollution closures further restrict the fishery in addition to the above management measures. The DEM, in cooperation with both federal government and non-government organizations, has been conducting oyster restoration in the salt ponds and Narragansett Bay.

In 2014, the Natural Resources Conservation Service (NRCS) provided funding for a statewide oyster restoration project to help increase the spawning and recruitment levels sufficient to reestablish a self-sustaining oyster population. DEM is overseeing and authorizing the placement of the stocked oysters into the state's waters. Currently, there are established shellfish spawner sanctuaries in state waters with habitat suitable for placement of the oysters. They are in designated portions of Winnapaug, Quonochontaug, Ninigret Ponds, Potters Pond, Jenny's Creek, and Bissell cove. The Nature Conservancy (TNC) is also assisting with restoration efforts.

DFW Recommendation: DFW recommends status quo for the *shellfish other endorsement* until better data is available on their status.

RI Marine Fisheries Council: The Industry Advisory Committee (IAC) of the RIMFC met on July 21 and supported status quo in 2016. The RIMFC met on October 5, 2015 and concurred with the Division and IAC.

LITERATURE CITED

- Erkan, D.E. and M.R. Gibson. 2006. 2005 Shellfish Survey of Potter Pond South Kingstown, Rhode Island. RI Division of Fish and Wildlife.
- Ganz A., Lazar N., and A. Valliere. 1999. Narragansett Bay Quahaug Management Plan. RI Division of Fish and Wildlife. Report to the Narragansett Bay Project and RI Marine Fisheries Council.
- Gibson, M.R. 1999. Assessment of quahaugs (*Mercenaria mercenaria*) in Narragansett Bay: technical analyses in support of a bay wide quahaug management plan. RI Division of Fish and Wildlife. Res. Ref. Doc. 99/2.
- Gibson, M.R. 2010. Stock Assessment of Whelk in Rhode Island and Recommendations for Research and Management. In progress
- Gibson, M.R. 2012. Stock Assessment of Soft-Shell Clams (*Mya arenaria*) in Rhode Island Using a Dynamic Depletion Model Applied to SAFIS Data. Draft Report - RI Division of Fish and Wildlife.
- Murphy, B.R. 2007. Estimation of Catch per Unit Effort for the Commercial Soft-shell Clam (*Mya arenaria*) Fishery in Rhode Island. RI Division of Fish and Wildlife.
- Oviatt, C, Wolff, N, VanKeuren, D, and E. Nicosia. 1998. Oysters (*Crassostrea virginica*) as indicators of a climate warming trend in Northeast waters. CR822051-010 Final report. Funding agency: Environmental Protection Agency.
- Restrepo, V.R. 2001. Dynamic depletion models. Pages 345-356, In: J. G. Cano and V.R. Restrepo, eds. Report on the FAO/DANIDA/CFRAMP WECAFC regional workshops on the assessment of spiny lobster *Panulirus argus*. Belize City, Belize April 21- May 2, 1997 and Merida, Yucatan Mexico June 1-12, 1998. FAO Fish. Rep. 619. Part III: Stock Assessment Methods.
- Sosa-Cordero, E. 2003. Trends and dynamics of the spiny lobster, *Panulirus argus*, resource in Banco Chinchorro, Mexico. Bull. Mar. Sci. 73: 203-217.
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TABLES AND FIGURES

Table 1. RI commercial quahaug landings (A= numbers and B= lbs) for 2014 by shellfish tagging area (broad areas) and market category.

A

Shellfish Tagging Areas	Individual Quahogs Landed by Market Size				Total (#)	% of Total
	Littleneck	Top Neck	Cherry	Chowder		
<i>Unknown</i>	409,094	142,362	546	52,527	604,529	1.8%
RI 1A - Conditional Area A	7,493,915	2,740,593	89,336	1,039,491	11,363,335	32.9%
RI 1B - Conditional Area B	5,065,458	1,736,949	68,618	440,631	7,311,656	21.2%
RI 1C - Conditional Area C	5,835	2,149		1,163	9,147	0.0%
RI 2 - Greenwich Bay	1,424,409	246,117	13,540	40,078	1,724,144	5.0%
RI 3A,C,F,H - West Passage Management Areas	86,446	12,680	4,060	2,770	105,956	0.3%
RI 3W - West Passage	5,302,189	1,786,167	257,938	614,944	7,961,238	23.1%
RI 4A,B - East Passage	2,668,124	1,138,083	1,143	704,629	4,511,978	13.1%
RI 5A,K - Mount Hope Bay	2,074	721		266	3,061	0.0%
RI 5B - Sakonnet River	92,127	50,888	324	52,705	196,043	0.6%
RI 6B,N,P,Q,W - Coastal Ponds & Block Island	618,113	66,130	2,797	21,073	708,113	2.1%
Grand Total	23,167,784	7,922,839	438,300	2,970,276	34,499,199	-

