

Washington Coastal Pink Shrimp Fishery Management Plan



by Lorna L. Wargo and Dan L. Ayres



*Washington Department of
FISH AND WILDLIFE
Fish Program
Fish Management Division*

November 26, 2018

Dear Interested Parties:

In 2016 the Washington Department of Fish and Wildlife initiated a fishery management plan for the Washington Coastal Pink shrimp fishery. The purpose of the management plan is to formally document existing policy and objectives, and a new policy, specific for management of the Washington coastal pink shrimp fishery. The new policy introduces a management measure based on the concept of biological reference points.

The plan was developed with input from stakeholders at public meetings. Public opportunity to comment was also provided as the fishery management plan underwent review through the Washington State Environmental Policy Act (SEPA) process in June 2018. One comment in support of the plan as proposed was received during that review.

Pursuant to SEPA and consistent with state rules, the Washington Department of Fish and Wildlife concluded that the plan as proposed and the policies contained herein will not likely have a significant adverse impact on the environment, i.e., a determination of non-significance (DNS). Establishment of seasons, catch limits, and geographical areas for fishing and shellfish removal are exempt from SEPA under WAC 197-11-835(1) and were not included in the SEPA determination. Full SEPA documentation can be found at the WDFW SEPA website: <https://wdfw.wa.gov/licensing/sepa/>. DNS 18-038:
COASTAL PINK SHRIMP FISHERY MANAGEMENT PLAN, June 6, 2018

Therefore, the Washington Department of Fish and Wildlife presents this final fishery management plan to inform and direct agency decision-making in its management of the Washington coastal pink shrimp fishery.

Sincerely,



Lorna L. Wargo
Coastal Marine Fish Science Manager

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Washington Coastal Pink Shrimp Fishery Management Plan

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12/10/18

Date

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Introduction

The intent of this Fisheries Management Plan (FMP) is to establish the framework for Department management of the Washington non-treaty coastal pink shrimp fishery to promote pink shrimp resource conservation and the socio-economic benefits derived from its harvest.

This policy formally articulates, refines and updates the over-arching set of principles guiding coastal pink shrimp fishery management. Further, this policy documents the long-standing commitment by the Washington Department of Fish and Wildlife (WDFW) to coordinated management of the coastal pink shrimp fishery with the states of Oregon and California. In 1981, the Pacific Fishery Management Council (PFMC) considered bringing the pink shrimp trawl fishery under federal management. However, the Council ultimately made the decision to refer management to the three coastal states under an “alternative” that the states would adopt similar rules (PFMC 1981). Previous to this FMP, no written Washington policy captured this Council alternative but WDFW has demonstrated a commitment to it nevertheless.

This FMP only applies to the coastal population of ocean pink shrimp (*Pandalus jordani*). Here, “ocean” reflects Washington regulatory species classification and common usage for this species of shrimp, whereas the term “coastal” refers to state waters (0-3 miles) west of the Bonilla-Tatoosh line and federal waters of the U.S. Exclusive Economic Zone (3-200 miles) off Washington and Oregon. This FMP does not apply to ocean pink shrimp fisheries in Puget Sound. Unless, otherwise noted, the term pink shrimp is synonymous with ocean pink shrimp.

Regulatory Authority

The Washington Department of Fish and Wildlife and Fish and Wildlife Commission (FWC) have a legislatively mandated mission to preserve, protect, and perpetuate shellfish in state and offshore waters. In addition, WDFW is directed to manage shellfish resources in a manner that does not impair the resource. Consistent with this goal, WDFW must also seek to maintain the economic well-being and stability of the fishing industry in the state. Finally, WDFW is required to promote orderly fisheries and enhance and improve recreational and commercial fishing in this state (RCW 77.04.012).

In addition, the FWC may authorize the taking of shellfish only at times or places, or in manners or quantities, as in the judgment of the commission does not impair the supply of these resources (RCW 77.04.055).

The Washington State Legislature has also given the FWC the authority to adopt, amend, or repeal rules including: specifying the times when the taking shellfish is lawful or unlawful; specifying the areas and waters in which the taking and possession of shellfish is lawful or unlawful; specifying and defining the gear, appliances, or other equipment and methods that may be used to shellfish, and specifying the times, places, and manner in which the equipment may be used or possessed; and regulating the importation, transportation, possession, disposal, landing, and sale of shellfish within the state, whether acquired within or without the state. (RCW 77.12.047)

Coastal states, including Washington, are authorized to regulate fishing activity of state-registered vessels outside of state boundaries when no federal fishery management plan is in place (Magnuson-Stevens Fishery and Management Act P.L. 104-297, sec 306). Consistent with this federal authorization, state law extends the authority of the FWC to fishing in offshore waters by residents of this state. (RCW 77.12.045)

Although, the US west coast ocean pink shrimp fishery is state managed, it is subject to federal restrictions for groundfish catch and essential fish habitat (EFH) through the PFMC Groundfish Fishery Management Plan (PFMC 2016).

Resource Analysis

Species

Ocean pink Shrimp (*Pandalus jordani*)

Summary of Biological and Ecological information

The Washington coastal commercial trawl shrimp fishery is a single species fishery targeting the coldwater-shrimp species ocean pink shrimp (*Pandalus jordani*). With a U.S. west coast distribution ranging from northern California to southeast Alaska, these shrimp are the well adapted to the climate and ocean conditions of the eastern Pacific (Zirges and Robinson 1980, Collier et al. 2001). Ocean pink shrimp are found at depths from 25 fathoms to 200 fathoms. The highest densities of pink shrimp are generally found off the Washington coast over shrimp “beds” consisting of green mud or mud-sand substrates between 60 and 140 fathoms.

Washington commercial trawl fishers have long observed that ocean pink shrimp are most successfully fished during daylight hours. This is because they exhibit diel vertical migration where they concentrate above the shrimp beds (sea floor) during daylight hours and migrate and distribute up into the water column during the night to feed. Their source of feed is primarily as euphausiids, copepods and smaller zooplankton (Collier et al. 2001). Ocean pink shrimp is prey to many omnivorous fish species, including Pacific hake, *Merluccius productus*; arrowtooth flounder, *Atheresthes stomias*; sablefish, *Anoplopoma fimbria*; petrale sole, *Eopsetta jordani*; spiny dogfish, *Squalus acanthias*; and several species of rockfish (*Sebastes* spp.) and skates (*Rajidae* spp.).

Many pandalid shrimp species, including ocean pink shrimp, have a life cycle that is unique to most marine species as they are born male and remain so only during the first year or two of their lives. As protandric hermaphrodites they change sex, generally around the age of 2, and live the remainder of their lives as females. (Butler 1980, Zirges and Robinson 1980, Collier et al. 2001).

Female ocean pink shrimp carry their eggs externally where they are fertilized during mating which takes place during September and October. Fecundity ranges from about 800 eggs for small age-1 females up to about 5000 eggs for large age-3 females (Hannah et al. 1995). The peak hatching period occurs during late March and early April after which ocean pink shrimp go through a larval period which lasts between 2 and 3 months. The developing juvenile shrimp occupy successively deeper depths as they grow, and often begin to show up in commercial catches by late summer.

Annual recruitment success has been linked to the strength and timing of “spring transitions”. The spring transition marks the beginning of the upwelling season and can occur at any time between March and June. An early, strong transition is thought to be necessary to produce a large year class. (Hannah 1993; 1999).

