

Washington Coastal Spot Shrimp Fishery



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Washington Department of
FISH AND WILDLIFE
Fish Program
Fish Management Division

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Many people have played important roles in the years since the state began to actively manage the coastal spot shrimp fishery. High on this list are the contributions of retired Washington Department of Fish and Wildlife (WDFW) fisheries biologist, Steve Barry and former University of Washington graduate student Nicholas Lowry. We are also indebted to a long list of WDFW technicians who provided dedicated sampling coverage in often challenging conditions: Glen “John” Beck, Carol Henry, Donna Downs, Terry Wilson, Leopold Sanchez, Clayton Parson and John Deibert.

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Executive Summary

Spot shrimp (also referred to as prawns or spot prawns) are the largest shrimp on the US West Coast. Their geographic range extends from Southern California to Alaska's Aleutian Islands, around to the Sea of Japan and the Korea Strait. Spot shrimp tend to inhabit rocky or hard bottoms that include glass-sponge reefs, coral beds, and the edges of marine canyons. Along the Washington coast, spot shrimp habitat is mostly in deep ocean canyons that are located from 20 to 40 miles offshore, and typically at depths from 70 to 100 fathoms.

Washington's coastal spot shrimp were not actively fished prior to 1992. As interest in the fishery grew, WDFW saw a need to begin to manage the fishery. An advisory board was appointed, comprehensive regulations were developed and in 1999 the Fish and Wildlife Commission authorized the fishery under the provisions of the Emerging Commercial Fisheries Act (ECFA). At that time a total of 15 permits were issued, five to trawl fishers and ten to pot fishers. In 2003, the fishery transitioned to a pot gear only fishery. During the ensuing years the number of permits dropped; by 2009 only 8 remained. With this reduction, usage patterns in the fishery stabilized and gear conflicts diminished. Also, during this period, management actions addressed significant biological concerns relative to harvest, habitat, and bycatch.

In 2010, WDFW staff and current holders of spot shrimp permits agreed that the Washington coastal spot shrimp fishery was no longer an "emerging" fishery; it had matured and there were no further significant benefits to it remaining under the ECFA. Action by the Washington Legislature passed SHB 1148 which converted the fishery to a separate limited entry license, specific to coastal spot shrimp. This action does not preclude future management action to address resource or fishery concerns that might arise. However, conversion of the spot shrimp permit to a limited entry license does allow for license transfers either by sale or inheritance.

Table of Contents

List of Figures	iii
List of Tables	iv
List of Appendices	v
Background of the Coastal Spot Shrimp Fishery.....	1
Introduction.....	1
Management History of the Coastal Fishery	1
Trawl Gear Banned.....	4
Vessel Length Limitations and Vessel Ownership	4
Commercial Season Established.....	5
Total Allowable Catch Reduced and Allocated by Region	5
Minimum Landing Requirement Repealed.....	6
Limited Entry License Program.....	6
Coastal Spot Shrimp Fishery Profile.....	9
Description of fishery	9
Recreational	9
Commercial.....	9
Regulations	10
Recreational	10
License	11
Area, Season and Catch Limits.....	11
Gear Requirements.....	11
Commercial.....	12
License and Permit.....	12
Season	12
Total Allowable Catch	12
Gear Requirements.....	12
Logbook	12
Landing Notification, Sampling and Monitoring.....	13
Harvest	13
Commercial Fishery Income.....	18
Commercial Vessel Size	19
Commercial Fishing Grounds.....	21
Treaty Indian Fishing.....	21
Spot Shrimp Life History,.....	22
Fishery Observation and Assessment	22
Spot Shrimp Life History.....	22
Fishery Observation and Biological Data Collection	23
Dockside Sampling Program	23
Carapace Length Frequency Data.....	25
Ovigery Data.....	27
At-sea Fishery Observation.....	28

Fishery Assessment.....	33
Discussion.....	35
Conclusions and Recommendations for Management.....	38
Literature Cited	40

List of Figures

Figure 1. Catch by trawl gear	4
Figure 2. Egg-bearing spot shrimp	5
Figure 3. Setting shrimp pots	9
Figure 4. Emptying shrimp pot.....	9
Figure 5. Offloading spot shrimp catch.....	10
Figure 6. Shrimp catch is sorted.....	10
Figure 7. A typical commercial shrimp pot.....	12
Figure 8. Coastal commercial non-treaty spot shrimp harvest (pounds) by year and gear type	16
Figure 9. Coastal commercial non-treaty spot shrimp harvest (pounds) by state	16
Figure 10. Distribution of spot shrimp catch by aggregated fish ticket catch areas.....	17
Figure 11. Fish ticket catch area map.....	17
Figure 12. Total direct fishery value in dollars (1000's) and harvest (pounds), 1992 – 2012	19
Figure 13. Direct fishery value in dollars (1000's) per fisher, 1992 – 2012.....	19
Figure 14. Median vessel size (feet) of vessels in the spot shrimp fishery	20
Figure 15. Usual and accustomed fishing grounds of four coastal treaty tribes: Makah, Quileute, Hoh and Quinault	21
Figure 16. Biological sampling regions	25
Figure 17. Area 1 average (mean), minimum and maximum carapace lengths (2003-2009).....	26
Figure 18. Area 3 average (mean), minimum and maximum carapace lengths, 2003-2009.....	26
Figure 19. Area 1 percentage of egg-bearing (ovigerous) spot shrimp by month.....	28
Figure 20. Area 3 percentage of egg-bearing (ovigerous) spot shrimp by month.....	28
Figure 21. Pot fishery bycatch.....	31
Figure 22. Comparison of fish bycatch by pot soaking time.....	32
Figure 23. Comparison of invertebrate bycatch by pot soaking time	32

List of Tables

Table 1.	Annual total harvest by gear and state; total number of vessels	15
Table 2.	Average spring-time carapace lengths (mm) by sex, Area 1 and 3	27
Table 3.	At-sea observations of the coastal spot shrimp trawl fishery, 1999 and 2000.....	29
Table 4.	At-sea observations of the coastal spot shrimp pot fishery, 2003-2007	30
Table 5.	Estimates of MSY	34

List of Appendices

Appendix A. Emerging Commercial Fishery Regulations	43
Appendix B. House Bill 1148	49
Appendix C. Final Spot Shrimp Limited License Program Legislation	57
Appendix D. Coastal Spot Shrimp Pot Experimental Fishery Permit Conditions	61
Appendix E. Coastal Spot Shrimp Fishery Regulations	65
Appendix F. Coastal Spot Shrimp Fishery Log	71
Appendix G. Coastal Spot Shrimp Surplus Production Model	75

Background of the Coastal Spot Shrimp Fishery

Introduction

Spot shrimp (*Pandalus platyceros*) are the largest shrimp on the West Coast and are found in Washington's ocean waters and the waters of Puget Sound and Hood Canal. Each region – coastal, Puget Sound, Hood Canal – is managed under separate regulations. Puget Sound and Hood Canal support both non-Indian commercial and recreational fisheries whereas on Hood Canal non-Indian fishers are allowed only recreational harvest opportunities.

The coastal fishery is almost exclusively commercial because known coastal spot shrimp grounds are largely inaccessible to the average sport fisher. This is due to the distribution of spot shrimp habitat, which ranges from 20 to 40 miles offshore, and typically at depths from 70 to 100 fathoms. In more recent years, gauging by the number of inquiries about coastal fishing opportunity by sport fishers, interest in the recreational fishery has grown. This growth appears to coincide with the increase in the number of recreational fishers pursuing albacore tuna and halibut with privately owned vessels sized and equipped to fish further off-shore. Two coastal tribes have at one time or another either agreed to fishery management plans with WDFW and/or filed regulations opening a tribal fishery, however only nominal tribal harvest has been reported to date.

Management History of the Coastal Fishery

Historically, there has not been an active recreational fishery for coastal spot shrimp. Thus, there's been little need for active management. Periodic reviews of coastal recreational regulations have been conducted through the Department's sport rule-making processes. Generally, regulations were set to provide opportunity. The year-round recreational season was originally set to be consistent with the twelve month season for commercial pot-gear. Given the unknown, but presumed very low effort in the sport fishery, the year-round recreational season has been maintained despite changes to the commercial fishery seasons. Daily bag-limits and gear requirements have followed the Puget Sound spot shrimp fishery rules.

Directed commercial fishing for spot shrimp on the Washington coast began in 1992 when two fishers based in Westport, Washington started fishing longline pot gear. Prior to this time incidental catches occurred in the ocean pink shrimp and groundfish trawl fisheries. Although there are anecdotal reports that a few large catches were made, catches were typically small and seldom documented on fish receiving tickets.

For several years, spot shrimp fishing activity was low and sporadic. This changed in 1997, when five trawlers entered the fishery in response to increased market demand for live shrimp. Combined, these trawlers landed 112,300 pounds, or about 84% of the total catch taken off Washington that year. WDFW staff became concerned about this sudden increase in effort and catch. Very little was known about the distribution, abundance, and sustainability of the resource, yet interest in the fishery was growing with the potential for rapid expansion of fishing effort.



Spot shrimp (*Pandalus platyceros*)

In November 1997 the WDFW Commission approved a staff recommendation to apply provisions of the Emerging Commercial Fisheries Act (ECFA) legislation to the coastal fishery. As required by the ECFA, the WDFW Director appointed an industry advisory board to make recommendations regarding the “number and qualifications of the participants” for permits.

The advisory board and WDFW staff met during 1998 and produced a comprehensive fishery regulation package that included permit qualification criteria based on prior participation in the fishery (Appendix A). The WDFW Commission adopted the regulation package in December 1998 and WDFW issued permits to qualifying fishers in January 1999. Five trawl gear fishers and ten pot gear fishers received permits.

These regulations were amended in 2000 due to concerns about stock health and fair allocation of the resource. One of the changes established a shorter season for trawl gear to constrain overall trawl effort, and thereby provide more equity for pot gear fishers. However, even with the shorter season trawl catch was nearly eight times greater than pot catch in 2001 and double the pot catch in 2002. Fishers offered varied opinions for this continued disparity in catch: trawlers claimed they were more diligent in their efforts, pot fishers reported that they were still precluded adequate access to the fishing grounds by the presence of the trawlers (including groundfish trawlers).

Regulation Timeline

1999 ECFA Designation

- Annual TAC of 250,000 pounds, equally allocated pot and trawl gear
- Trawl season from May 1 through November 30; open to pot gear year-round
- Limitations to trawl gear to prevent the use of “mud” and “tire and rockhopper” gear; limit number of pots to 500 per vessel

2000

- A cap, limiting total harvest south of 47°04.00' N. latitude to 100,000 pounds was adopted to protect the heavily fished Grays Canyon
- The opening date for an area encompassing Grays Canyon was moved from May 1 to July 1 for trawl gear to reduce the disparity of catch between gear types

2003

- Trawl Gear Banned
- Vessel Length Limits Instituted
- Ownership of vessel requirement dropped

2006

- Year-round fishery reduced to 6-month season

2008

- Annual TAC reduced; split by region
- Minimum landing requirement dropped

2011

- Limited Entry License Program

Trawl Gear Banned

As the coastal fishery expanded, bycatch in trawl spot shrimp fisheries along the west coast of the United States, particularly of rockfish species, was coming under greater scrutiny. The Pacific Fishery Management Council (Council) was in the process of declaring canary and other rockfish species to be overfished under the terms of the Sustainable Fisheries Act enacted by Congress in 1996. Coastal commercial groundfish fisheries directed at rockfish and other groundfish were being severely curtailed, and fisheries with rockfish bycatch were coming under increasing pressure to reduce or eliminate their catch of the overfished species.

To assess bycatch from the Washington ocean trawl fishery, WDFW and the University of Washington conducted on-board observations from commercial spot shrimp trawl vessels in the fall of 1999 and 2000. The majority of the catch observed during these trips consisted of non-spot shrimp species, including rockfish, flatfish, sea urchins, sponges and other invertebrates. Based on these observations, combined with other information obtained from research assessing the impacts of trawl gear, WDFW and some spot shrimp permit holders (including one trawler) proposed that trawl gear be phased out of the ocean fishery. This decision was supported by the availability and effectiveness of pots as an alternative gear type to catch spot shrimp.



Figure 1. Catch by trawl gear.

In recognition that elimination of trawl gear from the spot shrimp fishery would create a hardship for the trawl fishers, two strategies were developed with permit holders to minimize the impacts. First, trawl permits issued for 2002 authorized trawl fishers to fish either gear type. This would afford trawlers the opportunity to familiarize themselves with pot gear before they became dependent solely on that gear. Second, a portion of the annual total allowable catch (TAC) was set aside for converted permits for a period of four years. Beginning in 2003, pots were the only legal gear in the fishery.

Vessel Length Limitations and Vessel Ownership

In 2003, vessel length restrictions were enacted to avoid overcapitalization of the fleet by reducing the incentive to engage increasingly larger vessels in the fishery. Also a requirement that permit holders have ownership interest in the designated vessel was eliminated.

Commercial Season Established

Since inception, the fishery was open year-round for pot gear. To protect egg-bearing spot shrimp a six-month (March 15 to September 15) season was adopted in 2006 for implementation in 2007. This action was based on biological sampling of commercial landings. By this time sufficient data had been collected to characterize the pattern of egg-bearing in coastal spot shrimp.



Figure 2. Egg-bearing spot shrimp.

Total Allowable Catch Reduced and Allocated by Region

In 2007, an evaluation of fishery logbook data from 1996-2006 led to a couple of precautionary actions to further protect the fishery and resource productivity.

The evaluation revealed the resource's capacity to sustain harvest was lower than the total allowable catch (TAC) of 250,000 pounds and that capacity differed by region. The analysis split the coast into two regions and produced maximum sustained yield (MSY) estimates for each. The MSYs for the regions were estimated at 99K and 104K pounds, north and south, respectively.

A linkage of spot shrimp populations to benthic topography (canyons, deep water coral, rock substrate, etc.) was substantiated through plots of harvest sites from logbook entries and supported the recommendation that a northern cap be added forcing a split of harvest, to reflect the producing habitat and further prevent local area depletion. A sub-area cap adopted in 2000 to protect the fishing grounds around Grays Canyon did not afford an equivalent level of protection for fishing grounds to the north; in theory the entire 250,000 pound TAC could be taken from the north.

Based on this evaluation, the rules were amended to reduce the TAC by 50,000 pounds coast-wide. Further, the new rule split the TAC, assigning 100,000 pounds to each area south and north of 47°04.00' N. latitude. The combined effect of these actions was a permanent separation of the coast into two regions, to be managed independently relative to the harvest caps, each of which is 100K pounds. These numbers can change again in the future as additional information becomes available.

Minimum Landing Requirement Repealed

Management action also addressed another issue in 2008 involving the landing provision for maintaining a valid permit. The initial implementing rules required a permit holder to land a minimum of 1,000 pounds in a two calendar year period. For those fishers who landed product head-off, the poundage was multiplied by a factor of 2.22 (Crapo – Recoveries and Yields). Those permit holders who could not document such a volume of landings were denied a permit for the following licensing year. Failure to meet the minimum landing requirement (MLR) reduced the field of participants from fifteen to eight.

Support for the MLR waned as the fleet size decreased. The MLR was perceived by some participants to have accomplished the removal of fishers less dependent on the fishery, and that it was posing an economic hardship as well by requiring fishers to fish spot shrimp and miss other, more lucrative fishing opportunities (e.g. albacore tuna). All permit holders did not share this view; in a survey two of eight were not in favor of repealing the MLR citing concerns the fishery was still overcapitalized. However, the Department moved to drop the MLR because it did hinder economic flexibility and it likely would no longer effect a reduction in fleet size. The remaining eight participants had demonstrated they would work aggressively to maintain their permits including going through legal appeals.