B

Shellfish Tagging Areas	Pounds (lbs) Landed by Market Size				Total (lbs)	% of Total
	Littleneck	Top Neck	Cherry	Chowder		
<i>Unknown</i>	58,442	24,759	121	21,011	104,333	1.7%
RI 1A - Conditional Area A	1,070,559	476,625	19,852	415,796	1,982,833	33.2%
RI 1B - Conditional Area B	723,637	302,078	15,248	176,253	1,217,216	20.4%
RI 1C - Conditional Area C	834	374	0	465		
RI 2 - Greenwich Bay	203,487	42,803	3,009	16,031	265,330	4.4%
RI 3A,C,F,H - West Passage Management Areas	12,349	2,205	902	1,108	16,565	0.3%
RI 3W - West Passage	757,456	310,638	57,320	245,978	1,371,391	23.0%
RI 4A,B - East Passage	381,161	197,927	254	281,852	861,193	14.4%
RI 5A,K - Mount Hope Bay	296	125	0	106	528	0.0%
RI 5B - Sakonnet River	13,161	8,850	72	21,082	43,165	0.7%
RI 6B,N,P,Q,W - Coastal Ponds & Block Island	88,302	11,501	622	8,429	108,854	1.8%
Grand Total	3,309,683	1,377,885	97,400	1,188,110	5,971,406	-

Table 2. RI commercial soft-shell clam landings (lbs) for 2008-2014 by shellfish tagging area.

Shellfish Tagging Areas	2008	2009	2010	2011	2012	2013	2014	2014 % Δ from '08-'10 mean
<i>Unknown</i>	8,820	46,169	7,922	183	1,134	410	740	-96.5%
RI 1A - Conditional Area A	519,762	351,635	138,754	66,576	2,371	999	5,225	-98.4%
RI 1B,C - Conditional Area B & C	-	-	498,901	46,476	192	92	6,255	-98.7%
RI 2 - Greenwich Bay	5,704	4,182	70	358	286	0	1,073	-67.7%
RI 3 - West Passage	151,825	72,660	36,227	16,745	10,377	14,453	10,024	-88.5%
RI 4 - East Passage	4,856	5,636	2,692	19,400	377	336	3,926	-10.7%
RI 5 - Sakonnet River & Mount Hope	860	1,930	427	394	97	157	231	-78.5%
RI 6 - Coastal Ponds	22,333	12,421	13,602	33,619	27,053	29,334	10,420	-35.4%
Grand Total	714,160	494,633	698,595	183,751	41,887	45,781	37,894	-94.0%

Figure 1. Shell weight (metric tons) of quahaugs commercially landed in Rhode Island from 1946 – 2014.