Available Data

Fishery independent surveys are not conducted for the coastal pink shrimp stock. The Oregon Department of Fish and Wildlife (ODFW) has conducted substantial research examining pink shrimp population dynamics, fishery gears, bycatch, and bycatch reduction devices, and this body of work has been published in various journals and agency technical reports.

Washington coastal annual landings data are available beginning from 1957 in various published reports (Magill 1963, Tegelberg 1969, PFMC 1981). From 1970 onward, fish receiving/landing receipts data are available through a centralized agency database, i.e., WaFT.

Biological sampling was conducted for a period in the 1980’s through 1992 but these data were not archived and no longer exist. WDFW initiated a new biological sampling program, sending staff to be trained by ODFW biologists in 2015. Following ODFW protocols, routine sampling was fully reestablished in 2016.

Similar to biological data, historical logbook data were not archived and no longer exist. A mandatory logbook program was reinstated in 2011. Discards of target and non-target species are to be documented on fishery logbooks. There are no species subject to mandatory retention regulations.

At present biological sampling and logbook data are housed in stand-alone databases. One objective of the shrimp fishery management program is to move these to agency supported databases, i.e., the Biological Database System and Trawl Logbook System.

Beginning in 2010, Washington licensed pink shrimp trawl fishers were required to carry a federal program observer upon request. Administered by the National Marine Fisheries Service (NMFS), the West Coast Groundfish Observer Program (WCGOP) collects at-sea catch data including retained and discarded catch. Annual estimates of observed discards (bycatch) are produced for the Washington shrimp trawl fishery and are published by NMFS. In addition, WDFW conducted a two-year at-sea observer project of the pink shrimp trawl fishery to evaluate the bycatch of eulachon smelt (*Thaleichthys pacificus*) following the listing of this fish as threatened under ESA (Wargo et al. 2016).

Analysis of Stock Status, Trends or Indicators

As earlier mentioned, no fishery-independent surveys are conducted for the coastal pink shrimp stock. A substantial body of population dynamics research has been conducted by the ODFW Marine Resources Program. One key finding from this research is that environmental variation strongly drives pink shrimp recruitment, more so than fishery effects (Hannah 2014a; 2016a). The precise mechanism through which ocean environmental conditions affect recruitment are unknown. Shrimp larvae are first found in surface waters and the strength and timing of the spring transition of coastal currents are known to affect sea surface temperatures, and larval survival and retention.

To inform management Hannah (2014b; 2016a) has developed, updated and re-evaluated several methods to index pink shrimp recruitment (age 1) and spawning stock using a VPE (virtual population estimate) model. For both indices, values are estimated for northern, southern, and combined Oregon waters from 1980 to 2013. Trends between northern and southern waters follow generally, but not wholly, consistent patterns in recent years. The combined index for the recruitment years 2009-2012 is relatively high and stable compared to the prior period. The combined spawner index records the highest value for the time series in 2011 declining in 2012 and 2013 while yet remaining above average.

Hannah (2014a) also evaluated historical stock status from 1980-2011 using a separable, VPA, catch-at-age model and found that annual fishing mortality estimates widely varied but did not show any consistent decline; a 14-fold variation was found in estimated age-1 recruitments; and, estimated spawning stock biomass was lowest at 2.9 million kg in 1983 and nearly that low in 1998. In both instances, biomass levels in the year following exceeded 10 million kg. This analysis is used to derive the biological reference points and is further discussed under the section “Precautionary Management Approach and Reference Points.”

One constraint to these modeling efforts and fully understanding the dynamics of the pink shrimp stock has been the lack of biological and logbook data from pink shrimp landings into Washington after 1992. The long-standing assumption is that there is only one pink shrimp stock. However, as noted above regional differences are apparent within Oregon and it is likely that this pattern extends along the distribution of the pink shrimp stock. With re-established logbook (2011) and biological sampling (2015) programs, future analyses can anticipate incorporating a Washington time series.

Other trend information can be derived from Washington fishery data. Results from the WDFW monitoring of the Washington fleet are compiled annually and published in the “Washington Pink Shrimp Newsletter.” The newsletter summarizes total annual landings, landings by fish

ticket catch area, total effort (hours fished), total annual catch per unit of effort (CPUE) and CPUE by fish ticket catch area, the number of biological samples collected, and length frequency data.

Habitat

Pink shrimp are caught over mud and muddy-sand bottoms (Collier and Hannah 2001). These habitat types are fairly resilient to habitat damage. Pink shrimp fishers often refer to this bottom habitat as “green mud.”

The physical and depth boundaries associated with this general bottom type are located in specific and relatively fixed areas. However, the physical characteristics of ocean water masses and the large zooplankton communities that pink shrimp are dependent on are much more dynamic in location and time and largely independent of the bottom habitat. Nevertheless, changing ocean conditions that are driven by large ocean processes including upwelling, sea surface temperatures, and the timing of the spring transition all affect the overall habitat pink shrimp depend on. (Mackas, et al., 2005; McGowan, et al., 1998; Peterson, et al., 2002; Peterson and Schwing, 2003)

Research Needs, Data Gaps

1. Develop time series of biological data.
 - a. With an on-going effort to contribute to a better understanding of shrimp resource across fishery range (and across state borders) WDFW will continue the collection of fishery dependent biological information. This information will be used to expand stock assessment modelling by ODFW to include that portion of the shrimp population found off Washington.
2. Develop methods and strategies to further reduce bycatch.
 - a. In recognition that fishery participants have worked to successfully reduce by-catch through the use of biological reduction devices (BRDS) and light emitting diode (LED) lights, WDFW will continue to focus attention on this issue. While the “threatened” status of eulachon is the primary driver, the reduction of all bycatch is important to the future of this fishery.

Fishery Description

Non-treaty

Commercial

The ocean pink shrimp fishery dates from the late 1950's. Beginning off Grays Harbor in 1956, the inception of mechanical peelers and growing consumer demand for “cocktail” shrimp spurred fishery development. Catches in 1958 exceeded 6.5 million pounds (Alverson et al. 1960). Through the 1960's landings did not exceed two million pounds; but, during the following two decades the fishery expanded with abundant shrimp and good markets (Figure 1). In 1990, nearly 100 vessels landed about 15 million pounds. However, subsequent dramatic declines in local abundance drove many fishers out of the fishery and by 1994 the active fleet totaled just over 50 vessels, with fewer than 30 several years later (Figure 2). From the late 1990's fleet size continued to decline, hitting a record low of 13 active vessels in 2007. Landings were unremarkable, averaging about 5 million annually. More recently the fishery experienced back to back record breaking seasons. In 2014, the fishery landed 30.5 million pounds, in 2015 it landed 41.5 million pounds (Figure 1), and the number of actively fished licenses surged to levels reminiscent of the mid-1990's (Figure 2). These increases in the Washington fishery can be attributed to a combination of factors: shrimp abundance – the strong 2013 year-class; a substantial increase in processing capacity at Westport beginning in 2014; the influx of latent licenses, and a shift of vessels from Oregon after a processing facility at Warrenton was destroyed by fire.