Limited Entry License Program

In 2004, as required by the ECFA, a report with fishery management recommendations was submitted to the Washington State Legislature. The report recommended converting the fishery to a limited entry fishery. However, at the request of one industry member, Legislators agreed to delay implementing any changes to allow time to assess whether or not other permit holders would consider converting to an individual TAC regulatory structure. This idea met with strong opposition by several permit holders and because the Department was not willing to pursue this alternative without broad support from industry the idea was dropped. There was no further Legislative action and the fishery retained its experimental status under the ECFA.

Originally, 15 permits were issued in 1999. During the ensuing years the number dropped; by 2007, there were 8 permits remaining in the fishery. For various reasons, mostly economic, only a few of the permit holders consistently participated with substantial effort. The fishery did provide significant harvest opportunity to larger vessels that could fish more easily offshore, particularly during the spring months when weather is more severe. The value of the fishery for most is that it provided a lucrative supplement to Dungeness crabbing. As crabbing slowed during the summer, these fishers alternated between fishing for crab and spot shrimp.

While the fleet stood at just half of its original size, fishery managers did not recommend issuing additional permits. Although, under rules in place at the time, the Director did have the

discretion to issue permits up to the cap of 15. As a pot only fishery, the TAC had not been caught. However, certain permit holders demonstrated the potential for a few similarly skilled and outfitted operators to harvest the entire TAC and close the fishery. Also, because the primary fishing grounds are not extensive (most effort is concentrated in a couple of offshore canyons) fishers have developed individual fishing strategies that spread fishing activity over the 6 month season. However, at times fishers complain of crowding, with only a few vessels fishing simultaneously.

Around 2009, coastal spot shrimp fishers began expressing that they were ready to transition from the emerging commercial status and establish the fishery as a limited entry fishery with a separate license for coastal spot shrimp. The coastal spot shrimp fishery was no longer an “emerging” fishery, it had matured and there were no further benefits to it remaining under the ECFA. Interest in securing their investment in the fishery was strong: unlike standard fishing licenses, emerging commercial fishery licenses have no value, cannot be transferred to another person, or included as part of an estate. Pot-gear had proven to be an effective harvest strategy, the number of permit holders and usage patterns had stabilized, gear conflicts had diminished and significant biological concerns relative to harvest, habitat, and bycatch had been addressed. Further, converting the fishery to a separate license, specific to spot shrimp, would not preclude future action to address resource or fishery concerns that might arise.

A series of meetings with permit holders were held beginning in 2009 to identify license structure alternatives and options for future operating rules for the fishery. These meetings were concluded in 2010. A proposal was developed that sought to protect the spot shrimp resource, and preserve the positive characteristics of the fishery identified and valued by the permit holders. In 2011, a bill based on this proposal was sponsored by Washington State Representative Brian Blake. The original bill and the final legislation are presented in Appendix B and C, respectively. The key elements of the bill are listed below:

- Establish eight (8) coastal spot shrimp pot fishery licenses and provide for new licenses to be issued if the total number falls below eight.
- A license holder is required to own or be the operator of the vessel designated on the shrimp pot-coastal license.
- Allow only one license per natural person (i.e. human being)
- Attach a vessel length cap to each license

All four coastal treaty tribes: Quinault Indian Nation, Hoh Tribe, Quileute Tribe and Makah Tribe have treaty rights to harvest spot shrimp. Limiting the number of licenses to eight was proposed as a conservative approach relative to potential tribal fishery growth, particularly given the limited understanding of the coastal spot shrimp resource. This approach sought to avoid

expansion of the non-treaty fleet under a permanent license program that might then have to be reduced to accommodate tribal effort in the future.

Experimental fishery permits are not transferable (cannot be sold) which tends to keep the permit holders “close” to the fishery. However, spot shrimp permit holders were not required to own, wholly or in part, the vessel being fished and the spot shrimp experimental fishery rules allowed alternate vessel operators. As a result of this, a number of fishers, particularly younger ones were able to participate and gain experience in the fishery. Permit holders rejected the idea of requiring the license owner to be on board. While such a requirement would eliminate “absentee” owners, it was viewed as unduly restrictive and made it difficult to address contingencies for medical emergencies, etc. The proposed legislation sought a middle ground by requiring that the license holder be a natural person to prevent corporate ownership, and own the vessel or be the vessel operator.

Limiting vessel size moderated competition within the fleet and avoided a derby style fishery from developing. Larger vessels have the advantage of being able to fish in this off-shore fishery in conditions unsafe for smaller vessels. Typically, the larger vessels in the fleet have been able to fish when the season opens March 15 whereas the smaller vessels wait until better weather in May before beginning to fish. If vessel length was not capped, increasingly larger vessels could enter the fishery. It already had been demonstrated that a single large vessel could harvest a significant portion of the TAC. A primary concern was that once licenses were available for sale, effort would increase significantly over historic levels as license purchasers seek to recoup their investment. This increase in effort might be achieved by starting to fish earlier in the season, by making more trips, or both. The ability to fish any size vessel could compound this increase in effort.

Coastal Spot Shrimp Fishery Profile

Description of fishery

Recreational

The extent of recreational fishing activity and catch is unknown. Anecdotal reports of spot shrimp fishing are sparse but suggest anglers set pots for spot shrimp while participating in other fisheries. As has been described earlier in this report, known spot shrimp fishing grounds are located between 20 to 40 miles off shore in depths from 70 to 100 fathoms. This fact alone has kept the recreational harvest of spot shrimp to a very bare minimum. WDFW has received anecdotal reports that indicate a few owners of larger recreational vessels have attempted to harvest spot shrimp recreationally in the ocean. However, no data exists to confirm these reports or to indicate if those attempts to harvest spot shrimp were successful.

Commercial

Westport is and has been the hub of most spot shrimp fishing activity. One fisher has operated out of Ilwaco and another out of Ocean Shores. On occasion, fishers have landed in Neah Bay, Port Townsend, Anacortes or Seattle. All but one license holder, who resides in California, are residents of Washington.

The majority of coastal spot shrimp fishers use Ladner® conical, nesting pots. Pots are attached to a common line or “string” about 30 feet apart. A single “string” may have from 10 to 100 pots attached to it; a string of 50 pots is typical.

The strings of pots are typically set at depths from 75 to 120 fathoms and once deployed the strings are generally left to soak a minimum of 24 hours. Shorter soaks are rare while strings may be left a number of days before being hauled. These longer soaks occur when fishers set gear and are forced by weather to return to



Figure 3. Setting shrimp pots.



Figure 4. Emptying shrimp pot.

port, or as a means to hold their place on the grounds.

As the pots are hauled on board, the contents are dumped on a sorting table, bycatch is returned to the water and the live spot shrimp are lowered into totes. The water in the totes is pumped from the area fished, chilled to about 36-38°F and aerated. When the spot shrimp are off-loaded the water is transferred to totes on the truck. Fishers take great care of the shrimp because the majority of spot shrimp in the coastal fishery are sold live.

Before being loaded into the truck the spot shrimp are sorted to remove any that have died or are dying from handling stress. This “dead-loss” is removed to minimize further stress on the remaining spot shrimp during shipping yet is still a high quality product which can be sold “tailed” (heads removed) in more local markets. Live spot shrimp are shipped by truck primarily to out-of-state dealers in Portland, San Francisco, Los Angeles, or Vancouver, British Columbia.

One fisher has had the capacity to box the spot shrimp by size and freeze them at sea. Some fishers “tail” the spot shrimp as they are caught and bring them iced into port. These spot shrimp are usually sold directly from the boat or to local seafood markets.



Figure 5. Offloading spot shrimp catch.



Figure 6. Shrimp catch is sorted.

Regulations

Recreational

A citizen proposal to increase the daily bag limit for ocean spot shrimp (from 80 shrimp or 10 pounds to 200 shrimp or 25 pounds) was put forward during the 2012-13 Sport Rule Proposal process. A total of 109 comments were received during the rule change process, with the vast majority recommending the change. With no objections, the Washington Fish and Wildlife Commission adopted the rule change and it became effective on May 1, 2013.

License

A license is required for all individuals 15 years of age and over to catch spot shrimp from coastal (Pacific Ocean) waters. Several types are available including a combination license for salt and freshwater fish and shellfish, a saltwater fish or shellfish license, or a shellfish only license.

Area, Season and Catch Limits

The waters of the Pacific Ocean (Marine Areas 1-3 and Marine Area 4 west of the Bonilla-Tatoosh line) are open year-round, but fishing is allowed only from one hour before official sunrise to one hour after official sunset. The daily limit is 25 pounds, including heads and tails, of all shrimp species combined with a maximum of 200 spot shrimp. Shrimp heads may be removed, but must be retained while in the field until ashore and finished fishing for the day. There is no minimum carapace size. Each harvester must have a separate container for their catch, either in their possession or identified with their name.

Gear Requirements

Fishers are limited to a maximum of two shrimp pots per person with no more than four shrimp pots per boat. The pots may be constructed of either flexible or rigid mesh material (no liners allowed). Entrance tunnels can be made of any size mesh material but must be located on the sides of the pot. Overall shrimp pots dimensions must not exceed 10 feet in perimeter and 18" in height.

Unlike commercial gear, which can be tethered on a single line, every sport shellfish pot must have its own buoy line and a separate buoy that is permanently and legibly marked with the operator's first name, last name, and permanent address. All recreational shrimp pot buoys must be yellow in color. Buoys must be constructed of durable material (no bleach, antifreeze, detergent bottles, paint cans, etc.) and must be visible on the surface at all times, except during extreme tidal conditions. Personal flags and staff, if attached to buoys, can be of any color. Buoy lines must be weighted sufficiently to prevent them from floating on the surface.

The minimum mesh size for shrimp pots is 1" mesh such that a $\frac{7}{8}$ " square peg must be able to pass through each mesh opening, except for flexible (web) mesh pots, where the opening must be a minimum of 1 $\frac{3}{4}$ " stretch measure. All pots must be equipped with a biodegradable device (rot/escape cord) in one or more of the following designs: 1) a pot lid hook or tie down strap secured with a single loop of cord; or (2) a 3" by 5" escape panel sewn in the upper half of pot closed with cord; or (3) the pot lid or one pot side (serving as a pot lid) attached with no more than three single loops of cord.

Commercial

License and Permit

Participants are required to hold a Washington coastal spot shrimp limited entry fishery license (\$185 for residents, \$290 for non-residents). In addition, each fisher participating in the fishery must obtain a fishery permit (no cost) issued by the Director (Appendix D). Coastal spot shrimp fishers are subject to conditions set forth in the permit as well as regulations defined in: WAC 220-52-052 Ocean spot shrimp pot fishery — Coastal waters (Appendix E).

Season

The commercial fishery opens March 15 and closes September 15 each year.

Total Allowable Catch

The fishery is divided into two regions of Washington waters. One region is the area south of 47°04.00' N. latitude and the other is the area north of that line. Each of these areas has a total allowable catch of 100,000 pounds.

Gear Requirements

Pot size is limited to a maximum 153-inch bottom perimeter and a maximum 24-inch height. Shrimp pot gear must be constructed with net webbing or rigid mesh, and at least 50 percent of the net webbing or mesh covering the sides of the pot must easily allow passage of a seven-eighths inch diameter dowel. An escape mechanism is required (WAC [220-52-035](#)). The groundline end marker buoys must be floating and visible on the surface of the water, equipped with a pole, flag, radar reflector and operating light, and marked with the clear identification of the license holder and the vessel designated on the coastal spot shrimp license. The common trawl mesh size measurement of 1 ¾” when used to cover a pot will result in a 7/8” diameter opening. However, WAC 220-52-052 requires that only 50% of the pot mesh pass a 7/8” diameter dowel because the tapering of cone shaped pots reduces the effective opening.



Figure 7. A typical commercial shrimp pot.

Logbook

Fishers are required to maintain a log of all fishing activity (Appendix F) to include time, location, number of pots, depth, soak-time, and pounds harvested. Logbooks are due by the 10th day of the month following the fishing. Logbooks are maintained in an Access database at the WDFW regional office at Montesano.

Landing Notification, Sampling and Monitoring

To ensure adequate sampling and monitoring of the fishery, fishers are required to notify Department staff at least 24 hours in advance of returning to port. Access to the catch for sampling is required and fishers are also expected to comply with at-sea observation of fishing activity.

Harvest

Commercial harvest in the spot shrimp fishery has been highly variable from the beginning. In 1992 total harvest was 2,000 pounds; in 1998 it peaked at 250,000 pounds (Table 1). From 1999 to 2002 harvest ranged from 100,000 to 200,000 pounds annually. Total harvest exceeded 100,000 pounds in 2003, 2004, 2009, and 2012 but averaged less than half that from 2005 through 2008 and 2011 through 2012. Although resource abundance accounts for some of this variability, these fluctuations are largely due to fishers choosing to participate in other fisheries expected to provide higher returns, such as albacore tuna.

In 1998, the industry advisory board established March 30, 1998, as the cut-off date for fishers to qualify for a permit. This action spurred increased fishing effort during the remainder of the year as fishers took the opportunity to catch spot shrimp before permits were required. The total harvest that year of 250,000 pounds remains the highest. Before 2003, when trawl gear was banned, pot fishers claimed conflicts with trawl gear – entanglement, loss of pots – diminished their opportunity and discouraged greater fishing effort (Figure 8). Individual harvest patterns of some permit holders also suggested their level of fishing effort was tied to just achieving the minimum biannual requirement while that requirement was in place. Finally, the small fleet size also means harvest totals are sensitive to individual decisions to pursue other opportunities either locally or in Alaska (crab, salmon, and albacore tuna).

Early on, Oregon fishers were active participants in the coastal spot shrimp fishery; trawlers particularly were responsible for its expansion. Figure 9 shows the pounds of spot shrimp harvested from Washington waters that were landed and sold into Oregon. In 1994, 1997 and 1998, half or more of the pounds harvested in those years were landed in Oregon. When the fishery was established under the ECFA rules in 1999, three Oregon based fishers were included in the original group of permit holders. These fishers were able to document through logbooks and fish landing receipts their activity in the fishery off Washington. The inclusion of Oregon-based fishers in the qualifying group allowed WDFW to secure a reciprocal agreement with Oregon wherein each state agreed to only permit spot shrimp fishing in waters adjacent to each state, respectively.

In most years prior to 2004, the majority of the annual harvest was taken in catch-reporting areas 60A-1, 60A-2 and 61. In subsequent years effort shifted, and more catch came from the northerly fishing grounds in catch areas 58A and 58B. Beginning in 2009, most fishing was again concentrated on the southerly fishing grounds. These shifts are illustrated in Figure 10, by aggregating catch geographically. Figure 11 depicts the commercial marine fish-shellfish catch area designations coded on fish landing receipts.

Table 1. Annual total harvest by gear and state; total number of vessels.