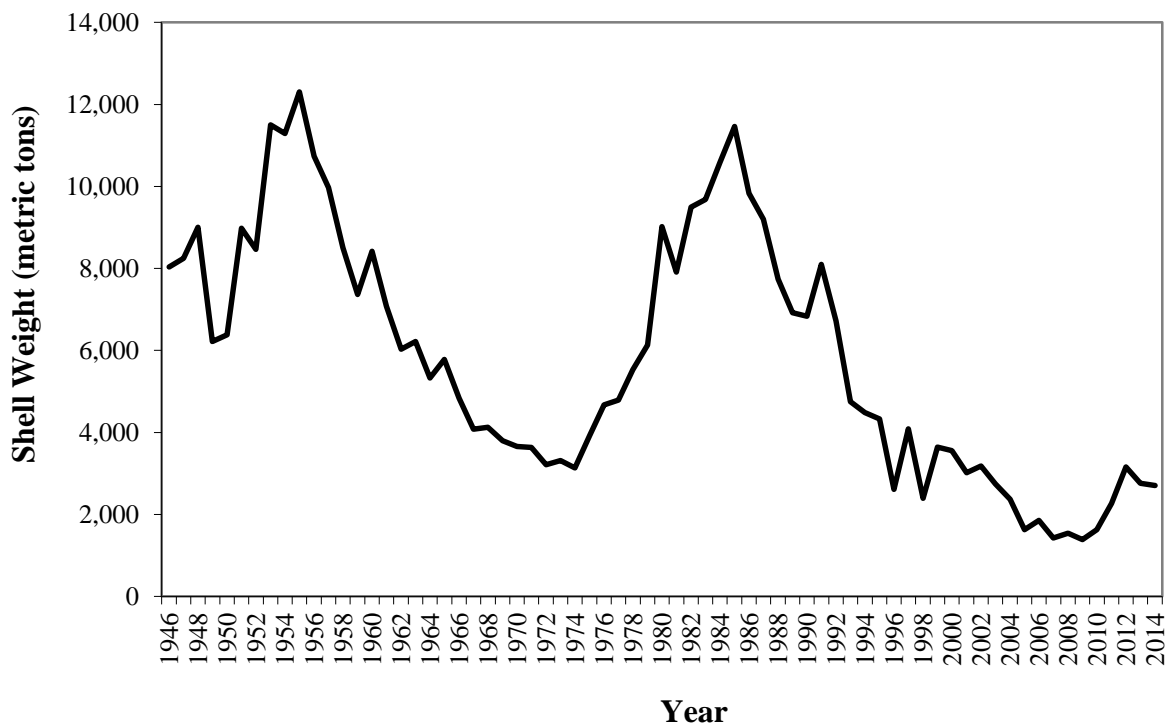


Figure 2. RI commercial quahaug landings in metric tons of shell weight and catch per unit effort (CPUE) from 2006-2014. CPUE was calculated as metric tons landed per year divided by the total number of SAFIS trips.

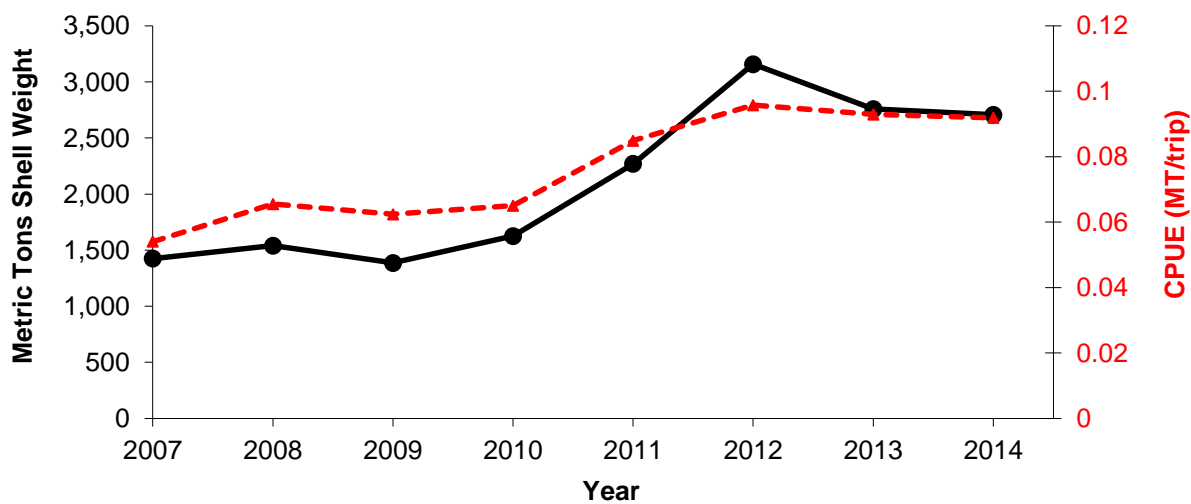


Figure 3. Recent sampling locations and survey strata in Narragansett Bay as measured by RI DEM Fish and Wildlife's hydraulic dredge survey (2013-2014)