Washington pink shrimp compete in markets dominated by northern shrimp (*Pandalus borealis*) which accounts for over 80% of the global catch of coldwater shrimp (FAO 2017). Leading northern shrimp producers include Canada, Greenland, and Norway. Smaller, and therefore somewhat less prized than northern shrimp, pink shrimp are sold as a machine peeled and cooked product. On the US westcoast, the Washington fishery ranks behind Oregon, the leading producer, and ahead of California (Figure 3). In Washington, the pink shrimp fishery is an important contributor to the coastal economy. Total exvessel value, in nominal dollars, has ranged from \$100,000 in 1970 to \$8.6 million in 2016 (Figure 4). The pink shrimp fishery's recent 10-year exvessel value averaged about 8 million dollars, representing a little over 7% of the coastal commercial fisheries' total. Encompassing the period of recent record high landings, the fishery's five-year (2009-2016) average value ranked fourth after Dungeness crab, Whiting, and Albacore tuna. However, the pink shrimp fishery relies on volume to be lucrative. Relative

to other seafood products, pink shrimp commands a comparatively low exvessel price. Between 1970 and 2017, the nominal average weighted exvessel price per pound ranged from 11 to 74 cents (Figure 5). Processors use a split pricing structure and pay based on size; this practice encourages shrimpers to target larger shrimp. The interplay of market forces and shrimp abundance, globally and locally, and operational costs shape the economics of the pink shrimp fishery. Nevertheless, the fishery's value measured as an average per vessel exhibits a strongly positive trend (Figure 6).

Landing receipts (fish tickets) and logbook data document that Washington licensed vessels deliver shrimp caught frequently offshore Washington and Oregon, and occasionally California into Washington ports. Washington coastal shrimp fishing activity is split between two ports: Westport and Ilwaco, with processors located at each.

Fishing occurs over muddy bottom within the continental shelf. Vessels operate during daylight hours reflecting the behavior of pink shrimp which exhibit a vertical diurnal migration, moving to the bottom during daylight hours and ascending to feed at night. The typical commercial trip ranges from 3 to 6 days including transit to and from the fishing grounds. Shorter trips can occur when fishing is especially productive. The fleet includes vessels that tow one or two independent nets, which are referred to as single or double-rigged, respectively. Towing duration is typically 0.5 to 2 hours at speeds of 1.5 to 2 knots.

Nearly all active vessels in the Washington fleet are double-rigged with semi-pelagic, fine-meshed shrimp trawl nets. These vessels tow their nets from the end of their out-riggers (a long boom extended out perpendicular to the centerline of the vessel) which handle each net independently. Each net has its own mouth-spreading doors and is operated by its own winch to maintain an even balance while towing. Figure 7 depicts a trawl net and excluder configuration typical to the Washington fleet. The excluder panel is set at an angle, with the degree varying by vessel. As catch moves down the net, the excluder allows or deflects larger fish out through an escape hole generally positioned in front of and atop the excluder; shrimp and smaller fish unable to escape, pass through the bars and into the codend of the net. Some skippers report placing the escape hole at the bottom of the net to reduce clogging of the excluder bars by species other than shrimp, or small, less desirable shrimp.

Recreational

While WDFW does not require the reporting of sport shrimp catch, fishery managers are confident that few if any pink shrimp are harvested by sport fishers in the Pacific Ocean off

Washington. There have been recent changes in regulations to provide some improved general shrimp harvest opportunities in coastal waters. The daily bag limit for spot shrimp (*Pandalus platyceros*) was raised to 25 pounds (a maximum of 200 shrimp) from the previous limit of 10 pounds. This is in recognition that known fishing grounds for spot shrimp are up to 30 miles offshore and not readily accessible to the casual sport fisher. In addition, a rules change allowing for a smaller mesh size in pots fished in less than 20 fathoms will allow sport fishers to more easily target coon-striped shrimp (*Pandalus hypsinotus* and/or *Pandalus danae*) in shallower nearshore waters.

Treaty Fisheries

Four Coastal Tribes, the Hoh, Makah, Quileute, and Quinault have treaty-reserved fishing rights to fish and shellfish passing through or within each tribe's respective usual and accustomed fishing grounds. The determination of each tribe's usual and accustomed areas are affirmed in several federal district court orders including; subproceeding 89-3 of United States v. Washington No. 9213; and subproceeding 09-01 of United States v. Washington No. 70-9213.

To date, only one of those four tribes has signed a State-Tribal Pink Shrimp Harvest Management Plan. For the 1996, 1997, 1998, and 2005 seasons WDFW technical and policy staff worked closely with their counterparts with the Makah Tribe to develop and agree to pink shrimp plans. No landings were made by Makah fishers during the life of any of these plans. Since 2005, the Makah have not asked to renew a pink shrimp plan.

The plan contains a list of goals that would likely be included in any future state and tribal pink shrimp management plans. The goals in the 1996, 1997-98, and 2005 state Makah pink shrimp management plans were the same and included:

1. Preserve, protect, and perpetuate the Maximum Sustainable Yield (MSY) of pink shrimp.
2. Maintain consistent conservation based regulations for state and tribal fisheries.
3. Maintain effective resource management while minimizing management costs.
4. Protect the reproductive capacity of the pink shrimp stocks.
5. Minimize harvest of small, unmarketable shrimp.
6. Use simple, enforceable, management tools.

Harvest Management

The overarching goal of this plan, consonant with agency mission and goals, is to preserve, protect, and perpetuate the pink shrimp resource and to provide for its sustainable harvest. In this section, specific guiding principles are identified and the approaches and tools to achieve those are described. Supporting treaty co-management is listed here as this represents significant legal and policy obligations but this plan is not intended to serve as co-manager harvest agreement/plan.

A principal objective of this plan is to realize a non-treaty commercial fishery that experiences stable seasons, is managed to clearly defined benchmarks, is appropriately capitalized, and pursues optimal bycatch reduction. This plan supports recreational shrimp fishing opportunity yet focuses on commercial harvest because pink shrimp are typically not targeted by recreational fishers.

The best available science will be used to inform management decisions through processes that ensure transparency and stakeholder input and engagement. The annual WDFW pink shrimp newsletter is an example of a way information is made accessible to fishery participants and other interested stakeholders.

As noted previously, another important objective is to achieve, as much as possible, similar regulations with Oregon such that Washington licensed shrimpers are not disadvantaged and that resource protection measures can be more fully realized. In practice, Washington, Oregon, and California fishery managers have informally but routinely conferred on management needs and actions to ensure consistent regulatory measures.

Guiding Principles for Resource and Fishery

- Use best available science to inform management decisions.
- Utilize a precautionary approach to guide decision-making in the face of scientific and/or management uncertainty.
- Support tribal fisheries, which are consistent with the applicable federal court orders while recognizing the need for management flexibility to optimize fishing opportunity.
- Structure fishery regulations to pursue effective enforcement and avoid conflicting regulations with adjacent states.

- Engage and collaborate with stakeholders, consumptive and non-consumptive, ensuring public transparency.
- Consider socio-economic effects on harvesters, dealers and processors, and coastal communities dependent on the fishery.
- Support development of innovative harvest methods or gears to reduce bycatch and any adverse effects on seafloor habitat.
- Employ technologies to achieve effective, efficient use of agency resources.
- Allow for recreational opportunity if/as interest arises.
- Manage fishery using reference points to ensure long-term conservation of the resource.

Precautionary Management Approach and Reference Points

Since inception, Washington pink shrimp fishery management has been accomplished through various input controls, e.g., limited entry, and technical regulations, e.g., season closure, mesh size. Despite being largely passive measures, the outcome has been a sustainable fishery over its history (MRAG 2017). The fishery’s sustainability is conditioned on effort levels which, in Washington, have been constrained until more recent years by a lack of processing capacity in conjunction with a protracted period of soft demand and low market prices. However, extensive research suggests that the pink shrimp resource is highly resilient to fishing pressure at levels experienced currently and in the past, as environmental conditions primarily drive pink shrimp stock abundance (Hannah 2016a; 2016b). Nonetheless, establishing a precautionary approach can supplement existing management measures to reduce risk of negative fishery impacts to the resource.