Year	Gear	Number Vessels Landing in WA	Pounds landed in		Total Pounds
			WA	OR*	
1992	Pot	2	2,000	-	2,000
1993	Pot	4	14,900	-	14,900
1994	Pot	6	2,800	19,600	22,400
	Trawl	2	16,100	17,400	33,500
	Total	8	19,000	37,000	56,000
1995	<i>No Landings</i>				
1996	Pot	4	22,800	900	23,700
	Trawl		0	100	100
	Total	4	22,800	1,000	23,800
1997	Pot	5	21,200	600	21,800
	Trawl	5	39,600	72,700	112,300
	Total	10	60,800	73,300	134,100
1998	Pot	10	37,600	7,500	45,100
	Trawl	8	89,500	117,100	206,600
	Total	18	127,100	124,600	251,700
1999	Pot	5	5,000	100	5,100
	Trawl	3	78,200	17,700	95,900
	Total	8	83,200	17,800	101,000
2000	Pot	10	12,000	0	12,000
	Trawl	3	85,600	61,800	147,400
	Total	13	97,600	61,800	159,400
2001	Pot	9	24,600	0	24,600
	Trawl	3	118,200	52,100	170,300
	Total	12	142,800	52,100	194,900
2002	Pot	6	54,100	2,400	56,500
	Trawl	3	80,600	40,400	121,000
	Total	9	134,700	42,800	177,500
2003	Pot	9	115,800	0	115,800
2004	Pot	8	137,400	0	137,400
2005	Pot	6	64,100	0	64,100
2006	Pot	7	14,500	0	14,500
2007	Pot	7	36,600	0	36,600
2008	Pot	4	30,600	0	30,600
2009	Pot	7	115,500	0	115,500
2010	Pot	7	127,000	0	144,100
2011	Pot	8	56,500	0	57,400
2012	Pot	4	36,700	0	36,700

* Catch harvested off WA coast, sold in Oregon.

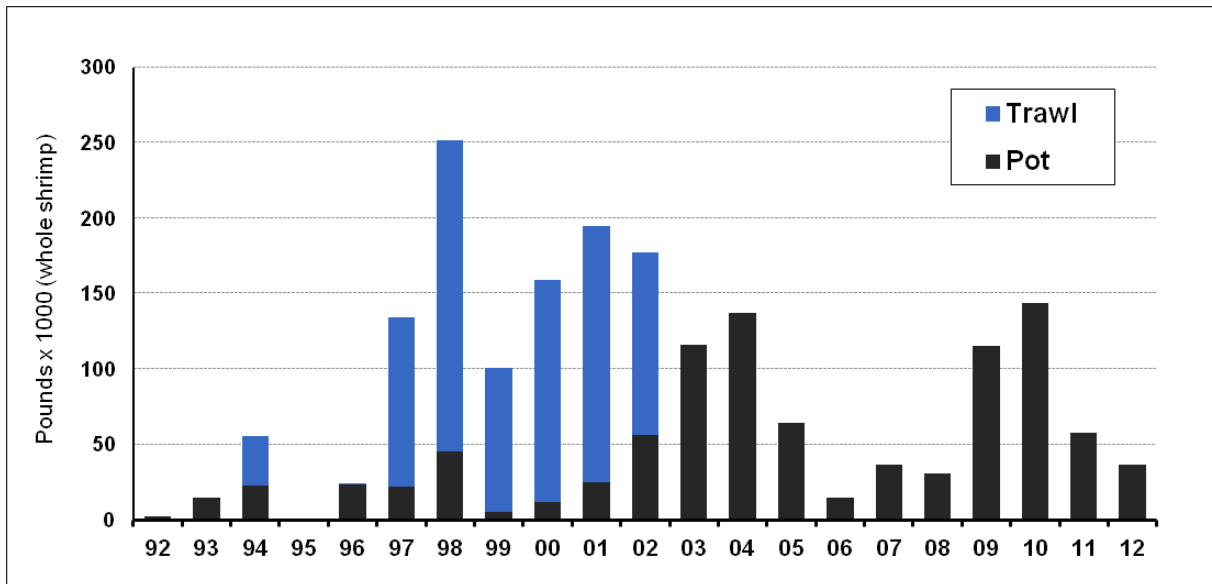


Figure 8. Coastal commercial non-treaty spot shrimp harvest (pounds) by year and gear type.

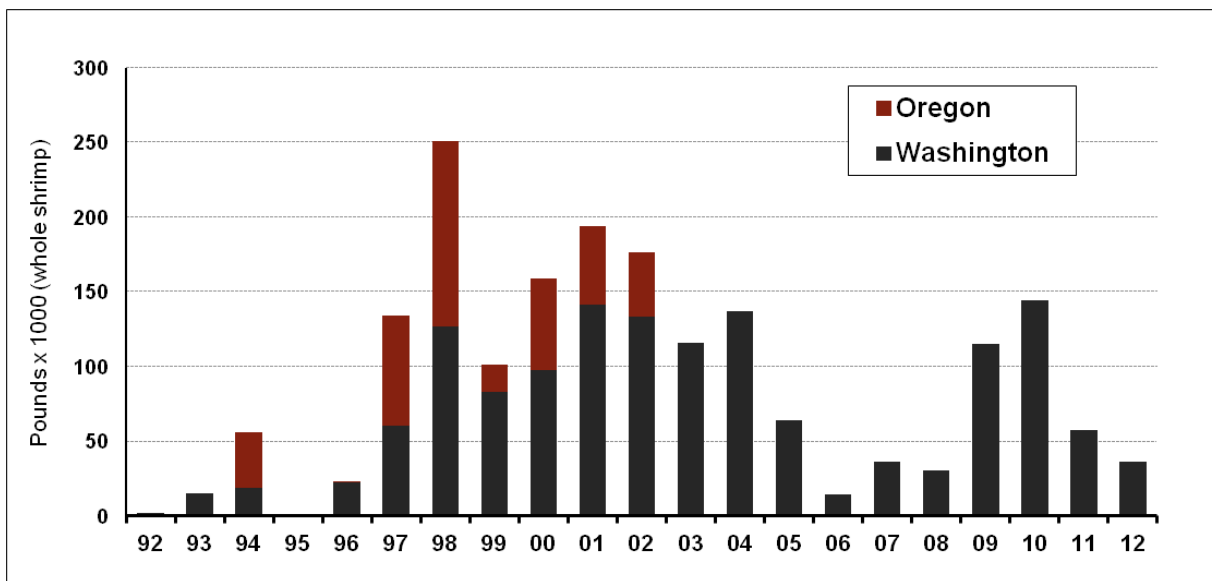


Figure 9. Coastal commercial non-treaty spot shrimp harvest (pounds) by state.

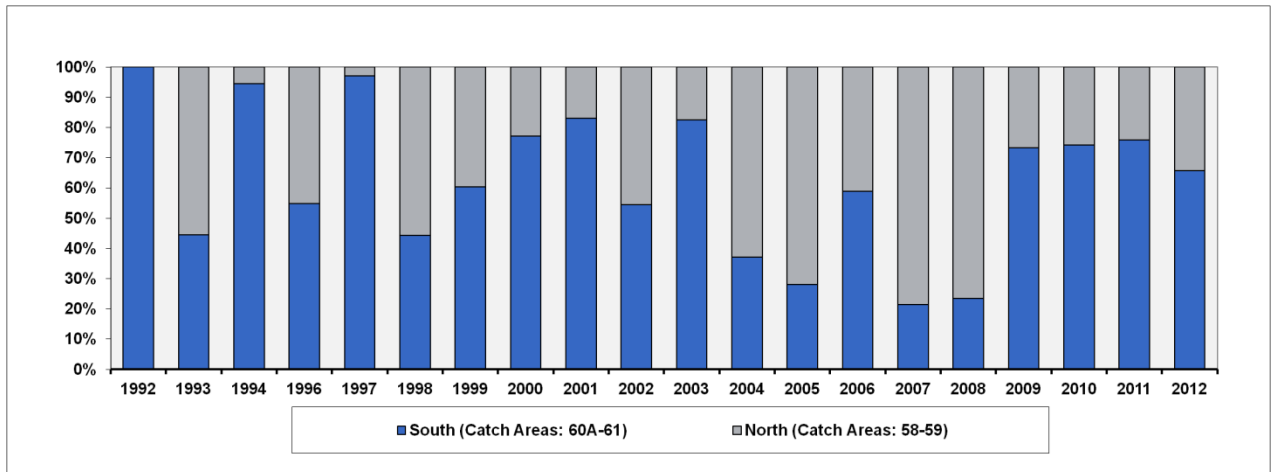


Figure 10. Distribution of spot shrimp catch by aggregated fish ticket catch areas: “South” (60A-61) and “North” (58-59)

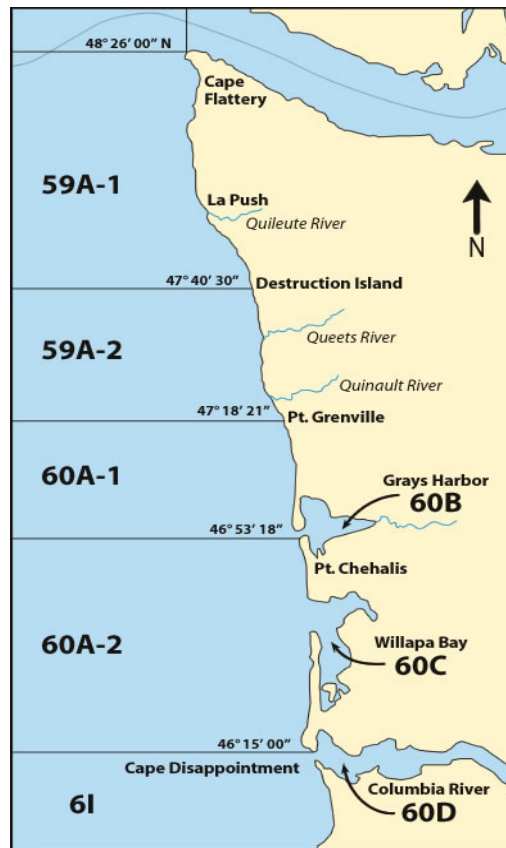


Figure 11. Fish ticket catch area map.

Commercial Fishery Income

Spot shrimp command comparatively high prices. In the coastal fishery, excluding obvious below market values, the price for whole spot shrimp has ranged from just above \$4 per-pound to \$12 per-pound since 1999. Typically, a fishery's value is simply the total of direct gross income. Direct income (also known as "ex-vessel value") is the amount paid to the fisher and is reported on fish landing receipts. The prices reported on these receipts are expected to represent fair market value of the product. Because fishers sell to a variety of dealers, the price paid per pound naturally varies. However, evaluating direct income is difficult in the coastal spot shrimp fishery; a comparison of spot shrimp receipts suggests below market rates have frequently been reported – which can occur when fishers have a dealer license and sell to themselves

To better portray the value of the spot shrimp fishery, a weighted average price was calculated for each year. Total annual catch was then multiplied by the weighted average to depict direct income. In this estimation, the weights of "take home" spot shrimp were included. "Take home" refers to spot shrimp retained for personal use and as such has no market value. However, in some years the amount of "take home" spot shrimp was substantial (worth several thousands of dollars) and to exclude their value would misrepresent the fishery's overall value. The weighted average calculated from Washington fish ticket data was also used to estimate the value of spot shrimp landings into Oregon.

The value of the fishery, using the weighted average applied to total catch including Oregon, trends with harvest and thus reflects the same annual variability: income in the fishery has ranged from \$10,000 to \$1,380,000 (Figure 12). The recent year average fishery value from 2009 through 2012 is approximately \$610,000.

Direct income on a per-fisher basis, calculated only from Washington data has ranged from \$5,000 to \$138,000 per year (Figure 13). Prior to 1999, average direct gross income per fisher was \$20,000 per year. Once under management of the ECFA in 1999, this average rose to a gross income of \$62,000 per fisher through 2008. The average direct gross value per fisher from 2009 through 2012, increased to \$93,000, representing a 50 percent increase over the previous period.

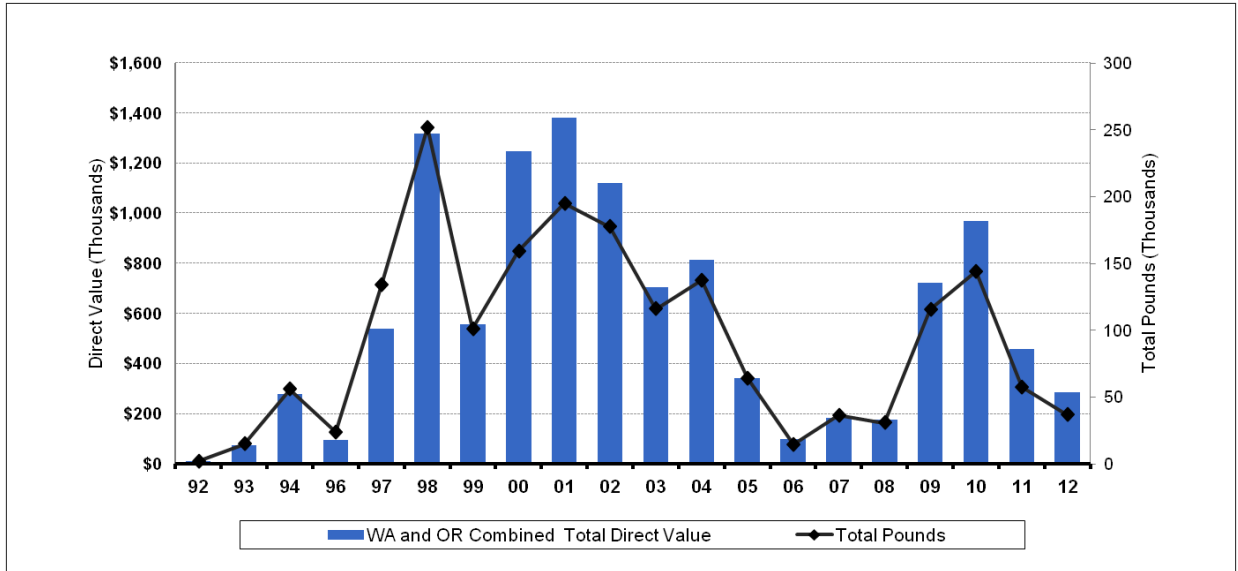


Figure 12. Total direct fishery value in dollars (1000's) and harvest (pounds), 1992 – 2012.

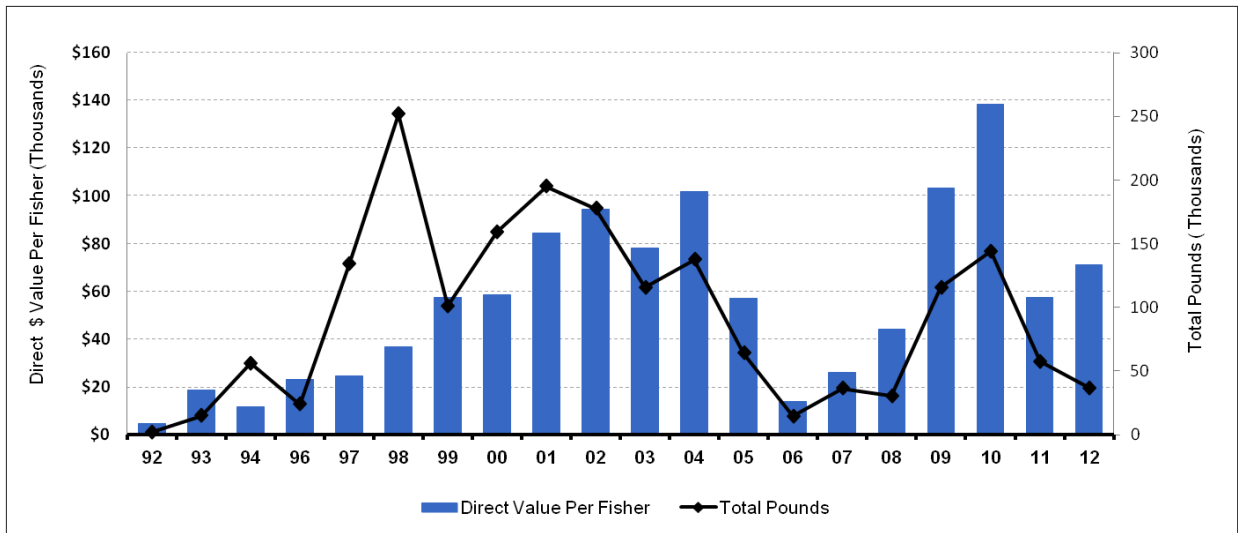


Figure 13. Direct fishery value in dollars (1000's) per fisher, 1992 – 2012.