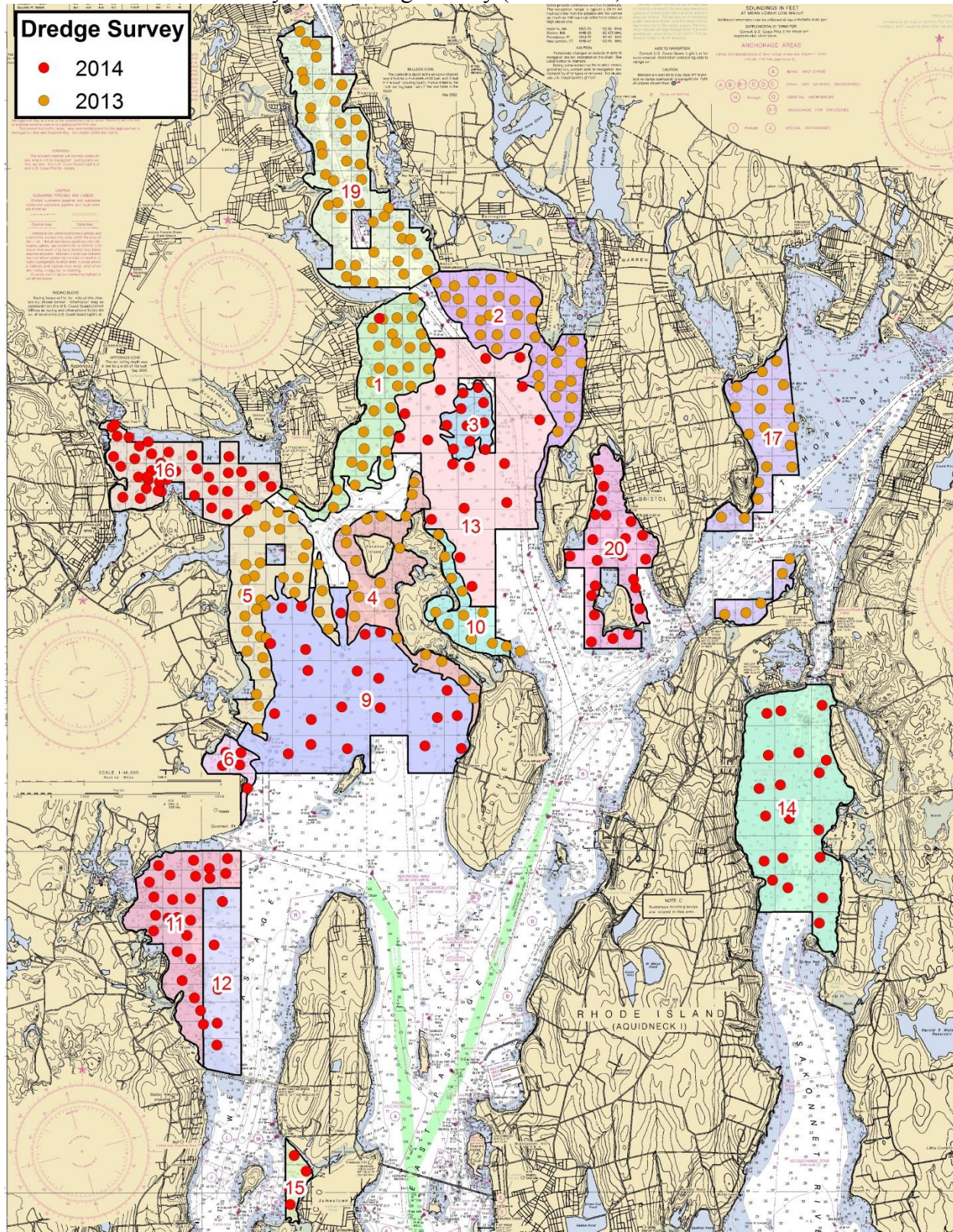


Figure 4. RI commercial soft-shell clam landings (shell weight, metric tons) from 1945-2014.