A precautionary approach can be achieved through the use of reference points. For fisheries managers, reference points serve as benchmarks to guide fishery management decisions and aid meeting policy objectives (FAO 1996). Rather than establishing independent metrics, WDFW policy closes the Washington pink shrimp fishery when ODFW-determined reference points are triggered. From a management perspective, this is simply an extension of policy to achieve similar across-state fishery regulations, i.e., “a level playing field.” Biologically, this approach is supported by the assumption of one coast-wide stock (Hannah 1993). Moreover, absent coordinated closures, effort shifts between states would ensue, diminishing the value of a single state action.

The ODFW Pink Shrimp FMP outlines a strategy that uses catch as proxies for target and limit reference points (Hannah 2016b). This strategy is based on analyses from a stock reconstruction model that identified historically low years of spawning stock abundance, and associated those with sea-level height, and June fishery CPUE as a proxy for shrimp biomass (Hannah 2014). The premise is that the shrimp resource, in retrospect, would have benefited from reduced fishing during years of low abundance. At the “target” level, June catch of 12,500 pounds per trip indicates a need to take action to protect shrimp spawning stock biomass. In this instance, the fishery is closed two weeks early, i.e., on October 15 and the next season’s fishery opening is delayed two weeks, i.e. until April 15, to reduce fishing pressure on egg-bearing females. The “limit” reference point presumes more serious circumstances and prompts immediate closure of the fishery coupled with a two-week opening delay the next season. The “limit” level incorporates two elements: sea-level height and June CPUE less than 10,000 pounds per trip. Sea-level height is included based on research that connects shrimp recruitment to ocean environmental conditions (Hannah 2016). Table 1. summarizes the reference points and their associated management actions.

Table 1. Action levels for management of the ocean (pink) shrimp fishery (Hannah 2016b).

June average shrimp catch (lbs.)/trip	Current season will close	Following season will open
More than 12,500	October 31	April 1
Less than 12,500	October 15	April 15
Less than 10,000 and prior April-January SLH exceeds 7.5 ft.	As soon as possible	April 15

To evaluate the appropriateness of referring to Oregon action levels, fishery landings data for the Washington and Oregon were compared. The number of fish receiving tickets and June landings from 1978 – 2016 were used to calculate CPUE for Washington. These were then compared to Oregon June CPUE data for the same time period (Figure 8). There are few years in which Washington CPUE were meaningfully different from Oregon’s. The similarity in catchability follows as the fisheries in both states are operationally very similar and are presumably fishing one stock. This and the reasons stated above support tying Washington management actions to Oregon-derived fishery reference points. However, this policy approach is necessarily dependent on close collaboration between the states’ agency fishery managers, particularly if the limit reference point is reached triggering immediate closure of the fishery.

Finally, because this policy rests on externally accomplished work, maintaining strong coordination between Washington and Oregon fishery managers is important. Periodic re-

evaluation of the scientific basis of the policy, the assumptions made, gear efficiency, and choice of reference points should be encouraged and facilitated as much as possible, e.g., through aligned monitoring programs and data sharing.

Current Management Tools

Implementing management authority for the coastal non-treaty pink shrimp fisheries is accomplished through statutes describing the limited entry license program and administrative regulations specifying legal areas, seasons, gears, and size (via counts). By regulation each shrimp vessel must obtain a pink shrimp trawl fishery permit and abide by its conditions which include carrying onboard observers, submitting logbooks, and specific requirements for vessels that might freeze catch at-sea (Appendix A). In addition to these regulatory tools, fishery monitoring is accomplished through logbook and biological sampling programs.

Commercial

Area closures

Along the Washington coast, the pink shrimp fishery operates only in federal waters (3-200 miles); most commercial gears, including trawl, are prohibited inside Washington state waters (0-3 miles).

Season and gear rules

In 1982, the states of Washington, Oregon, and California established a common season and a maximum count per pound regulation to minimize regulatory conflicts. The fishing season is fixed in permanent regulation, opening April 1 and closing October 31.

Washington rules for minimum codend mesh size were rescinded in 1994. Following the overfished designation of canary rockfish (*Sebastes pinniger*) by the PFMC in 1999 (Wallace 2011) and a two-year implementation program, the mandatory use of biological reduction devices (BRDs), also known as finfish excluders, was set in permanent rule, effective 2003. Spurred by the convenience of sorting less bycatch, many fishers began installing excluders with narrower bar-spacing, effectively staying ahead of regulatory requirements. Based on this and findings by Hannah (2007) that 0.75 in. (19 mm) bar-spacing could maintain shrimp production while reducing bycatch, Washington rules were amended in 2012 to allow only rigid-panel style

excluders and to reduce legal bar-spacing to a maximum of 0.75 in. Washington regulations stipulate a minimum escape hole of 100 square in. (0.64 m²).

Size limit

To reduce fishing mortality of age 1 shrimp, the harvest of unmarketable shrimp and to maximize the economic yield from the fishery, a minimum count regulation limits the average number shrimp to fewer than 160 per pound.

Licenses and Permits

A 1994 limited entry (LE) license program established 143 licenses (Appendix B). As of 2016, the number of LE licenses stood at 81. Licenses must be renewed annually, but do not need to be fished actively to remain valid; the decline is attributed to LE license owners electing not to renew. No minimum number of licenses has been established to maintain the fishery, and at present no regulatory mechanism exists to issue/reissue expired licenses.

Logbook program

A mandatory logbook program has been in place since 2011. Agency-provided logbooks are due monthly. Information collected includes: vessel and skipper names, US Coast Guard vessel number, date and port of landing, the corresponding fish landing receipt (fish ticket), and rig type (i.e. single or double). For each tow, vessel skippers document the date, location (latitude and longitude), duration and depth, and estimates of retained and discarded catch. These data provide geographic and quantitative estimates of catch including: fleet-wide season total hours fished, annual catch CPUE, catch by management area and CPUE by management area.

Biological sampling program

The aim of the biological sampling program is to develop a time series of age and sex composition, and average carapace length data. WDFW scientific technicians collect shrimp samples at off-loading and process the samples in a laboratory. The WDFW program adopted protocols used by ODFW to ensure compatible datasets. These protocols define the sampling parameters, including limiting collection to catch dates between the 10th and 20th of each month, and sampling for sex to the months of April, September, and October. Data collected include count per pound, length frequency, and sex. Count per pound data provide a simple metric of shrimp size, and support compliance monitoring. Size data are also used to derive age and this information can be applied to catch to estimate year class strength. Length data are collected using electronic calipers with data uploaded directly to an Excel spreadsheet.

Biological data will be shared with ODFW to foster possible development of coast-wide indices of recruitment and spawning biomass. In addition, or as a separate effort, biological data can be used to monitor the Washington fishery for growth and recruitment overfishing.

Recreational

The sport fishery for all shrimp species, including pink shrimp, is open year-round in waters of the Pacific Ocean off Washington (Marine Areas 1-3 and Marine Area 4 west of the Bonilla-Tatoosh line).

Rules governing the sport harvest of shrimp (including pink shrimp) from Pacific Ocean waters mostly mirror those used in Puget Sound. A recreational shellfish license is required to retain sport-caught shrimp. Only shrimp pot gear may be used to fish for all shrimp species and that gear is limited to 2 pots per person, with a minimum mesh size of 1 inch, except that in coastal waters less than 20 fathoms the minimum mesh size is ½ inch. Any pots left unattended must each have a buoy line and a separate buoy that is permanently and legibly marked with the operator's first name, last name, and permanent address. In addition, each harvester must have a separate container for their catch, either in their possession or identified with their name.