Commercial Vessel Size

Over time overall vessel size in the fishery has declined. Between 1999 and 2001 the median vessel size was stable at 58 feet; it dropped to 55 feet in 2002, peaked at 59 feet in 2003 and declined steadily through 2012 to 41 feet (Figure 14). The decline is largely due to trawl vessels leaving the fishery, either for failing to meet minimum landings requirements, or as a result of the trawl gear ban.

This decline was moderated somewhat in 2003 when one pot shrimp fisher designated a vessel over 30 feet longer than the one previously fished. Although, permissible under the rules, this alarmed other permit holders and prompted a request for limits to prevent future unrestricted increases in vessel size.

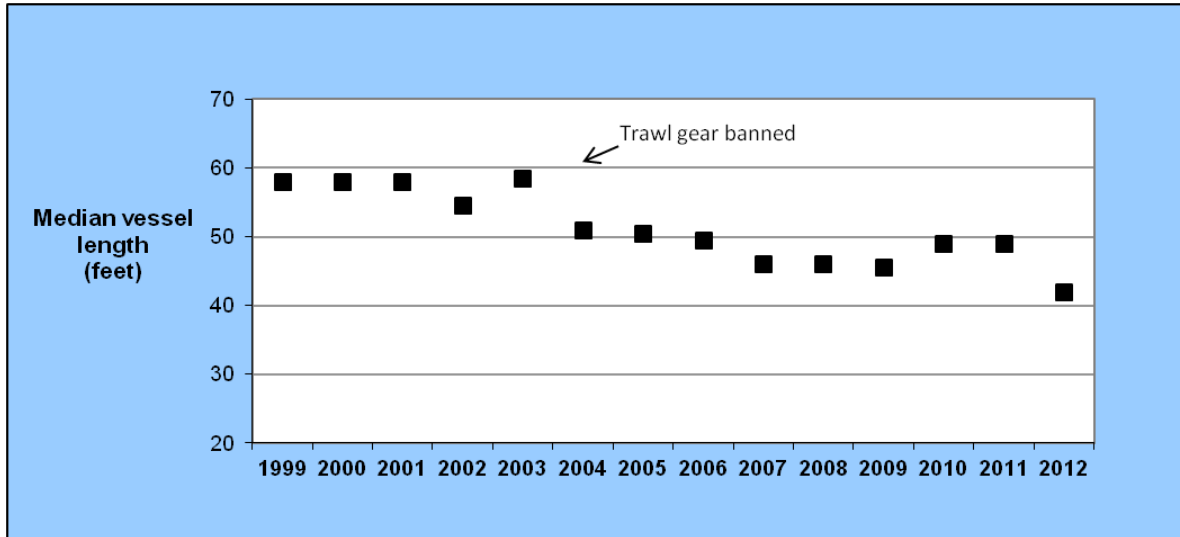


Figure 14. Median vessel size (feet) of vessels in the spot shrimp fishery.

Subsequently, a new rule was adopted in 2003 that allowed permit holders to designate a vessel that was no more than 10 feet greater in length than the vessel they'd used to qualify for the permit originally. But, the rule excluded any permit holder from this option if the vessel they designated in 2003 was already greater than 10 feet longer than their original qualifying vessel. The limited entry license program legislation permanently attached a length limit to each license that applies even upon transfer or sale of the license.



Commercial Fishing Grounds

The primary fishing grounds in the coastal fishery are associated with three offshore canyons: NitiNat and Juan De Fuca Canyons along the north coast of Washington, and Grays Canyon located along the central Washington coast. Depths fished typically range from 75 to 150 fathoms. Although specific fishing locations are obtained through logbooks, these data are not reported here. Spot shrimp are largely sedentary (Kimker 1996) with a patchy distribution. As a result, even summarized versions of this data could reveal economically valuable information.

Treaty Indian Fishing

Four coastal treaty tribes, the Makah, Quileute, Hoh, and Quinault have harvest entitlements to spot shrimp as affirmed by Federal District Court Judge Edward Rafeedie in a December 1994 federal court decision. While not specific to spot shrimp, this decision upheld the rights to harvest up to 50% of the harvestable shellfish in the usual and accustomed fishing areas of all Washington treaty tribes (Figure 15). Cooperative spot shrimp management plans with the Makah Tribe were developed in 2006 and 2009, but no landings were reported. The Quinault Indian Nation promulgated rules for a fishery beginning in 2011; only limited “test” fishery landings were reported.

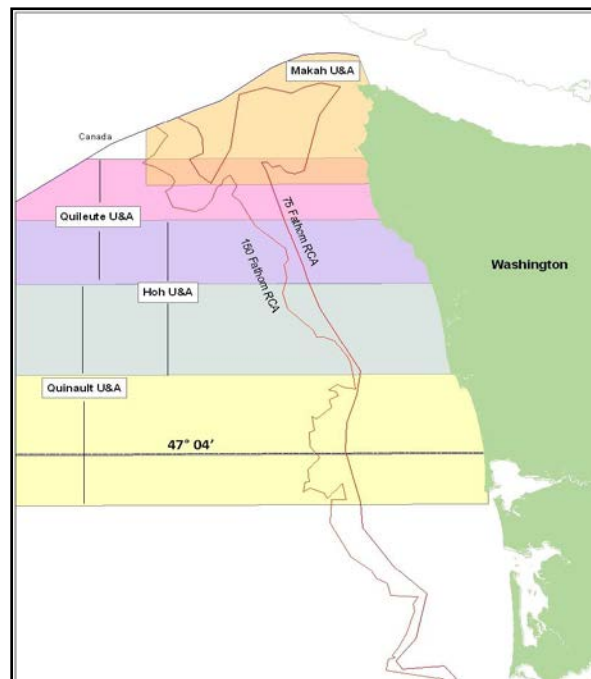


Figure 15. Usual and accustomed fishing grounds of four coastal treaty tribes: Makah, Quileute, Hoh and Quinault.

Spot Shrimp Life History, Fishery Observation and Assessment

Spot Shrimp Life History

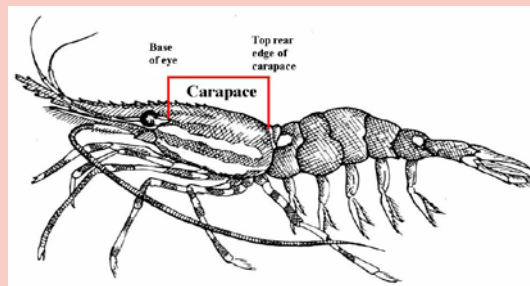
Commonly called “spot shrimp”, spot shrimp belong to and are the largest members of a family of medium to large shrimp. Along the Washington coast the typical male spot shrimp is about 7 ½ inches (190 mm) in total length; female spot shrimp are about 8 ½ inches long (216 mm), but can reach 11 inches (279 mm). This is generally larger than spot shrimp found in the more protected waters of Puget Sound where the typical male and female spot shrimp are 6 and 8 inches (152 mm and 203 mm) long, respectively.

Spot shrimp are found from Alaska to Baja California (Lowry 2007). Spot shrimp inhabit a wide depth range from shallow, near-shore reaches to 500 meters or 1,640 feet (Butler 1970).

Distribution of the spot shrimp along the Washington coast has been documented from 300 to 1,200 feet (91 to 366 meters) in commercial fishery logbooks.

Spot shrimp prefer some type of cover and usually inhabit rocky or hard bottoms that include glass-sponge reefs, coral beds, and the edges of marine canyons, but the animals are not simply distributed in the most commonly available habitat type. Spot shrimp distribution tends to be patchy; the factors determining the size and location of these patches is unclear, yet is probably a function of active habitat selection and larval transport (Mormorunni 2001). Off the Washington coast particularly large aggregations are associated with the rocky edges of three marine canyons including Gray’s Canyon, Juan De Fuca and NitiNat Canyon.

Spot shrimp (*Pandalus platyceros*)



Key Life history traits and management implications

- Spot shrimp life span is presumed to be about 4-5 years - some evidence for longer life span from tagging studies
 - Longer life span decreases resiliency to overharvest
- Distribution is patchy; adults largely sedentary
 - Risk of successively over-harvesting key grounds
- Spot shrimp mature first as males, then transition to females
 - Pot fishery targets females
- Spot shrimp can transition to become female at an earlier age and therefore smaller size.
 - Smaller female size correlates with reduced fecundity (eggs per female) and reduced stock productivity

Based on work in British Columbia, the life span of spot shrimp has been generally presumed to be about 4 to 5 years (Butler 1970). However, more recent research and tagging studies suggest a longer life span of up to 7 years (Sunada 1986, Kimker et al. 1996, Bishop et al. 2009).

Spot shrimp are protandric hermaphrodites meaning that they mature first as males, mate and subsequently transition to females to mate again and bear eggs. The size that spot shrimp transition from male to female varies regionally, with water temperature, and population density (Koeller 2007).

As opportunistic foragers, spot shrimp typically feed on other shrimp, plankton, small mollusks, worms, sponges, and dead animal material. Adults are believed to be *benthic* (bottom) feeders that forage mostly at night. Spot shrimp in turn are prey for other pelagic and demersal marine predators. As has been reported in other parts of the world for *Pandalus borealiseous*, or the pink shrimp, predators can play an important role in determining the reproductive success and recruitment of spot shrimp to the fishery. To date, such studies have not been conducted in the spot shrimp's geographic range. Mortality due to predation is likely to be quite high during the larval and juvenile stages, but is significantly reduced once the animals settle out of the water column. In benthic habitats, spot shrimp are prey for bottom-dwelling fish and octopus. Mid-water fish species such as salmon are not known to prey on spot shrimp.

Fishery Observation and Biological Data Collection

Dockside Sampling Program

Biological information about the coastal spot shrimp resource is limited and the lack of data upon which to base management decisions continues to be a challenge. Routine collection of biological data began in 2002; some data are available prior from previous years but these were collected in conjunction with specific projects of limited scope and duration.

Fishers land at various Washington coastal ports, but primarily Westport and Ilwaco. On occasion fishers land at Neah Bay, Port Townsend, Port Angeles or Seattle. Most years, there is no typical operational pattern across the fishery. Individual fishers do follow a routine, but each is unique and this results in landings that occur 24/7. To facilitate sampling coverage given a limited number of staff and the number of potential ports and times at which fishers might land, fishers are required to provide at least 24 hours advance notice before landing.

The two primary objectives for dockside biological sampling have been to determine ovigery or egg-bearing periods, and to more generally describe the size composition of spot shrimp in the fishery. The goal for sampling has been to sample at least 10 landings per month or every landing if fewer than that are anticipated. However, due to the protracted season, unpredictable

and very sporadic fishing activity, the success at achieving this objective has varied. Although fishers have been required to notify the Department before arriving at port since 2007, there have been instances when fishers simply forgot, or were forced to return to port unexpectedly due to weather or mechanical issues and were unable to provide adequate notice. Staff unavailability and the distance of ports from each other – Ilwaco, Westport, and Neah Bay - have also resulted in missed samples. On a monthly basis the actual sample rate from 2002 to 2012 has ranged from zero to 80%; annually the sampling rate has ranged from 25% to 70%.

For each landing, 100 spot shrimp are randomly sampled from the entire landing for carapace length and the presence or absence of eggs, or evidence of recent egg release. Prior to 2009, transitional stage data were not routinely collected. Determining the sex of spot shrimp requires close visual inspection of the second pleopod and this is commonly accomplished with the aid of a microscope. However, with experience this can be done in the field unaided. Several factors have hindered collecting transitional data in the field including the need to work quickly during off-loads, often in poor light, at night, or in inclement weather. Also, due to the high-value of spot shrimp, fishers have not been asked to provide spot shrimp for sampling at the lab. At counts of 10 to 15 per pound, and prices from \$5 to \$10 per pound, a 100-spot shrimp sample would be valued at \$33 to \$100. Given the small fleet size, it is not possible to distribute sampling effort across different fishers to reduce the impact of taking shrimp for sampling.

Despite the challenges and limitations, sampling procedures were modified to include transitional stage data in 2009. To assess and improve samplers' skill and accuracy in indentifying the transitional stage, pairing dockside sampling with sampling in the lab is recommended for the future. Fishers will incur some loss but the long-term benefit from accurate data needs to be balanced against this cost to fishers.

Sampling data are summarized using area designations originally defined for the coastal spot shrimp logbook program. The Washington coast is divided into three large areas (1-3) based on latitude (Figure 16). These area designations roughly approximate the spatial distribution of the fishing grounds. Further geographic delineation may be appropriate biologically but would result in small and inconsistent data sets.

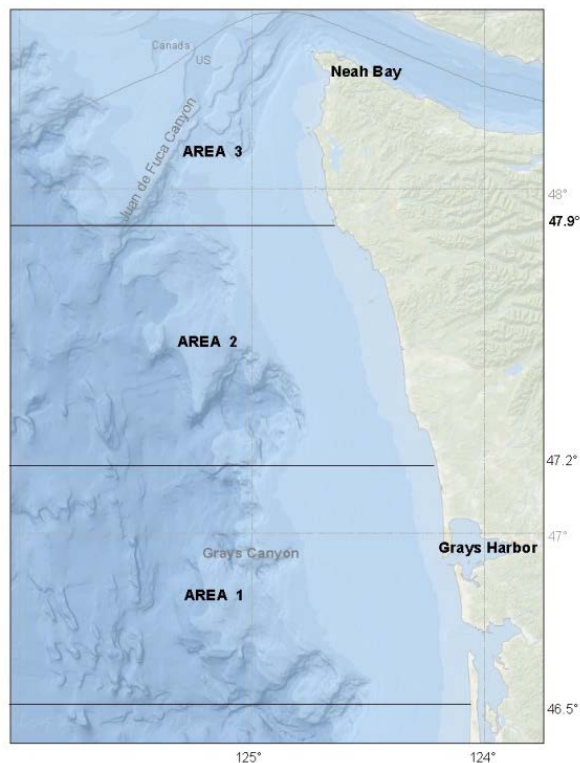


Figure 16. Biological sampling regions

Carapace Length Frequency Data

Spot shrimp sampled dockside from both trawl and pot gear have ranged in size from 25 mm to 61 mm. Given the depth at which most coastal fishing occurs, carapace size restrictions were not implemented for the fishery, it was assumed any released spot shrimp would not survive the descent. Only a few, out-of-sample spot shrimp smaller than 20 mm have been collected from commercial catches. These were discovered by fishers while fishing and set aside for examination.

Data from 2003 through 2009 were used to determine spot shrimp average carapace lengths presented below. Routine sampling of the fishery was established by 2003, and because 2002 was the last year trawl gear was legal the data reflect only one gear type. Logbook management areas were used to separate the north (Area 3) and south (Area 1) regions. Carapace lengths from other areas (0 and 2) were not evaluated due to the lack of data.

For each area, the mean, minimum and maximum carapace lengths were calculated from pooled fleet data. Evaluation of carapace length data trends was also accomplished by selecting a single vessel in each area that provided the most robust and consistent set of data. For each single-vessel data set, a period of two months was used to provide adequate sample sizes yet minimize

the effect of growth through the season. The single-vessel data set also eliminated shrimp-size selectivity differences that might exist between fishers due to differences in gear and manner of fishing.