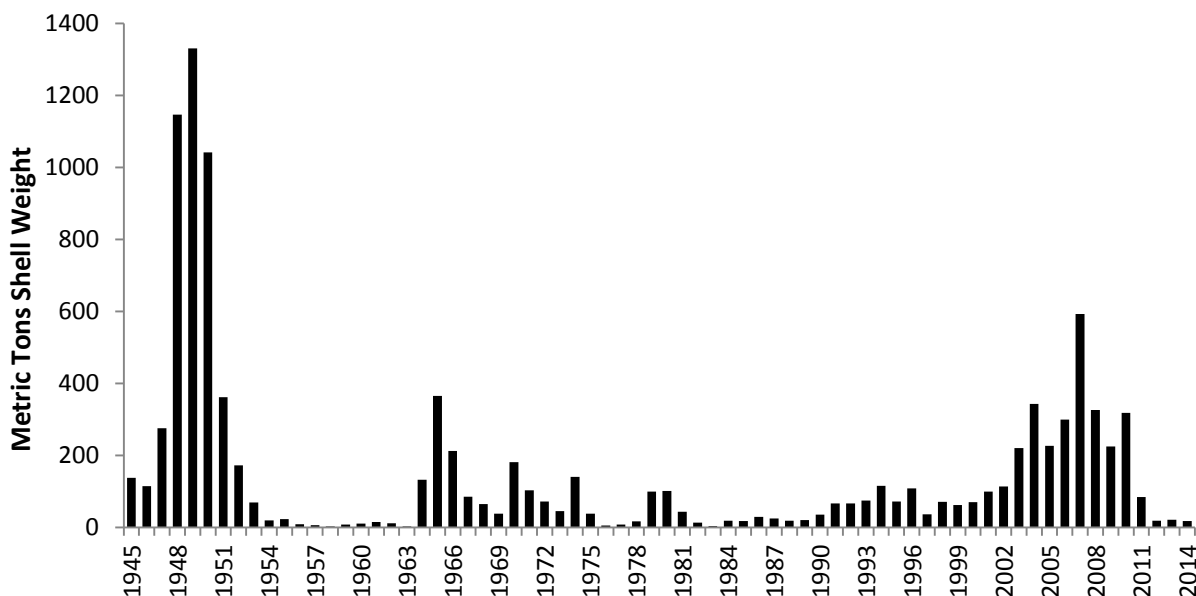


Figure 5. RI commercial soft-shell clam landings and catch per unit effort (CPUE) from 2006-2014. CPUE was calculated as pounds landed divided by the total number of SAFIS trip per year.

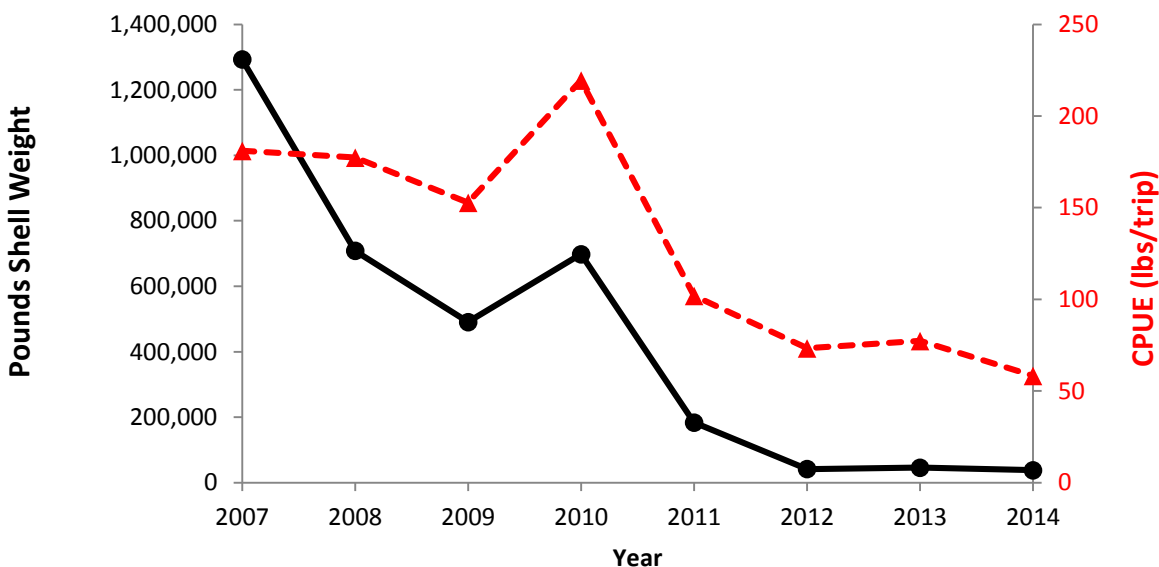


Figure 6. RI commercial whelk landings (species combined) for 2006-2014.