The daily limits for all shrimp in coastal waters are more liberal than in Puget Sound and allow licensed sport fishers to keep 25 pounds (including heads and tails) of all shrimp species combined (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.

Incidental Landings, Bycatch Information, and Listed Species Interactions

In some manner, addressing incidental catch, bycatch, or protected species in the pink shrimp fishery has been the primary focus of management since the early 2000s. Although not documented, in practice WDFW has followed a policy of encouraging industry to voluntarily experiment or adopt new fishing practices or gears ahead of rule-making, and of aligning its rule-making actions with Oregon. Capturing this policy formally is expected to support this approach as the fishery continues to progressively address identified conservation needs for over-fished or listed species.

For years incidentally landed groundfish comprised a valued component of the pink shrimp fishery. Early Washington regulations first limited, then allowed unrestricted groundfish catch for a period of time (PFMC 1981). With limits re-established, Washington shrimpers routinely landed groundfish and from 1990 through 2000; the value of this incidental catch averaged about 6% of the annual total ex-vessel fishery value. After the use of finfish excluders became mandatory in 2003, landings of marketable fish fell to negligible levels (Appendix C). This reduction cannot solely be attributed to finfish excluder use. In 2001, the West Coast Groundfish Observer Program was established primarily to collect catch and biological data from randomly selected vessels in the groundfish trawl fishery. However, under federal rules trawl vessel participation in the observer program is mandatory if groundfish are retained. By not retaining and landing groundfish, Washington shrimpers circumvented this requirement.

In 2000, the PFMC determined canary rockfish (*Sebastes pinniger*) to be over-fished under the terms of the Sustainable Fisheries Act enacted by Congress in 1996 and the accompanying National Standard Guidelines adopted by the National Marine Fisheries Service. For the next two fishing seasons, the PFMC, Washington, Oregon, and California followed a coordinated management strategy for the pink shrimp trawl fishery. This strategy entailed promoting the voluntary use of excluders and encouraging industry to experiment with gear modifications to achieve minimal fish retention and optimal shrimp catch until a trigger (landed pounds of canary rockfish) was reached, at which time excluders became mandatory for the remainder of the season. Following PFMC adoption of very conservative management measures affecting all sectors of the West Coast groundfish fisheries, including restrictions specific to the pink shrimp fishery that prohibited the retention or landing of canary, yelloweye, and thornyhead rockfish, WDFW mandated the use of excluders, effective with start of the fishery on April 1, 2003.

From 2003 to 2011, Washington regulations permitted rigid-panel finfish excluders, with bar spacing of up to 2 inches (51mm) or soft-panel excluders constructed of netting with meshes not exceeding 5.5 inches (140 mm). With excluders, fewer fish were brought onboard the shrimp trawlers and crews spent less time sorting the catch which encouraged skippers to install excluders with bars spaced more closely than required by regulation. By 2011, vessels in the Washington fleet were using excluders with bar spacing less than 1.5 inches (38mm). Based on this and research (Hannah 2007) that found that 0.75 inch (19mm) bar spacing could maintain shrimp production while reducing bycatch, Washington rules were revised in 2012 to allow only rigid-panel style excluders and to reduce legal bar spacing to a maximum of 0.75 inch.

Interest in bycatch in the pink shrimp fishery dates back to the 1960's when the National Marine Fisheries Service conducted gear studies aimed at reducing the quantity of unmarketable fish

mixed with pink shrimp. One design that reduced smelt and herring catch came into wide and persistent use, while others failed to gain traction with shrimpers because shrimp production was overly compromised (PFMC 1981). In the 1990's large catches of Pacific whiting, that at times made fishing some shrimp grounds impossible, reinvigorated interest and spurred shrimpers to install finfish excluders; their use picked up but only for a few years (Hannah 2000).

In 2010, eulachon were listed under the Endangered Species Act (ESA) as a threatened species by the National Marine Fisheries Service. Scientists cited various causes for the decline and also threats to the species' recovery (Gustafson, et. al., 2010). Among sixteen threats, they ranked bycatch in the Pacific Northwest (California, Oregon and Washington) pink shrimp trawl fishery second after climate change. At the time, very limited information or data about bycatch existed for the Washington shrimp trawl fishery. To close this data gap, the WDFW undertook several actions: 1) implemented regulations effective in 2010 to require Washington licensed shrimp trawl fishers to participate in the West Coast Groundfish Observer Program; 2) reinstated a fishery logbook program; and 3) sought and received a Species Recovery Grant to implement a state-based observer program. The Washington pink shrimp trawl observer program operated for two fishing seasons and evaluated bycatch of eulachon, rockfish, and flatfish. (Wargo et. al. 2016).

Recently, an ESA required five-year review concluded that despite general improvement in monitored eulachon populations, risks to eulachon recovery remain due to uncertain ocean conditions (Gustafson 2016). Published in September 2017, the Endangered Species Act Recovery Plan for the Southern Distinct Population Segment of Eulachon (Plan) assesses the severity of threats to recovery and ranks the shrimp trawl fishery as "high" while acknowledging the advances to reduce bycatch (NMFS 2017). The Plan also lays out priority actions for implementation in years 1 through 5. Among these is "continue to work with the ocean shrimp trawl fisheries and the states of California, Oregon, and Washington to implement actions, e.g., fleet-wide implementation of light emitting diode fishing lights, rigid grate bycatch reduction devices, and additional gear-type or operational modifications, to further reduce bycatch of eulachon in the ocean shrimp trawl fisheries." WDFW, concurrent with ODFW, anticipates effecting permanent rules mandating the use of LED's prior to the 2018 fishery season. Future actions will be considered as new information from research or observer data evaluations becomes available.

Emerging Technologies

Commercial fishers, fishery managers, and fishing gear designers continue to look for improvements and new technologies to further reduce as much the bycatch of finfish. The most encouraging of these technologies is the use of LED fishing lights. Research conducted by Oregon fishery managers in collaboration with members of the pink shrimp trawl industry in 2014 found dramatic reductions in bycatch of eulachon smelt after the relatively simple attachment of a series of LEDs to the fishing line of a pink shrimp trawl net. (Hannah et al. 2015). Because of the effectiveness of this technology commercial fishers in both Oregon and Washington were quick to adopt it into their fishing operations.

Additional research conducted by ODFW in the summer of 2017 aimed at refining the use of LEDs with attention on color of light, number of lighting devices, and configuration will inform effective rule development. Both ODFW and WDFW fishery managers intend to propose complementary rules to be adopted by each agency's fish and wildlife commissions for implementation before the start of the 2018 season. These rules will require the use of LED lights in 100% of shrimp trawls - meeting Recovery Action 5.4 in the Recovery Plan for the Southern Distinct Population Segment (SDPS) of eulachon (NMFS, September 2017).