In Area 1, the fleet-wide average carapace length has ranged from 42 to 45 mm and shows no trend across years for 2003 through 2009 (Figure 17). Average carapace length data from the single-vessel data set during August and September only similarly shows no trend across years.

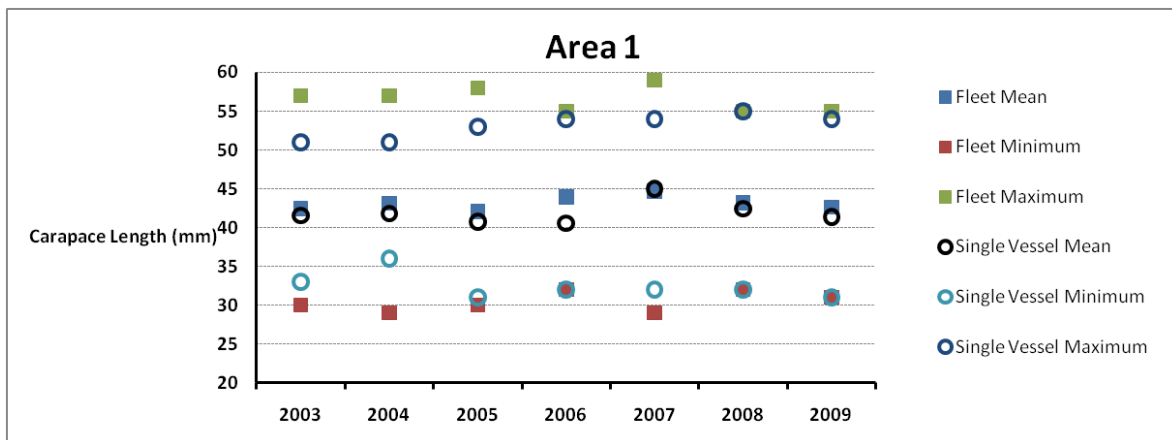


Figure 17. Area 1 average (mean), minimum and maximum carapace lengths (2003-2009).

In Area 3, the fleet-wide average carapace length has ranged from 41 to 44 mm and shows a declining trend across years (Figure 18). Minimum carapace lengths also exhibit a declining trend, whereas maximum lengths show no trend. The single-vessel data set using carapace length data from April and May only, for years 2004 through 2009, mirrors these trends.

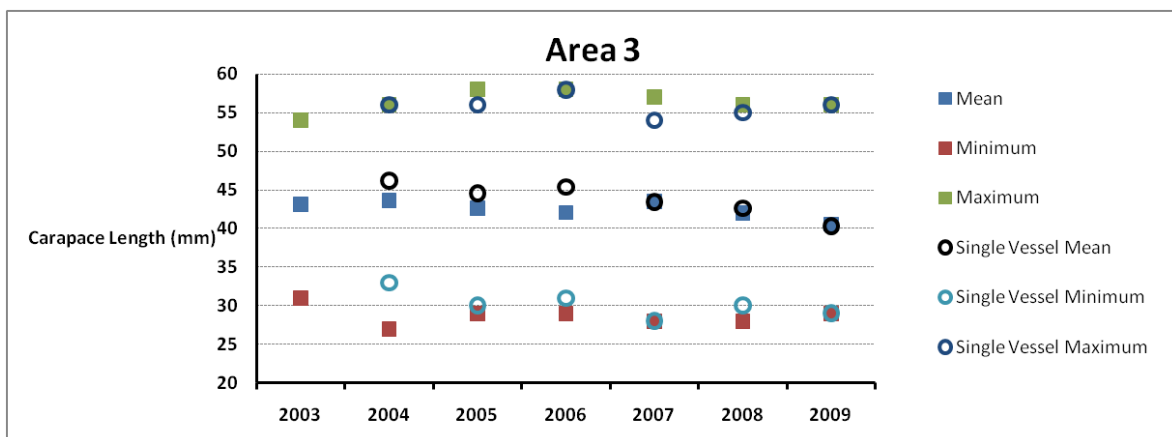


Figure 18. Area 3 average (mean), minimum and maximum carapace lengths, 2003-2009.

Size at transition for coastal spot shrimp ranges from 34 to 47 mm. This is a bit larger than the range of 32 to 43 mm reported for Puget Sound spot shrimp (Mark O’Toole, WDFW, personal communication). Average size for male, transitional, and female spot shrimp depicted below is based on spring 2009 sampling data for two coastal areas (Table 2). These also reflect the somewhat larger size of spot shrimp along the coast when compared with spot shrimp in Puget Sound and Hood Canal (Table 2). It should be noted when making comparisons that the Puget Sound and Hood Canal data represent a much longer time series (2004-2010).

Table 2. Average spring-time carapace lengths (mm) by sex, Area 1 and 3.

Area	Males	Transitional	Females
1	37	41	45
3	35	39	47
Puget Sound	33	39	42
Hood Canal	31	35	39

Ovigerity Data

The incidence of spot shrimp under 40 mm bearing eggs is rare in the coastal fishery. Of 24,200 spot shrimp sampled for ovigerity from both gear types from 1999 through 2009, only 84 spot shrimp with carapace lengths between 33 and 39 mm were ovigerous.

Figures 19 and 20 depict the monthly percent and average percent ovigerity for Area 1 and 3, respectively. For both areas, the ovigerous stage begins in late July and lasts through mid March. The variability for a month across years reflects natural shifts, but may also be strongly influenced by the lack of data for some months, in some years. In particular, data are more sparse for August and September, and for Area 3.

The figures present monthly averages, but sample data by date show that ovigerity in March declines after the middle of month from roughly 50% to less than 15% in Area 1 and from approximately 30% to less than 15% in Area 3. Thus, in most years by the end of March the presence of ovigerous shrimp in the catch is low. Virtually no ovigerous shrimp are seen in the catch until the latter part of July (after the 15th). From that time, through the end of the season on September 15th, ovigerous shrimp increasingly dominate the catch.

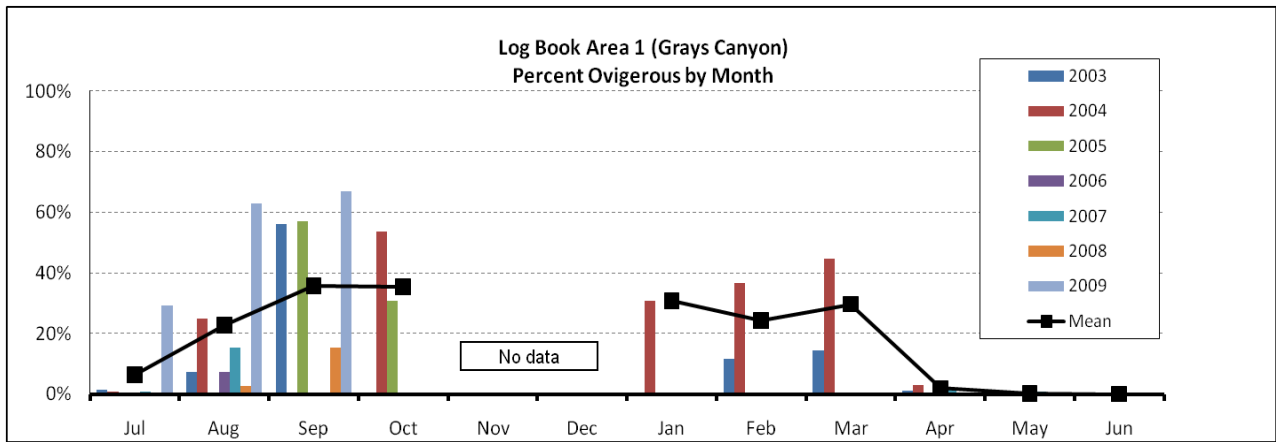


Figure 19. Area 1 percentage of egg-bearing (ovigerous) spot shrimp by month.

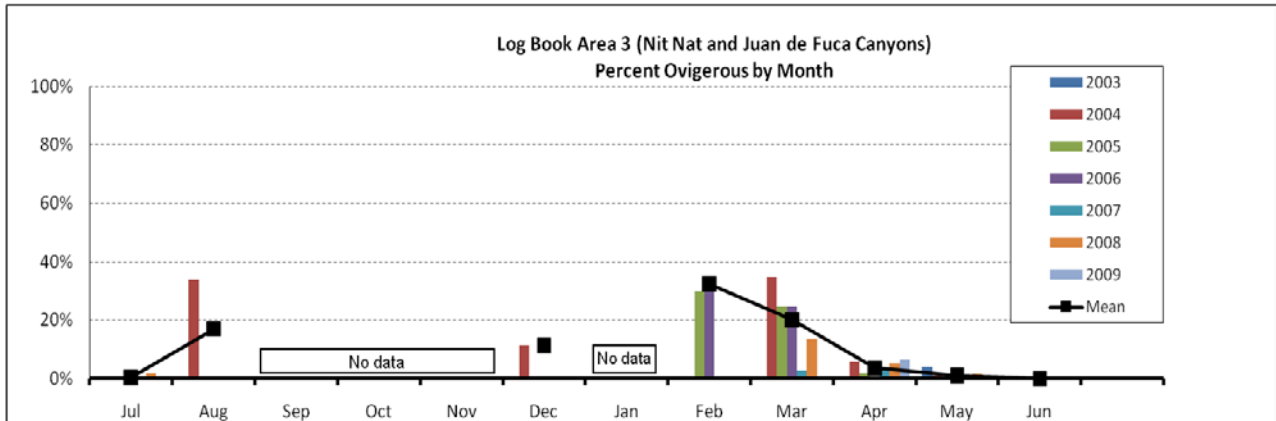


Figure 20. Area 3 percentage of egg-bearing (ovigerous) spot shrimp by month.

At-sea Fishery Observation

Initially, at-sea observation of the coastal spot shrimp fishery was undertaken to evaluate bycatch in the trawl gear fishery. As increasingly stringent regulations were instituted in the groundfish fishery from the late 1990's onward to protect overfished rockfish stocks, regulatory consistency across fisheries became important, both from a sense of fairness and to ensure that efforts to reduce rockfish catch in one fishery were matched in others.

In order to evaluate bycatch in the trawl fishery, WDFW staff and an University of Washington student observed on-board trawl vessels in the fall of 1999 and summer of 2000. Most of the catch during these trips consisted of non-spot shrimp species, including rockfish, flatfish, sea urchins, sponges and other invertebrates with spot shrimp comprising just 12 and 22 percent of the total catch (Table 3). Based on these observations and information obtained from research conducted in other areas evaluating impacts of trawl gear, WDFW and some spot shrimp fishers

(including one trawler) proposed that trawl gear be phased out of the ocean fishery. As noted previously, trawl gear was banned in 2003.

Table 3. At-sea observations of the coastal spot shrimp trawl fishery, 1999 and 2000.

Observed Trip Number - Trawl gear	1	2
Month-Year	Sep-99	Jul-00
No. of hauls observed	10	5
Total Spot Shrimp catch (pounds)	175	870
Total Bycatch (pounds)	1231	3065
Fish	624	2346
Invertebrates	607	719
Percent spot shrimp (total spot shrimp/total catch)	12%	22%

Beginning in 2003, efforts to estimate bycatch in the pot fishery were initiated. From that year through 2007, a total of 3,059 pot-lift over six fishing trips were observed on four different vessels. The duration of each trip varied, ranging from just over one day to five days (Table 4). During each trip, staff collected bycatch – anything that was not spot shrimp – as each pot was brought onboard, identified and either weighed or counted each specimen. In some instances average weights were applied to individual fish or invertebrates when the amount of bycatch was too little to obtain accurate weights with the scales used at-sea. In other cases, the number of individuals for a given species precluded counting and only total weight was measured. Other data collected included fishing location and depth, and the number of hours each pot or string of pots was fished.

Overall, bycatch in the coastal spot shrimp fishery by pot gear is much less than that observed in trawl nets. Where bycatch had comprised roughly 83 percent of the total pounds per trip in the trawl observations, it accounted for an average of 30 percent in the pot fishery. The amount of bycatch observed on the pot fishery trips ranged from almost nothing to a little over half the total catch by weight and was composed primarily of invertebrates: urchins, snails and sea stars (Figure 21). Fish species accounted from zero to 12 percent of the bycatch by weight and was composed mainly of hagfish and sculpin species.

Table 4. At-sea observations of the coastal spot shrimp pot fishery, 2003-2007.

Observed Trip Number - pot gear	1	2	3	4	5	6
Month-Year	April-03	June-03	April-04	June-06	April-07	August-07
No. of Pot lifts observed	804	279	300	178	1248	250
Total Spot Shrimp catch (pounds)	1245	445	295	137	2620	227
Total Bycatch (pounds)	978	173	381	5	971	71
Fish	42	30	46	0	15	3
Invertebrates	818	128	325	5	706	59
Percent spot shrimp (total spot shrimp/total catch)	56%	72%	44%	97%	73%	76%
Bycatch by species/species group (pounds)						
Canary Rockfish	-	-	-	-	-	0.1
Crab sp.	5.9	17.3	24.1	1.5	26.6	1.5
Hagfish sp.	18.2	23.4	42.1	-	15.0	-
Jellyfish sp.	-	0.2	-	-	-	-
Kelp Greenling	-	5.0	0.6	-	-	-
Lingcod	-	-	-	-	-	2.4
Octopus sp.	30.7	0.7	5.0	0.0	1.5	1.5
Pacific Cod	3.1	-	-	-	-	-
Poacher sp.	0.2	-	0.3	-	-	-
Rat fish	2.0	-	-	-	-	-
Red banded Rockfish	0.5	0.2	0.7	-	0.2	0.2
Rockfish sp.	0.2	0.4	1.6	-	-	-
Rosethorn Rockfish	1.3	0.8	0.5	0.1	-	0.4
Sablefish	16.5	-	-	-	-	-
Sculpin sp.	11.7	11.7	32.5	0.0	4.7	0.8
Sea Stars sp.	130.3	75.0	201.0	3.2	323.4	34.7
Snail sp.	117.7	14.9	10.4	-	250.5	8.2
Urchin sp.	639.4	23.3	62.6	-	349.6	20.7
Bycatch of fish by species/species group (count)						
Canary Rockfish	-	-	-	-	-	1
Hagfish sp.	46	59	105	-	38	-
Kelp greenling	-	10	1	-	-	-
Lingcod	-	-	-	-	-	1
Pacific cod	1	-	-	-	-	-
Poacher sp.	1	-	1	-	-	-
Rat fish	2	-	-	-	-	-
Red banded Rockfish	5	-	8	-	2	2
Rockfish sp.	1	4	4	-	0	0
Rosethorn Rockfish	10	6	4	1	0	3
Sablefish	6	-	-	-	-	-
Sculpin sp.	37	34	79	-	11	4
Splitnose Rockfish	-	-	4	-	-	-



Figure 21. Pot fishery bycatch.

The amount and composition of bycatch did vary with the number of hours the pots were fished. Pot soak times that were observed on trips 1, 2, 3 and 5 ranged from less than 24 hours to more than 100 hours. To simplify comparisons, bycatch data was combined into one of two categories: fish or invertebrates. Within each category, the data were divided into two groups: soak times of 24 hours and soak times of more than 24 hours. The bycatch of fish species was generally greater for pot soak times of 24 hours or less (Figure 22). Conversely, the bycatch of invertebrates was generally greater for pot soak times that exceeded 24 hours (Figure 23).