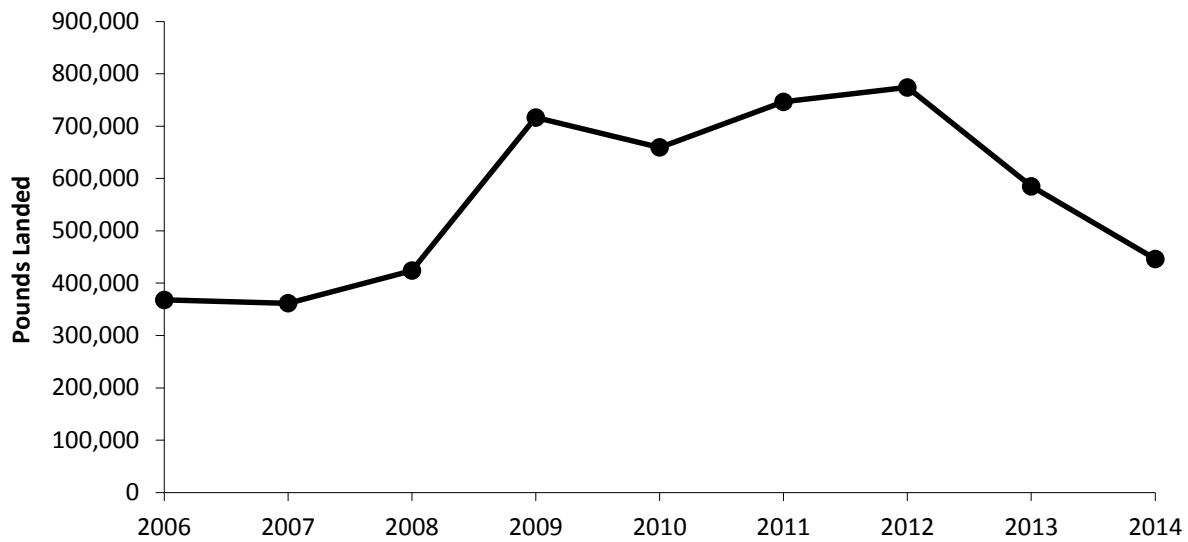


Figure 7. Number of reported fishers active in the fishery and mean landings per fisher recorded in SAFIS in the RI commercial whelk fishery from 2006-2014.