List of Figures

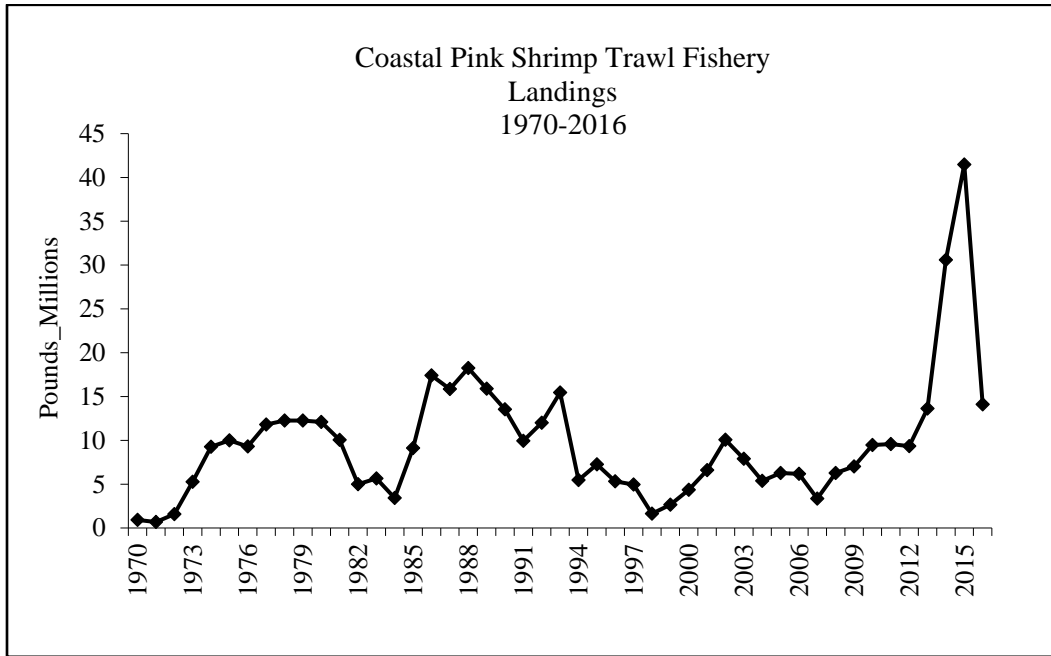


Figure 1. Washington pink shrimp landings in millions of pounds, 1970-2016.

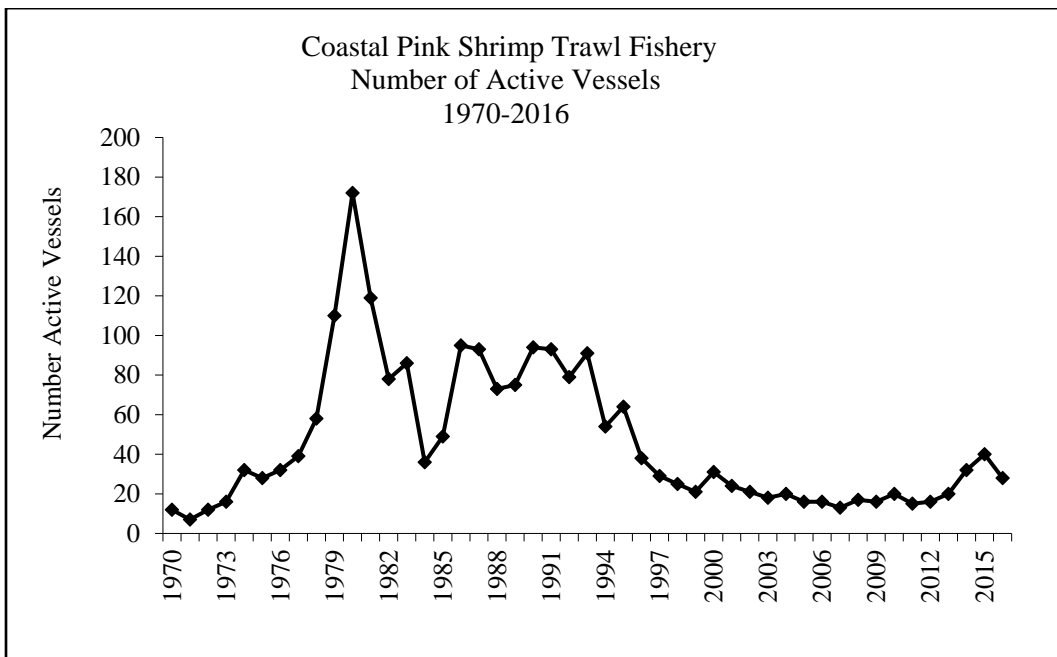


Figure 2. Number of active pink shrimp vessels, 1970-2016.

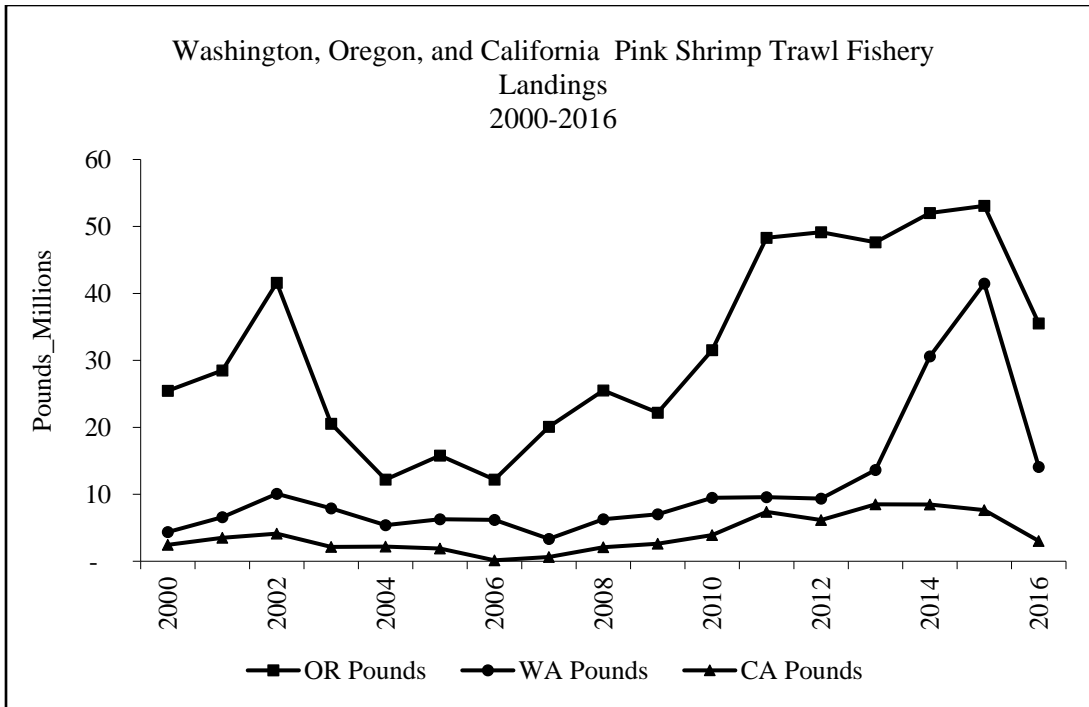


Figure 3. Pink Shrimp Trawl Fishery Landings, Washington, Oregon and California, 2000-2016.