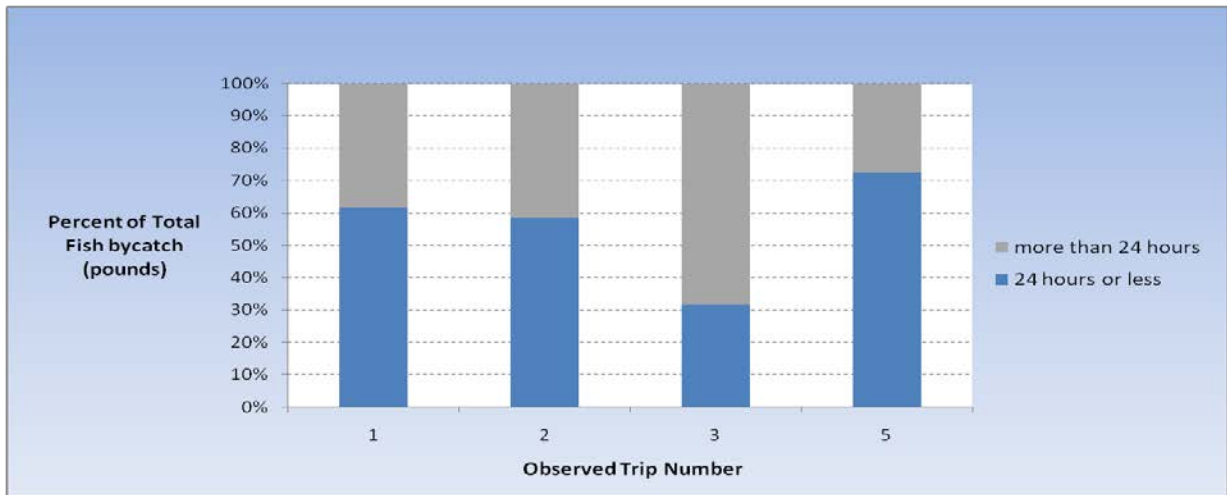


Figure 22. Comparison of fish bycatch by pot soaking time.

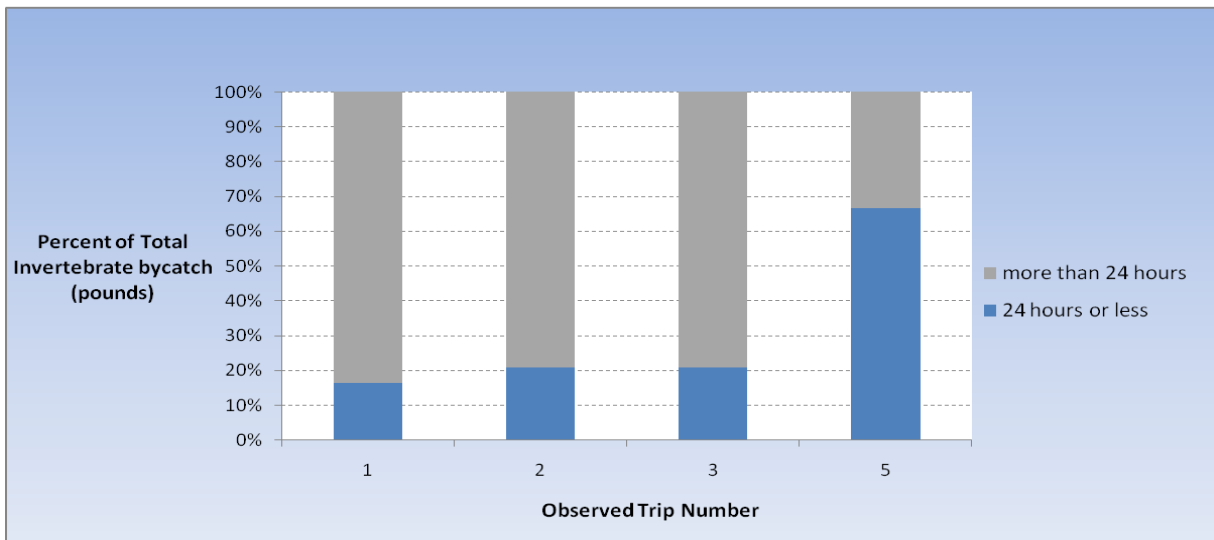


Figure 23. Comparison of invertebrate bycatch by pot soaking time.

A secondary objective of the at-sea observations was to determine if juvenile spot shrimp were present in the commercial fishery. Juvenile rearing areas have not been identified in near-shore or offshore coastal waters. Commercial size mesh, meant to allow mature males to escape also permits juveniles to escape. Capture of spot shrimp smaller than 20mm carapace length is rare in the coastal fishery.

In 2003, “experimental” pots, manufactured by Ladner Traps of Delta, British Columbia, with a mesh size of 0.5 inches, but otherwise similar to commercial gear were deployed during two observed trips, one in 2003 and one in 2004. Twenty experimental pots were attached alternately with standard pots on one string. No significant size difference was found amongst spot shrimp caught in the two pot types despite the smaller mesh of experimental pots (Lowry 2007). These results suggest the absence of juveniles on the grounds fished commercially, and that nursery areas are located elsewhere, presumably in shallower waters.

One possible approach to locate juvenile habitat, would be to deploy a string of experimental pots in shallower areas, not typically fished commercially. The Department lacks the resources to undertake such an approach independently, however, a cooperative effort with fishers may be possible whereby experimental gear is deployed and retrieved during routine commercial fishing trips. Any spot shrimp caught in the experimental gear would have to be kept separate from all other catch and made available for sampling dockside. Once sampled, the shrimp could be returned to the fisher.

Fishery Assessment

An overall TAC of 250,000 pounds was established in 1999 when the coastal fishery was established as an “experimental fishery” under the Emerging Commercial Fishery Act. Lacking an alternative, this original TAC simply represented the peak annual catch up to that time. Logbooks were required from the inception of the fishery however, and in 2006 managers requested a review to determine if the log data were sufficient for an analysis that would include resetting the TAC based on maximum sustained yield (MSY).

Due to limited biological parameter information, including growth and mortality needed for length structured models, surplus production models were employed to estimate the so-called MSY (Appendix G). The MSY is usually derived indirectly from the surplus production curve. Schaefer (1954) and Fox (1970) surplus production models are commonly used to estimate the MSY in fisheries with total catch and total fishing effort.

The surplus production models used logbook data from 1997-2006. Due to the change of fishing gears in year 2003 (elimination of trawl gear), standardization of gears in fishing effort was modeled with a generalized linear model by catch, depth and soaking time. The uncertainty in standardization was considered as measurement errors when the surplus models were applied. The best-fit model with the minimum sum of square of errors and sum of errors with both additive and multiple errors assumptions was selected. The results of the model agreed with

those derived from a length-structure model reported by Lowry (2007) in which critical biological assumptions were made.

The estimated MSY was 98,616 pounds (95% CI 89,844-139,453) for the zone north of 47°04' N. latitude and 104,061 pounds (95% CI 94,433-142,430) for the zone south of this latitude (Table 5). The 95% confidence interval was estimated by nonparametric bootstrapping with the incorporation of measurement and process errors. This estimated MSY agrees with the estimated MSY derived from stock synthesis model (SS2; Lowry 2007). But the surplus production with measurement errors produced a tighter 95% CI with fewer biological assumptions compared with SS2. In 2008, the total allowable catch for each zone was set at 100,000 pounds.

Table 5. Estimates of MSY.

Coastal Zone	MSY	95% CI
North	98,616 pounds	89,844 - 139,453
South	104,061 pounds	94,433 - 142,430

Discussion

Ideally a fishery independent assessment of the coastal spot shrimp stock would be used to support management decisions. Several factors combine to make this difficult to achieve for the coastal fishery. First, in general, the relationship between the number of adult spot shrimp and stock size in subsequent years is weak because environmental conditions significantly affect early life stage mortality, and for coastal spot shrimp stocks in particular, the relationship may be further weakened given the distance of juvenile rearing areas from known adult habitat (Lowry 2007). Second, pot gear is selective for larger, thus older spot shrimp which means it isn't suitable for predicting or estimating stock size beyond the immediate season. Third, the characteristics (distance offshore, weather, multi-day trips) of the coastal fishery make approaches used in other fisheries such as pre-season surveys in Puget Sound or in-season monitoring in British Columbia impractical. And finally, the scale of effort that would be required to produce valid estimates, or catch targets, on the coast is cost-prohibitive relative to the size of the fishery.

In light of these limitations, sampling efforts have attempted to collect sufficient biological information to develop baseline characteristics and perhaps enough to evaluate trends. Length data, particularly sex transition length data, have been utilized in pandalid stock assessments as a practical application of research that predicted that the size at which these shrimp transitioned from male to female decreased with low abundance (Charnov 1982) brought about by fishing pressure. But further studies suggest that other factors such as water temperature and food availability also influence length at transition and their influence varies in importance depending on population density (Skúladóttir 1998, Koeller 2003, Weiland 2004).

Regardless of the cause – fishing pressure, environmental factors or a combination of both – changes in the size at which spot shrimp transition are of interest because smaller females produce fewer eggs. Absent other factors that might offset the reduction in egg production, a decline in female size can affect the reproductive potential of the stock.

The ratio of length at transition to maximum length for spiny shrimp (*Pandalus borealis*) has been found to be constant at 0.80 (Charnov and Skúladóttir, 2000). Lowry (2007) noted a similar ratio for coastal spot shrimp. Given this relationship, the lack of any trend in maximum carapace length for Areas 1 and 3 from 2003 through 2009 suggests that transitional length has been equally stable. In Area 3 the average (or mean) size does exhibit a decline but this more likely a reflection of a strong recruitment and thus a greater number of younger and smaller spot shrimp. The lack of any trend in maximum lengths in Area 3 lends support to this conclusion.

That coastal spot shrimp are somewhat larger than those found in the more protected inside waters of Puget Sound may indicate a higher rate of growth. Areas of Puget Sound are known to have high densities of spot shrimp, whereas this is not generally assumed for coastal waters. In areas of high density, a lack of food may be limiting growth (Koeller 2000).

Protecting egg-bearing females has been an important principle in the management of shrimp resources in the state. Because spawning periods can vary from year to year, the goal is to provide protection when on average the bulk of the spawning population is bearing eggs. From its inception the coastal spot shrimp fishery occurred primarily during the summer. Over time however, fishing effort shifted as a few fishers developed markets during the winter (January and February). At the same time, later season starts – mid January as opposed to the more traditional December start – in the coastal Dungeness crab fishery spurred a few fishers to fish for spot shrimp until the crab fishery opened. The proportion of egg-bearing spot shrimp caught during these months was significant as was the amount of catch. On the other hand, effort during the late summer and fall months has been minimal and catch correspondingly low, although a large portion of the catch is egg-bearing from August onward.

In response to the changing fishing patterns, staff recommended closing the fishery during fall and winter months to protect egg-bearing spot shrimp. Based on the ovigery data, an April 1 to August 31 season was proposed. The WDFW Commission adopted a six-month season that opens March 15 and closes September 15 following industry requests to open March 1 and close September 30.

The possibility of expanding the season by two weeks on either end has been raised by fishers. A March 1 start, as opposed to March 15, would lengthen the period when the coastal fishery is open before the spot shrimp fishery in British Columbia opens May 1. The British Columbia fishery for spot shrimp ranks third in value behind Dungeness crab and halibut, with landing values ranging from CDN \$ 20 to 30 million annually (DFO, 2011). Coastal fishers claim the prices they can command fall after this date. Interest in extending the season by two weeks in the fall is not driven as much by market considerations but rather weather and convenience. Typically, the weather in September is milder than in early spring and more conducive to fishing by smaller vessels in the fleet. The coastal Dungeness crab fishery also closes September 15 and some fishers would like more time after that to retrieve their spot shrimp pots.

Because of their life history (male to female), taking any male or transitional spot shrimp is a removal of a female from the population. In Alaska the fishery opens in October and closes in February. Fishing during the peak of ovigery is coupled with stricter management regimes and more intensive sampling. The total allowable harvest is also reduced to compensate for the greater catch of females. Adjusting the coastal season to open earlier than March 15th or close

later than September 15th might be reasonable if done in conjunction with a reduction in the total allowable catch.

The at sea observations of the fishery confirmed that pot gear fisheries tend to be “cleaner” than other gear types relative to the amount of unwanted species that are caught, or bycatch, compared to the amount of the desired species. In some of the observed trips a substantial amount of invertebrates were caught. According to the vessel skippers these catches were not outside the norm, but were not typical. On some observed trips bycatch by pot was collected for a portion of the pots fished. This information showed that bycatch was not evenly distributed: many pots might have none and others a lot.

The difference in pot soak time relative to the bycatch of fish versus invertebrate species suggests that more frequent tending of the gear could reduce the catch of invertebrates. In the “more than 24 hours” category, there was a wide range of soak times observed from a little over twenty-four to over a hundred hours as pot gear had been left out on the fishing grounds between trips. The number of observations of the various soak times was insufficient to determine an optimum soak time. However, fishers may have insight based on their years of fishing that could help suggest when the presence of both fish and invertebrates are at a minimum.

Conclusions and Recommendations for Management

In the scope of commercial fishing on the Washington coast, the coastal spot shrimp fishery is relatively small. Likewise, the recreational fishery even as interest and activity in it increases, will be similarly small compared to spot shrimp fisheries in Puget Sound or Hood Canal, or other coastal sport fisheries in general. The state currently lacks funding to provide for anything beyond only low levels of active fishery management. An approach, albeit expensive, has been identified and could be considered in the future to evaluate the coastal spot shrimp resource using pre and post fishery season surveys.

With the present inability to conduct fishery independent surveys, the TAC established for each area should continue to be set conservatively. In addition, because the analysis used to derive the present TACs reflects the productivity of fishing grounds represented in the logbook data through 2006, a re-evaluation of the TACs should follow any expansion of the fishery into new locations. It is strongly recommended that even absent expansion or other significant change in the fishery, periodic modeling should be undertaken. It is important to note that since spot shrimp are prey for variety of fish including rockfish, overall ecosystem needs should also be considered in any such analysis.

Given its importance to understanding the spot shrimp resource and managing the fishery, the on-going logbook program should be monitored closely to ensure fishers provide complete and accurate information.

Commercial fishing patterns should also be monitored, particularly to track changes in late season activity. Most years little fishing effort has occurred in August and September. Catch during this time period is comprised of a high percentage of egg-bearing spot shrimp but because the catches have been small the impact to the resource was considered negligible.

Goals and Objectives

Maintain a healthy spot shrimp resource, provide for marine ecosystem needs, and promote sustained fishing opportunity.

- Protect the reproductive capacity of the spot shrimp stocks.
- Monitor and document total harvest, distribution of harvest, effort and catch per unit of effort (CPUE).
- Maintain consistent conservation based regulations for state and tribal fisheries.
- Ecosystem considerations
- Minimize bycatch of other species
- Minimize impacts to habitat
- Maximize economic value of the fishery balanced with equitable opportunity to access the spot shrimp resource

Monitoring the recreational fishery for coastal spot shrimp is not possible with the management programs or tools currently in place or available. Lacking a reporting mechanism, i.e. no catch record card, for coastal recreational shellfish fisheries, estimates of catch cannot be made.

At present the coastal fishery catches are not achieving the TACs and as long as this persists, overall resource conservation concerns are minimal. However, localized depletion may result from the concentration of either commercial or recreational gear on favored productive fishing grounds. Expansion of the fishery either by non-treaty (recreational or commercial) or treaty fishers may necessitate enhancing or creating reporting programs to produce total as well as spatial estimates of catch.