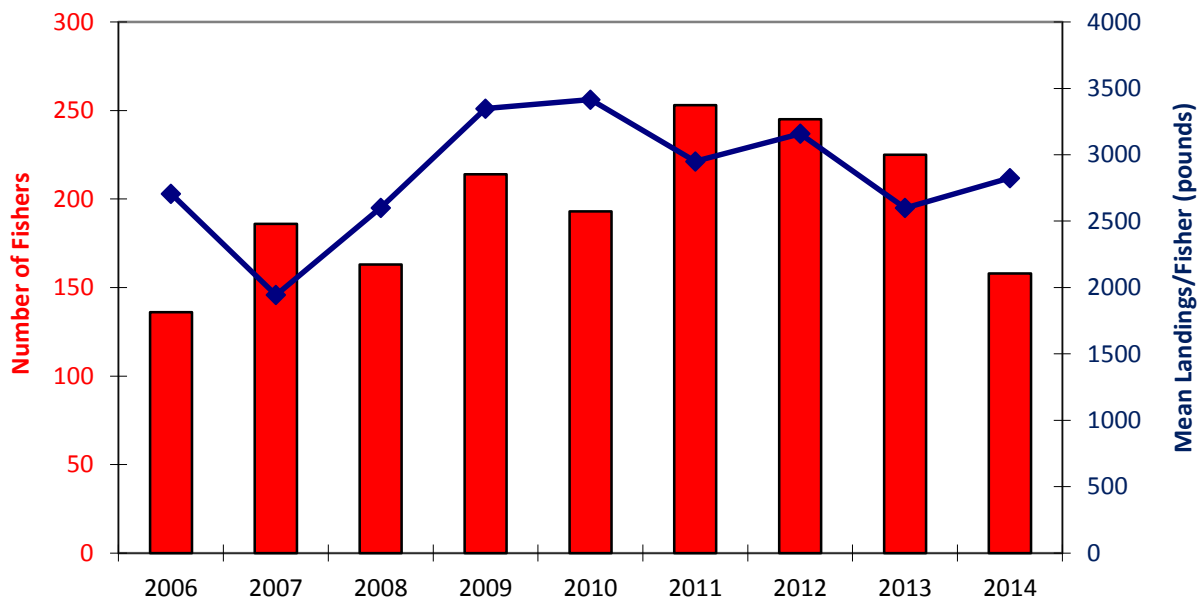


Figure 8. Phase plot for whelk fishing mortality rate (F) and stock biomass.

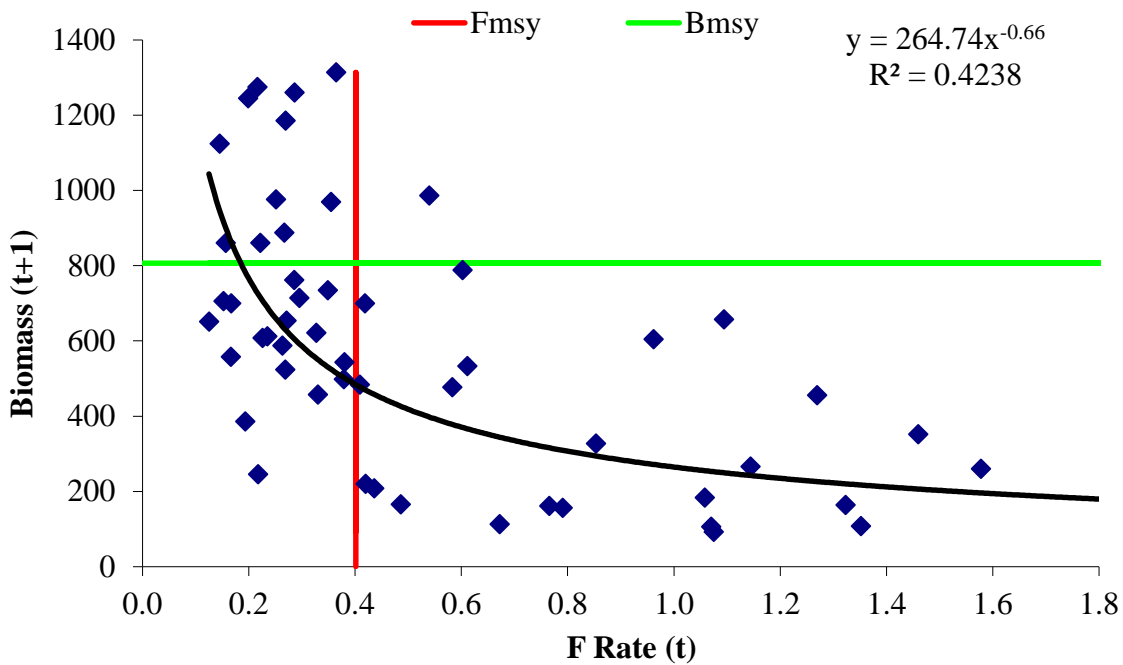


Figure 9. Estimated whelk fishing mortality rate (F) compared to F_{msy} .