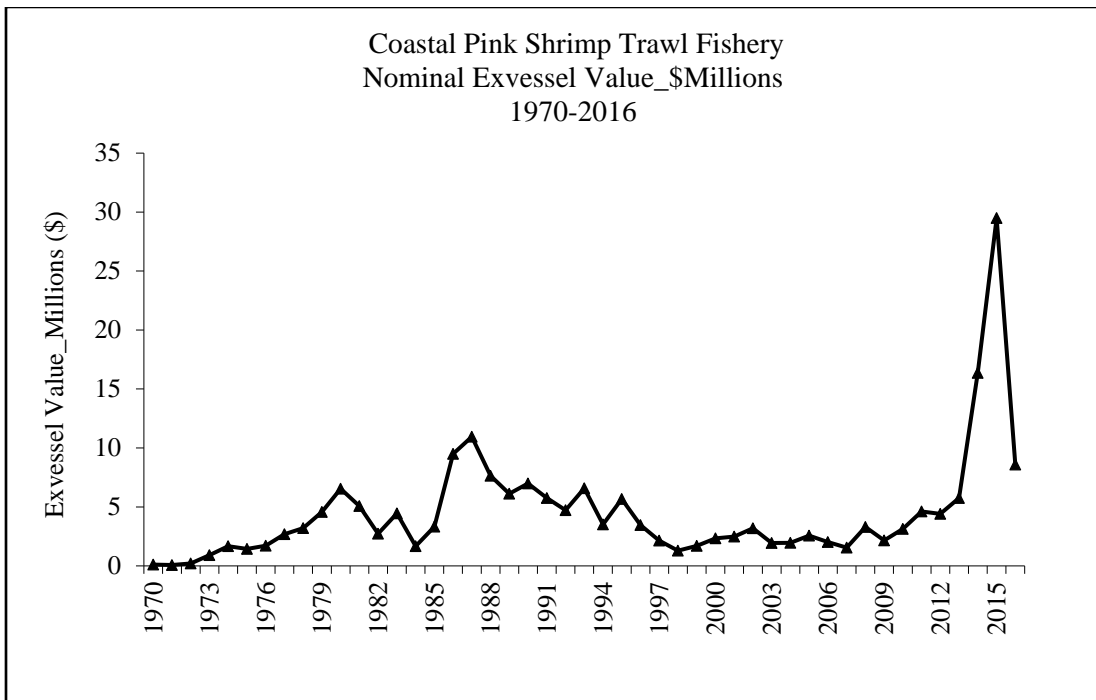


Figure 4. Exvessel pink shrimp fishery value in millions of dollars, 1970-2016.

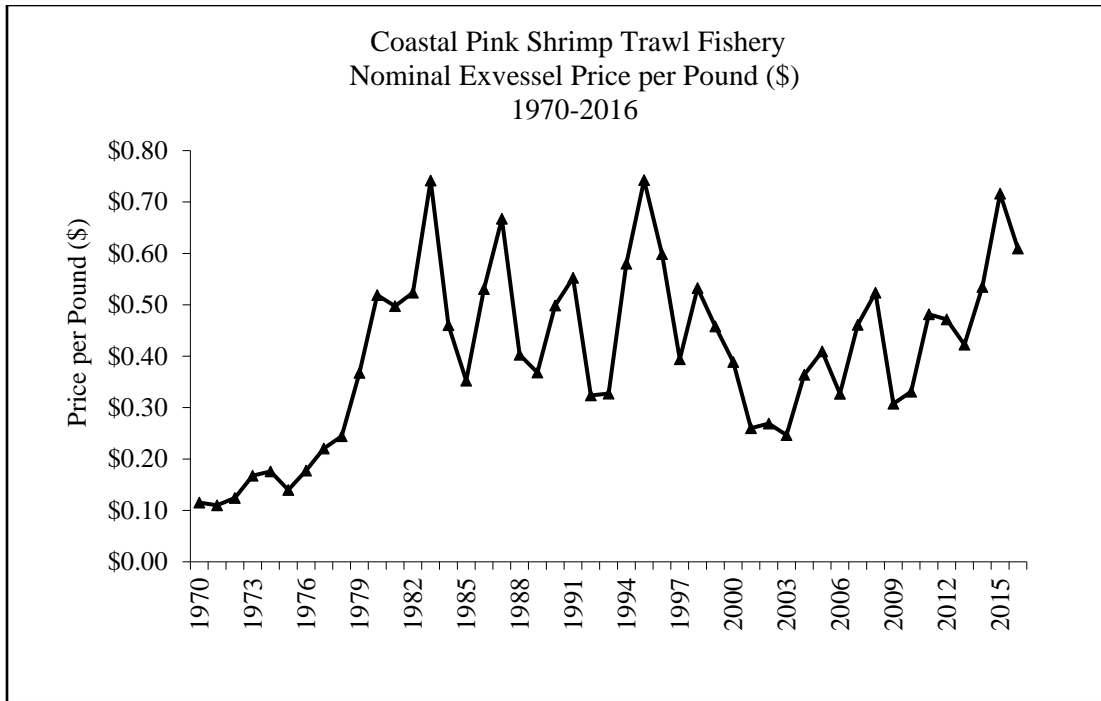


Figure 5. Exvessel pink shrimp nominal price per pound, 1970-2016.

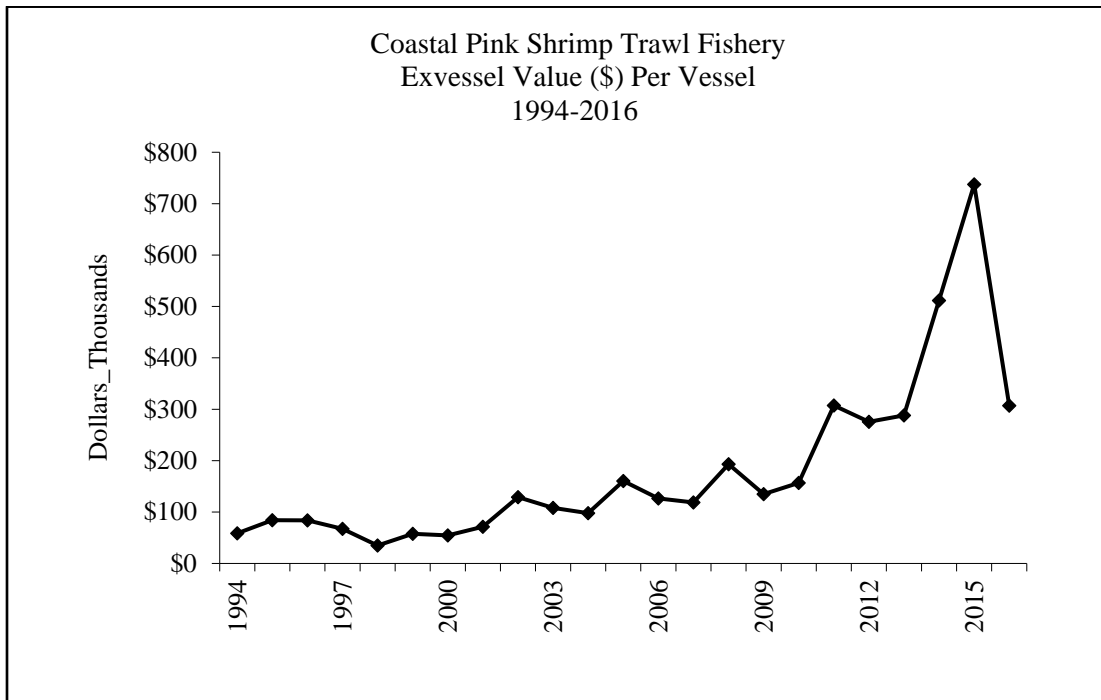


Figure 6. Pink shrimp exvessel value per vessel, 1994-2016.