Finally, the limited entry license program legislation enacted in 2011 included a provision that WDFW (i.e. the director) submit a report to the legislature recommending changes, if necessary, to the license program. This report is to consider the status of the coastal spot shrimp resource, the impact of spot shrimp harvest on the marine ecosystem and the market for coastal spot shrimp. This report is due January 7, 2016.

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**Appendix A. Emerging Commercial Fishery
Regulations**
(In effect up to 2009)

220-88B-010: Emerging commercial fishery - Coastal - Purpose.

220-88B-020: Designation of the coastal spot shrimp pot fishery as an emerging commercial fishery.

220-88B-030: Emerging commercial fishery - Eligibility for coastal experimental fishery permits - Terms and conditions of use – Renewal - Vessel restriction - Incidental catch.

220-88B-040: Coastal spot shrimp pot experimental fishery - Season and gear - Species restriction

220-88B-010 Emerging commercial fishery – Coastal - Purpose.

The purpose of this chapter is to establish the coastal spot shrimp pot fishery as an emerging commercial fishery, and to set time, place, and manner for participation in this fishery.

220-88B-020 Designation of the coastal spot shrimp pot fishery as an emerging commercial fishery.

(1) The director designates the coastal spot shrimp pot fishery as an emerging commercial fishery for which use of a vessel is required. It is unlawful to fish for, possess, or deliver spot shrimp taken for commercial purposes from Washington territorial waters west of the Bonilla-Tatoosh line or from waters of the Exclusive Economic Zone unless the fisher has a valid emerging commercial fishery license and a valid coastal spot shrimp pot experimental fishery permit.

(2) The following licenses may not be used to fish for, possess, or deliver spot shrimp taken in Washington territorial waters west of the Bonilla-Tatoosh line or waters of the Exclusive Economic Zone: Shellfish pot fishery license, nonlimited entry delivery license, salmon troll delivery license, salmon delivery license, crab pot fishery license, Dungeness crab -- coastal fishery license.

220-88B-030 Emerging commercial fishery — Eligibility for coastal experimental fishery permits — Terms and conditions of use — Renewal — Vessel restriction — Incidental catch.

(1) No individual may hold more than one Washington coastal spot shrimp experimental fishery permit.

(2) Coastal spot shrimp experimental fishery permits are not transferable. Only the vessel designated on the emerging commercial fishery license and coastal spot shrimp experimental fishery permit may be used to fish for or deliver spot shrimp.

(3) A coastal spot shrimp experimental fishery permit will be issued only to a natural person who held such a permit the previous year.

(4) Coastal spot shrimp experimental fishery permits may be revoked by the director, and future permits denied by the director, for failure to comply with conditions specified in the permits or violations of other fishing regulations. A coastal spot shrimp experimental fishery permit will not be renewed if the emerging commercial fishery license is revoked or future fishing privileges of the licensee are suspended.

(5) The director may issue a coastal spot shrimp experimental fishery permit to another person if a permittee fails to make the requisite landings, if the person's experimental coastal spot shrimp experimental fishery permit is revoked, or if no application for an emerging commercial fishery license is received by March 31st of each year. The total number of permits issued, including replacement permits, shall not exceed fifteen. Selection of persons to receive replacement permits shall be by gear or gear replacement type, and replacement permits will be offered in descending order first to persons who made the largest total of Washington coastal spot shrimp landings in each gear type during the original qualifying period, and then in descending order to persons who made the largest total of Washington coastal spot shrimp landings in each gear type. If no persons with coastal spot shrimp landings wish to participate, the director may offer a replacement permit by random drawing.

(6) Coastal spot shrimp experimental fishery permits are only valid for the year issued and expire on December 31st of the year issued with the expiration of the emerging commercial fishery license.

(7) The total allowable catch of spot shrimp taken from Washington territorial waters west of the Bonilla-Tatoosh line and from adjacent waters of the Pacific Ocean during a calendar year is 200,000 pounds round weight, provided that not more than 100,000 pounds be taken south of 47°04.00' N. latitude and no more than 100,000 pounds be taken north of 47°04.00' N. latitude.

(8) Vessel restriction: A coastal spot shrimp experimental fishery permit will not be issued to a person who designates a vessel greater than ten feet longer than the vessel designated as of March 31, 2003, provided that if the vessel designated as of March 31, 2003, is ten or more feet greater than the vessel used by the person to initially qualify for a coastal spot shrimp experimental fishery permit, the person may not designate a vessel greater in length than the vessel designated as of March 31, 2003.

(9) Incidental catch:

(a) It is unlawful to retain more than 50 pounds round weight of other shrimp species. It is permissible to retain octopus and squid.

(b) It is unlawful to retain salmon.

(c) It is unlawful to retain any bottomfish species.

220-88B-040 Coastal spot shrimp pot experimental fishery — Season and gear — Species restriction.

It is unlawful to fish for spot shrimp for commercial purposes in coastal and offshore waters using shellfish pot gear except as provided in this section:

- (1) Season - Open to shellfish pot gear March 15 through September 15.
- (2) Gear restrictions:
 - (a) Maximum of 500 shellfish pots per permit.
 - (b) Pot size is limited to a maximum 153 inch bottom perimeter and a maximum 24 inch height.
 - (c) Shrimp pot gear must be constructed with net webbing or rigid mesh, and at least 50 percent of the net webbing or mesh covering the sides of the pot must easily allow passage of a seven-eighths inch diameter dowel.
 - (d) Pot gear is required to have an escape mechanism as provided for in WAC 220-52-035.
 - (e) Groundline end marker buoys must be floating and visible on the surface of the water, equipped with a pole, flag, radar reflector and operating light, and marked with the clear identification of the permittee.
- (3) Incidental catch: It is unlawful to retain any species of finfish or shellfish taken with spot shrimp pot gear, except that it is lawful to retain octopus, squid, and up to 50 pounds round weight of other shrimp species taken with shrimp pot gear. It is unlawful for persons fishing in the coastal spot shrimp experimental fishery to deliver spot shrimp while having on board bottomfish taken in the coastal bottomfish fishery under WAC 220-44-050.

Appendix B. House Bill 1148

HOUSE BILL 1148

State of Washington

62nd Legislature

2011 Regular Session

By Representatives Blake and Kretz

Read first time 01/13/11. Referred to Committee on Agriculture & Natural Resources.

1 AN ACT Relating to the establishment of a license limitation
2 program for the harvest and delivery of spot shrimp originating from
3 coastal or offshore waters into the state; amending RCW 77.65.210,
4 77.65.220, and 77.70.005; adding a new section to chapter 77.65 RCW;
5 adding a new section to chapter 77.70 RCW; and prescribing penalties.

6 BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF WASHINGTON:

7 NEW SECTION. **Sec. 1.** A new section is added to chapter 77.65 RCW
8 to read as follows:

9 (1) A Washington-coastal spot shrimp pot fishery license is
10 required to:

11 (a) Use spot shrimp pot gear to fish for spot shrimp;

12 (b) Possess spot shrimp; and

13 (c) Deliver spot shrimp.

14 (2) Washington-coastal spot shrimp pot fishery licenses require
15 vessel designation under RCW 77.65.100.

16 (3) A violation of this section is punishable under RCW 77.15.500.

17 NEW SECTION. **Sec. 2.** A new section is added to chapter 77.70 RCW
18 to read as follows:

1 (1) A Washington-coastal spot shrimp pot fishery license:
2 (a) May only be issued to a natural person who held a coastal spot
3 shrimp experimental emerging commercial fishery license and coastal
4 spot shrimp fishery permit in 2010 or had the license transferred to
5 him or her, under RCW 77.65.020 and 77.65.040, by a person who held a
6 coastal spot shrimp experimental emerging commercial fishery license
7 and coastal spot shrimp fishery permit in 2010;
8 (b) Must be renewed annually by December 31st of the calendar year
9 to remain active; and
10 (c) Subject to the restrictions of subsection (7) of this section
11 and to RCW 77.65.020 and 77.65.040, is transferable to a natural person
12 beginning January 1, 2012.
13 (2) When a person fails to obtain a Washington-coastal spot shrimp
14 pot fishery license during the previous year because of a license
15 suspension, the person may qualify for a license by establishing that
16 the person held such a license during the last year in which the
17 license was not suspended.
18 (3) The annual fee for a Washington-coastal spot shrimp pot fishery
19 license is as specified in RCW 77.65.220.
20 (4) Beginning in 2013, after taking into consideration the status
21 of the coastal spot shrimp population, the market for spot shrimp, and
22 the number of active fishers, both nontreaty and treaty, the director
23 may issue a Washington-coastal spot shrimp pot fishery license to a
24 natural person if the issuance would not raise the number of active
25 spot shrimp pot fishery licenses to more than eight.
26 (5) Beginning 2012, a Washington-coastal spot shrimp pot fishery
27 license holder is prohibited from designating, on the Washington-
28 coastal spot shrimp pot fishery license:
29 (a) A vessel whose surveyed length overall is more than ten feet
30 longer than the surveyed length overall of the vessel designated on the
31 licensee's coastal spot shrimp experimental emerging commercial fishery
32 license as of March 31, 2003; and
33 (b) A vessel whose surveyed length overall exceeds ninety feet.
34 (6) In the event the Washington-coastal spot shrimp pot fishery
35 license is transferred by sale, lease, inheritance, or lottery, and
36 pursuant to subsection (4) of this section, the vessel length
37 restriction associated with that license must remain attached to the
38 license.

1 (7) A natural person may not own or hold an ownership interest in
2 more than one Washington-coastal spot shrimp pot fishery license at a
3 time.

4 (8) Only a person who owns or is designated as an operator of the
5 vessel designated on the license may hold a Washington-coastal spot
6 shrimp pot fishery license.

7 **Sec. 3.** RCW 77.65.210 and 2007 c 442 s 4 are each amended to read
8 as follows:

9 (1) Except as provided in subsection (2) of this section, a person
10 may not use a commercial fishing vessel to deliver food fish or
11 shellfish taken for commercial purposes in offshore waters to a port in
12 the state without a nonlimited entry delivery license. As used in this
13 section, "deliver" and "delivery" mean arrival at a place or port, and
14 include arrivals from offshore waters to waters within the state and
15 arrivals ashore from offshore waters. As used in this section, "food
16 fish" does not include salmon. As used in this section, "shellfish"
17 does not include ocean pink shrimp, coastal crab, coastal spot shrimp,
18 or fish or shellfish taken under an emerging commercial fisheries
19 license if taken from off-shore waters. The annual license fee for a
20 nonlimited entry delivery license is one hundred ten dollars for
21 residents and two hundred dollars for nonresidents, and an additional
22 thirty-five dollar surcharge for both residents and nonresidents to be
23 deposited in the rockfish research account created in RCW 77.12.702.

24 (2) Holders of the following licenses may deliver food fish or
25 shellfish taken in offshore waters without a nonlimited entry delivery
26 license: Salmon troll fishery licenses issued under RCW
27 77.65.160((τ))_i; salmon delivery licenses issued under RCW
28 77.65.170((τ))_i; crab pot fishery licenses issued under RCW
29 77.65.220((τ))_i; food fish trawl--Non-Puget Sound fishery licenses, and
30 emerging commercial fishery licenses issued under RCW 77.65.200((τ))_i;
31 Dungeness crab--coastal fishery licenses((τ))_i; ocean pink shrimp
32 delivery licenses((τ))_i; shrimp trawl--Non-Puget Sound fishery licenses,
33 Washington coastal spot shrimp pot fishery licenses issued under
34 chapter 77.70 RCW; and emerging commercial fishery licenses issued
35 under RCW 77.65.220 ((~~may deliver food fish or shellfish taken in~~
36 ~~offshore waters without a nonlimited entry delivery license~~)).

1 (3) A nonlimited entry delivery license authorizes no taking of
 2 food fish or shellfish from state waters.

3 **Sec. 4.** RCW 77.65.220 and 2000 c 107 s 43 are each amended to read
 4 as follows:

5 (1) This section establishes commercial fishery licenses required
 6 for shellfish fisheries and the annual fees for those licenses. The
 7 director may issue a limited-entry commercial fishery license only to
 8 a person who meets the qualifications established in applicable
 9 governing sections of this title.

Fishery (Governing section(s))	Annual Fee		Vessel Required?	Limited Entry?
	Resident	Nonresident		
(a) Burrowing shrimp	\$185	\$295	Yes	No
(b) Crab ring net- Non-Puget Sound	\$130	\$185	Yes	No
(c) Crab ring net- Puget Sound	\$130	\$185	Yes	No
(d) Dungeness crab- coastal (RCW 77.70.280)	\$295	\$520	Yes	Yes
(e) Dungeness crab- coastal, class B (RCW 77.70.280)	\$295	\$520	Yes	Yes
(f) Dungeness crab- Puget Sound (RCW 77.70.110)	\$130	\$185	Yes	Yes
(g) Emerging commercial fishery (RCW 77.70.160 and 77.65.400)	\$185	\$295	Determined by rule	Determined by rule
(h) Geoduck (RCW 77.70.220)	\$ 0	\$ 0	Yes	Yes
(i) Hardshell clam mechanical harvester (RCW 77.65.250)	\$530	\$985	Yes	No
(j) Oyster reserve (RCW 77.65.260)	\$130	\$185	No	No
(k) Razor clam	\$130	\$185	No	No
(l) Sea cucumber dive (RCW 77.70.190)	\$130	\$185	Yes	Yes
(m) Sea urchin dive	\$130	\$185	Yes	Yes

1	(RCW 77.70.150)				
2	(n) Shellfish dive	\$130	\$185	Yes	No
3	(o) Shellfish pot	\$130	\$185	Yes	No
4	(p) Shrimp pot-	\$185	\$295	Yes	Yes
5	Puget Sound				
6	(RCW 77.70.410)				
7	(q) Shrimp trawl-	\$240	\$405	Yes	No
8	Non-Puget Sound				
9	(r) Shrimp trawl-	\$185	\$295	Yes	Yes
10	Puget Sound				
11	(RCW 77.70.420)				
12	(s) <u>Spot shrimp-coastal</u>	<u>\$185</u>	<u>\$295</u>	<u>Yes</u>	<u>Yes</u>
13	<u>(t) Squid</u>	\$185	\$295	Yes	No

14 (2) The director may by rule determine the species of shellfish
15 that may be taken with the commercial fishery licenses established in
16 this section, the gear that may be used with the licenses, and the
17 areas or waters in which the licenses may be used. Where a fishery
18 license has been established for a particular species, gear,
19 geographical area, or combination thereof, a more general fishery
20 license may not be used to take shellfish in that fishery.

21 **Sec. 5.** RCW 77.70.005 and 2009 c 331 s 1 are each amended to read
22 as follows:

23 The definitions in this section apply throughout this chapter and
24 related rules adopted by the department unless the context clearly
25 requires otherwise.

26 (1) "Deliver" or "delivery" means arrival at a place or port, and
27 includes arrivals from offshore waters to waters within the state and
28 arrivals ashore from offshore waters.

29 (2) "Pacific sardine" and "pilchard" means the species *Sardinops*
30 *sagax*.

31 (3) "Spot shrimp" means the species *Pandalus platyceros*.

Appendix C. Final Spot Shrimp Limited License Program Legislation

RCW 77.70.510

Washington-coastal spot shrimp pot fishery license.