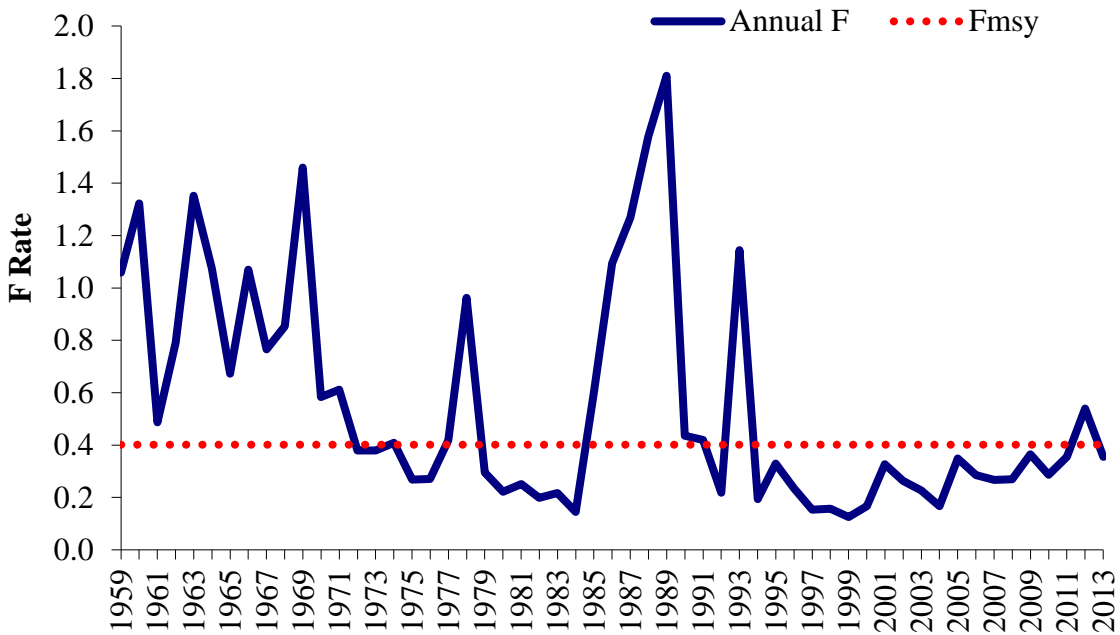
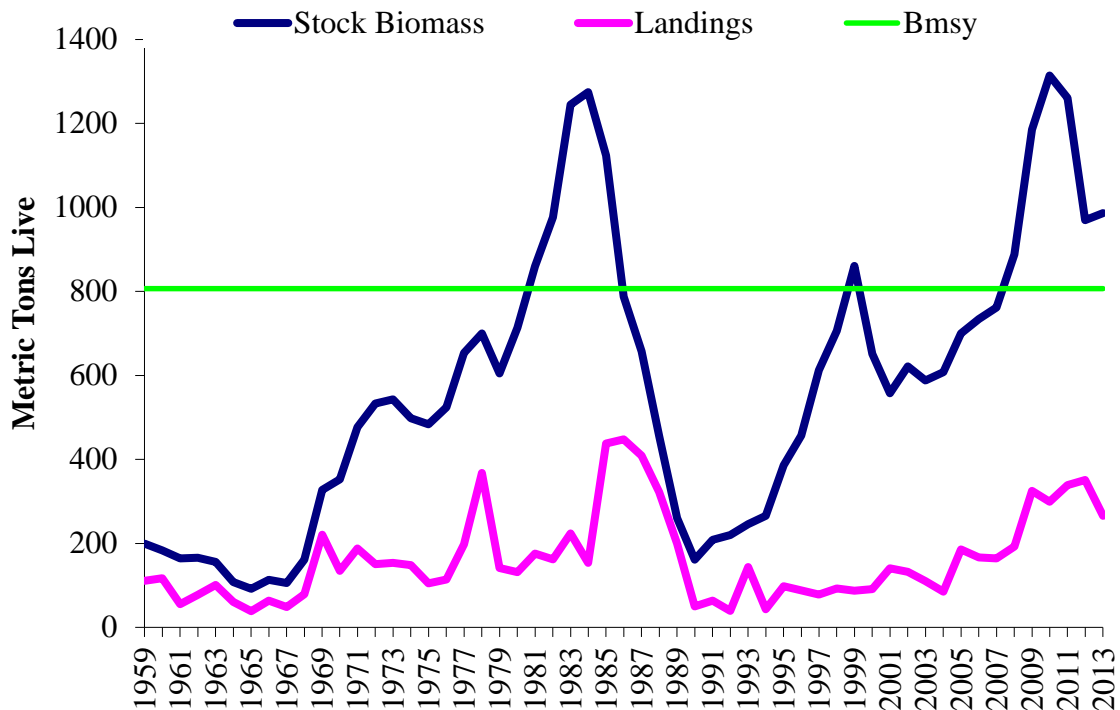


Figure 10. Estimated absolute whelk abundance and landings compared to Bmsy.



Plan approved:

 Jason McNamee, Chief
 Division of Fish and Wildlife
 Office of Marine Resource Management

 Date