(1) A Washington-coastal spot shrimp pot fishery license:

(a) May only be issued to a natural person who held a coastal spot shrimp experimental emerging commercial fishery license and coastal spot shrimp fishery permit in 2010 or had the license transferred to him or her, under RCW 77.65.020 and 77.65.040, by a person who held a coastal spot shrimp experimental emerging commercial fishery license and coastal spot shrimp fishery permit in 2010;

(b) Must be renewed annually by December 31st of the calendar year to remain active; and

(c) Subject to the restrictions of subsection (7) of this section and to RCW 77.65.020 and 77.65.040, is transferable to a natural person beginning January 1, 2012.

(2) When a person fails to obtain a Washington-coastal spot shrimp pot fishery license during the previous year because of a license suspension, the person may qualify for a license by establishing that the person held such a license during the last year in which the license was not suspended.

(3) The annual fee for a Washington-coastal spot shrimp pot fishery license is as specified in RCW 77.65.220.

(4) Beginning in 2013, after taking into consideration the status of the coastal spot shrimp population, the market for spot shrimp, and the number of active fishers, both nontreaty and treaty, the director may issue a Washington-coastal spot shrimp pot fishery license to a natural person if the issuance would not raise the number of active spot shrimp pot fishery licenses to more than eight.

(5) Beginning 2012, a Washington-coastal spot shrimp pot fishery license holder is prohibited from designating, on the Washington-coastal spot shrimp pot fishery license:

(a) A vessel whose surveyed length overall is more than ten feet longer than the surveyed length overall of the vessel designated on the licensee's coastal spot shrimp experimental emerging commercial fishery license as of March 31, 2003; and

(b) A vessel whose surveyed length overall exceeds ninety feet.

(6) In the event the Washington-coastal spot shrimp pot fishery license is transferred by sale, lease, inheritance, or lottery, and pursuant to subsection (4) of this section, the vessel length restriction associated with that license must remain attached to the license.

(7) A natural person may not own or hold an ownership interest in more than one Washington-coastal spot shrimp pot fishery license at a time.

(8) Only a person who owns or is designated as an operator of the vessel designated on the license may hold a Washington-coastal spot shrimp pot fishery license.

(9) Nothing in this section:

(a) Requires the commission to open a commercial coastal spot shrimp fishery in any given year;

(b) Prohibits the commission from closing or limiting an opened commercial coastal spot shrimp fishery for any reason; or

(c) Confers any right of compensation to the holder of a Washington-coastal spot shrimp pot fishery license if the license is revoked, limited, or modified by the legislature.

(10) Issuance of a Washington-coastal spot shrimp pot fishery license does not create, and may not be construed to create, any right, title, or interest in the coastal spot shrimp resource.

(11) The legislature recognizes that Washington-coastal spot shrimp pot fishery licenses may be revoked by future legislatures if the fishery is found to have jeopardized the sustainability of the coastal spot shrimp resource or the marine ecosystem.

RCW 77.65.540

Coastal spot shrimp fishery — Report to the legislature. (Expires July 31, 2016.)

(1) The director shall provide a report to the legislature, consistent with RCW 43.01.036, regarding the coastal spot shrimp fishery. The report must include any recommended changes to the licensing program created in RCW 77.65.530 deemed appropriate by the director. The report must take into consideration the status of the coastal spot shrimp population, the impact of the removal of coastal spot shrimp to the marine ecosystem, and the market for coastal spot shrimp.

(2) The report required by this section must be delivered by January 7, 2016.

(3) This section expires July 31, 2016.

Appendix D. Coastal Spot Shrimp Pot Experimental Fishery Permit Conditions

(as of January 2013).

This permit is issued under the authority of **WAC 220-52-052** to _____ to fish for spot shrimp (*Pandalus platyceros*) in waters of the Pacific Ocean adjacent to the State of Washington with shellfish pot gear using the designated vessel _____. The following conditions apply:

1. This permit is valid only if the permit holder also holds a valid commercial fishery license that has the above named vessel designated on the license.
2. This permit is non-transferable and must be carried aboard the vessel at all times the vessel is engaged in the fishery, including sale of catch. (WAC 220-52-052 subsections 14 and 15)
3. All fishing activity must be conducted in accordance with the fishery regulations of **WAC 220-52-052**. Nothing in this permit shall be construed to mean that the permittee is exempt from compliance with any other valid law or regulation of any governmental agency.
4. All shrimp harvested must be documented on commercial fish/shellfish receiving tickets.
5. At the option of the Department, WDFW personnel must be allowed to be on board the vessel to observe fishing operations and/or collect biological data on the catch. To facilitate data collection, WDFW personnel must be notified a minimum of 24 hours in advance of landing. Unless otherwise instructed, fishers must provide access to whole spot shrimp for sampling.
6. A violation of this permit is punishable under RCW 77.15.750 Unlawful use of a department permit — Penalty.
7. This permit is subject to revocation by the Director for failure to abide by the conditions of the permit, for violation of other fishing regulations, or if such action is deemed to be in the best interests of fisheries resources, subject to the permittee's opportunity to contest such action pursuant to the Administrative Procedures Act (Chapter 34.05, RCW).
8. This permit expires December 31, 20XX.

Appendix E. Coastal Spot Shrimp Fishery Regulations

WAC 220-52-052

Ocean spot shrimp pot fishery — Coastal waters.

It is unlawful to fish for, possess, or deliver ocean spot shrimp (*Pandalus platyceros*) taken for commercial purposes from state waters west of the Bonilla-Tatoosh line, or from offshore waters, except as provided for in this section:

License and area

(1) It is unlawful to fish for, possess, or deliver spot shrimp taken for commercial purposes from state waters west of the Bonilla-Tatoosh line, or from offshore waters, unless the fisher has a valid Washington-coastal spot shrimp pot fishery license. A violation of this subsection is punishable under RCW 77.15.500, Commercial fishing without a license -- Penalty.

(2) It is unlawful to fish for or possess spot shrimp or to set spot shrimp gear in waters of the Pacific Ocean adjacent to the state of Oregon without the licenses or permits required to commercially fish for spot shrimp within the state waters of Oregon. A violation of this subsection is punishable under RCW 77.15.550, Violation of commercial fishing area or time -- Penalty.

Season

(3) It is unlawful to fish for, take, or possess spot shrimp on board a commercial fishing vessel, except from March 15 through September 15 of each year. A violation of this subsection is punishable under RCW 77.15.550, Violation of commercial fishing area or time -- Penalty.

(4) The total allowable catch of spot shrimp taken from waters west of the Bonilla-Tatoosh line and from offshore waters during a calendar year is 200,000 pounds round weight. Of this 200,000 pounds round weight, no more than 100,000 pounds can be taken south of 47 degrees 04.00' N. latitude, and no more than 100,000 pounds can be taken north of 47 degrees 04.00' N. latitude.

Gear

(5) It is unlawful to fish with spot shrimp pot gear for commercial purposes if the pots exceed a maximum 153-inch bottom perimeter and a maximum 24-inch height. It is unlawful to possess spot shrimp taken with spot shrimp pot gear that exceeds a maximum 153-inch bottom perimeter and a maximum 24-inch height.

(a) Shrimp pot gear must be constructed with net webbing or rigid mesh. At least 50 percent of the net webbing or mesh covering the sides of the pot must easily allow passage of a seven-eighths inch diameter dowel.

(b) Pot gear is required to have an escape mechanism as provided for in WAC 220-52-035.

(c) Set line end marker buoys must be floating and visible on the surface of the water, equipped

with a pole, flag, radar reflector, and operating light, and marked with the clear identification of the license holder and the vessel designated on the coastal spot shrimp pot license.

(6) It is unlawful to fish for spot shrimp for commercial purposes with more than a maximum of 500 pots. It is unlawful to possess spot shrimp taken for commercial purposes with more than a maximum of 500 pots.

(7) A violation of subsection (5) or (6) of this section is punishable under RCW 77.15.520, Commercial fishing -- Unlawful gear or methods -- Penalty.

Incidental catch

(8) It is unlawful for persons fishing in any coastal spot shrimp fishery to deliver spot shrimp while having on board the fishing vessel any bottomfish taken in the coastal bottomfish fishery under WAC 220-44-050.

(9) It is unlawful to retain any species of finfish or shellfish taken with spot shrimp pot gear, except octopus, squid, or up to 50 pounds round weight of other shrimp species taken incidentally with spot shrimp pot gear.

(10) A violation of subsection (8) or (9) of this section is punishable under RCW 77.15.550, Violation of commercial fishing area or time -- Penalty.

Harvest logs

(11) It is unlawful for any spot shrimp pot fishery license holder or vessel operator engaged in fishing for spot shrimp in the coastal commercial spot shrimp fishery to fail to complete a department-issued harvest log for all fishing activity in state or offshore waters.

(12) It is unlawful for any vessel operator engaged in fishing for spot shrimp for commercial purposes to fail to comply with the following method and time frame related to harvest log submittal and recordkeeping:

(a) Completed harvest logs must be submitted so that the department receives them within ten days following any calendar month in which fishing occurred. Washington-coastal spot shrimp pot license holders can submit the completed harvest logs to a WDFW employee upon request, or mail the completed harvest logs to Washington Department of Fish and Wildlife, Attention: Coastal Spot Shrimp Manager, 48 Devonshire Rd., Montesano, WA 98563.

(b) Washington-coastal spot shrimp pot license holders or vessel operators engaged in fishing for spot shrimp in the coastal commercial fishery must complete a harvest log entry for each day fished, prior to offloading the spot shrimp. Washington-coastal spot shrimp pot license holders must maintain a copy of all submitted harvest log entries for no less than three years after the fishing activity ended.

(c) Washington-coastal spot shrimp pot license holders or vessel operators can obtain a harvest

logbook by contacting the department's coastal spot shrimp manager at 360-249-4628.

(13) A violation of subsection (11) or (12) of this section is a misdemeanor, punishable under RCW 77.15.280, Reporting of fish or wildlife harvest -- Rules violation -- Penalty.

Permit

(14) It is unlawful to fish for, retain, land, or deliver spot shrimp taken with pot gear for commercial purposes without a valid coastal spot shrimp pot fishery permit.

(15) It is unlawful to take, retain, land, or deliver any spot shrimp taken with pot gear without complying with all provisions of a coastal spot shrimp pot fishery permit.

(16) A violation of subsection (14) or (15) of this section is punishable under RCW 77.15.750, Unlawful use of a department permit -- Penalty.

Appendix F. Coastal Spot Shrimp Fishery Log

WASHINGTON COASTAL COMMERCIAL SPOT SHRIMP FISHERY LOG

Vessel Name _____ Landing Date _____ Bait type _____ Page ___ of ___
 Skipper _____ Fish Ticket # _____ Trip No. _____

SET DATE	HAUL DATE	STRING NO.	SET Latitude / Longitude	HAUL Latitude / Longitude	DEPTH (Fathoms)	NO. POTS	TIME For Sets less than 24 hours (use 24 hour time)		SOAK TIME Hours soaked if more than 24	ESTIMATED POUNDS Per String Round or Tails (circle one)	Other Species List name and estimated lbs. See cover instructions
							SET	HAUL			

SIGNED _____ DATE _____ PHONE _____

2010
 This log must be received by the tenth day of the month following harvest (WAC 220-52-075).
 Return logs to: WDFW – SHRIMP BIOLOGIST, 48 DEVONSHIRE ROAD, MONTE SANO, WA 98563

Office Use Only: Vessel ID _____
Permit # _____
Entered (date/initial) _____

Appendix G. Coastal Spot Shrimp Surplus Production Model

Let C_i^r , E_i^r and U_i^r be the total catch in kg, the total fishing effort in pot lift, and the CPUE and of region r ($=s$ -South, $=n$ -North) in year i . Both Schaefer (1954) and Fox (1970) surplus production models are commonly used to estimate the MSY in fisheries with total catch and total fishing effort. Schaefer (1954) assumes that U_i^r and E_i^r follow a linear relationship and we call it Model Ia.

$$\text{Model Ia: } U_i^r = \alpha + \beta E_i^r + \varepsilon_{1i},$$

where α and β are unknown to be determined, and $\varepsilon_{1i} \sim NID(0, \sigma_1^2)$. Alternatively, we can assume the errors came from C_i^r instead of U_i^r and we call it Model Ib.

$$\text{Model Ib: } C_i^r = \alpha E_i^r + \beta (E_i^r)^2 + \varepsilon_{2i},$$

where $\varepsilon_{2i} \sim N(0, \sigma_2^2)$.

If both ε_{1j} s and ε_{2j} s are equal to zero, the estimated unknown parameters in both Models Ia and Ib are equal. The estimated MSY is $\frac{-\alpha^2}{4\beta}$ and the fishing effort at MSY is $\frac{-\alpha}{2\beta}$

Fox (1970) considered the relationship between $\log(U_i^r)$ and E_i^r is linear and we call it Model IIa.

$$\text{Model IIa: } \log(U_i^r) = \alpha + \beta E_i^r + \varepsilon_{3i},$$

where $\varepsilon_{3i} \sim NID(0, \sigma_3^2)$.

Similarly we can assume the errors came from C_i^r instead of $\log(U_i^r)$ and we call it Model IIb.

$$\text{Model IIb: } C_i^r = E_i^r \exp(\alpha + \beta E_i^r) + \varepsilon_{4i},$$

where $\varepsilon_{4i} \sim N(0, \sigma_4^2)$.

The estimated MSY of the south and north regions (south and north of 47°04.00' N. latitude) from the four models are listed in Tables 1 and 2. The estimated MSY is $\frac{-e^{\alpha-1}}{\beta}$ and the fishing effort at MSY is $\frac{-1}{\beta}$.

Appendix G. Table 1. Summary of estimated parameters, MSY and fishing effort at MSY of the four models in South region.

Model	Schaefer (1954)		Fox (1970)	
	Ia	Ib	IIa	IIb
$\hat{\alpha}$ (st. error)	0.438 (0.094)	0.724 (0.116)	-0.881 (0.178)	-0.881 (0.178)
$\hat{\beta}$ (st. error)	0.001 (0.002)	-0.003 (0.001)	0.003 (0.003)	0.290(0.211)
$\sum_i (C_i^s - \hat{C}_i^s)^2$	720.387	341.331	755.834	351.633
$\sum_i (C_i^s - \hat{C}_i^s)$	0.000	-6.568	6.688	6.197
Estimated MSY(1000 lbs) (95% CIs) [95% CIs without measurement errors]		104.061 (94.433, 142.430) [85.920, 168.212]		118.987
Estimated fishing effort at MSY (1000 potlift) (95% CIs) [95% CIs without measurement errors]		128.284 (113.0517, 190.2071) [81.242, 286.525]		192.886

Appendix G. Table 2. Summary of estimated parameters, MSY and fishing effort at MSY of the four models in North region.

Model	Schaefer (1954)		Fox (1970)	
	Ia	Ib	IIa	IIb
$\hat{\alpha}$ (st. error)	0.594 (0.084)	0.810 (0.099)	-0.531 (0.150)	-0.178 (0.109)
$\hat{\beta}$ (st. error)	-0.0001(0.002)	-0.004(0.001)	-0.001 (0.003)	-0.006 (0.021)
$\sum_i (C_i^n - \hat{C}_i^n)$	0.000	5.889	5.639	-5.447
$\sum_i (C_i^n - \hat{C}_i^n)^2$	383.575	206.748	362.787	220.635
Estimated MSY(1000lbs) (95% CIs) [95% CIs without measurement errors]	605.3719	98.616 (89.844,139.453) [93.235,563.445]	1017.513	112.934
Estimated fishing effort at MSY (potlift) (95 (1000 potlift) (95% CIs) [95% CIs without measurement errors]	2038.812	108.670 (90.488, 191.042) [88.185,777.829]	2137.505	163.774



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