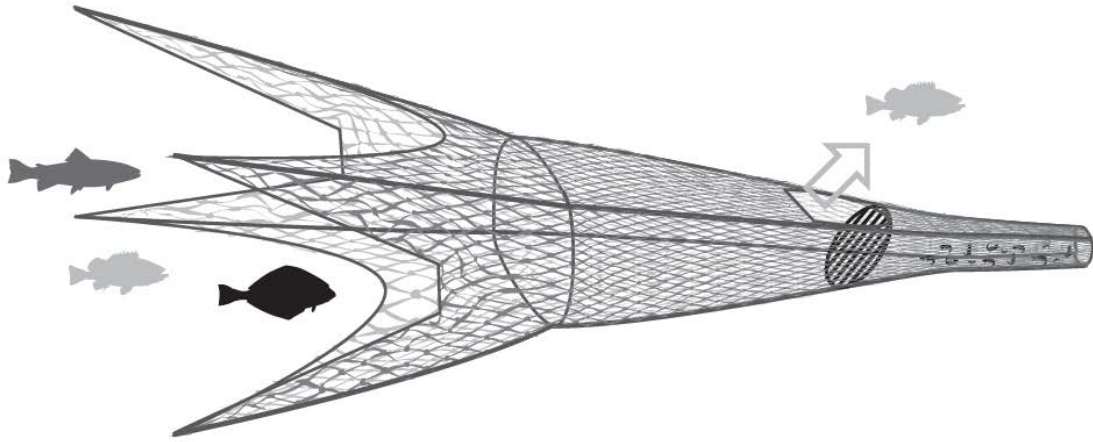


Figure 7. Stylized schematic of pink shrimp fishing net with bycatch reduction device (BRD) and escape hole, showing how fish enter net and can escape prior to entering the cod end (Doyle and Hildenbrand 2013).

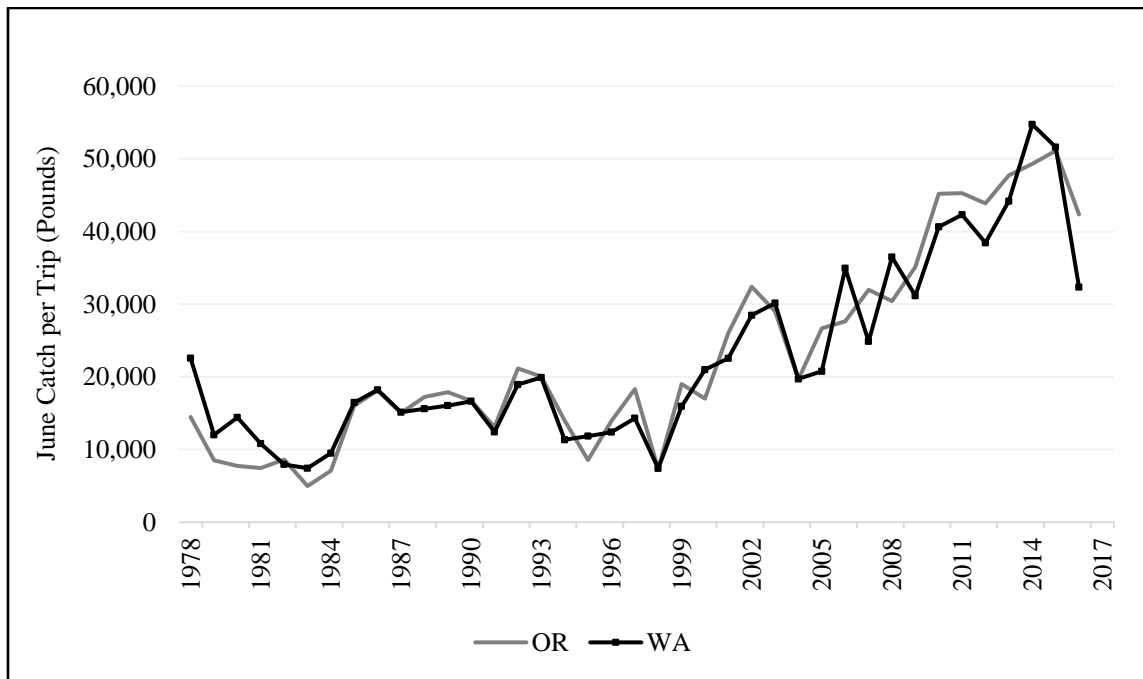


Figure 8. Washington and Oregon pink shrimp catch (lbs.) per trip for June, 1978 – 2016.

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Appendix A. Coastal Commercial Pink Shrimp Fishery Regulations and Fishery Permit

WAC 220-340-500

Ocean pink shrimp trawl fishery—Coastal waters.

It is unlawful to fish for, possess or deliver ocean pink shrimp taken for commercial purposes from the waters of the Exclusive Economic Zone, except as provided for in this section:

Area

(1) It is unlawful to fish for ocean pink shrimp within the territorial boundaries of the state. A violation of this subsection is punishable under RCW 77.15.550, Violation of commercial fishing area or time—Penalty.

Season

(2) It is unlawful to fish for, take, or possess on board a fishing vessel, pink shrimp, except during the following time: The open season for trawl gear is April 1 through October 31 of each year. A violation of this subsection is punishable under RCW 77.15.550, Violation of commercial fishing area or time—Penalty.

Gear

(3) It is unlawful to fish with trawl gear for pink shrimp for commercial purposes unless an approved by-catch reduction device is used in each net. A by-catch reduction device, also known as a finfish excluder, uses a rigid panel or grate of narrowly spaced bars to guide fish out of an escape hole forward of the panel, generally in the top of the net. An approved by-catch reduction device must meet the following criteria:

(a) The exterior circumference of the rigid panel must fit completely within the interior circumference of the trawl net;

(b) None of the openings between the bars in the rigid panel may exceed 0.75 inches;

(c) The escape hole must, when spread open, expose a hole of at least 100 square inches; and

(d) The escape hole must be forward of the rigid panel and must begin within four meshes of the furthest aft point of attachment of the rigid panel to the net.

(4) It is unlawful to modify by-catch reduction devices in any way that interferes with their ability to allow fish to escape from the trawl, except as provided by special gear permit as described in subsection (5) of this section.

(5) Testing of by-catch reduction devices is allowed by special gear permit only, consistent with the terms and conditions of the permit.

(6) It is unlawful to remove trawl gear from the vessel prior to offloading shrimp without advance notification to WDFW enforcement. To provide advance notification, contact 360-902-2936, and then press zero when the recording begins.

(7) A violation of subsections (3) through (6) of this section is punishable under RCW 77.15.520, Commercial fishing—Unlawful gear or methods—Penalty.

(8) It is unlawful to land or deliver pink shrimp to an original receiver that exceeds the following count per pound restriction: The count per pound must average no more than 160 shrimp per pound for a minimum of two samples, increasing at a rate of one sample per one thousand pounds landed or in possession, up to a maximum requirement of twenty samples. Such samples shall consist of at least one pound each of whole, unbroken shrimp taken at random from throughout the individual load landed or in possession. This landing restriction shall apply only to loads of 3,000 pounds of shrimp or more. A violation of this subsection is punishable under RCW 77.15.550, Violation of commercial fishing area or time—Penalty.

Incidental catch

(9) It is unlawful to take salmon incidental to any shrimp trawl fishery.

(10) It is unlawful to retain any bottomfish species taken incidental to any shrimp trawl fishery, except as provided for in WAC 220-44-050.

(11) It is unlawful to retain any species of shellfish, except that it is permissible to:

(a) Retain up to 50 pounds round weight of other shrimp species taken incidentally in the ocean pink shrimp fishery; and

(b) Retain octopus or squid.

(12) A violation of subsections (9) through (11) of this section is punishable under RCW 77.15.550, Violation of commercial fishing area or time—Penalty.

License

(13) An ocean pink shrimp delivery license is required to operate the gear provided for in this section, and it allows the operator to retain shrimp taken in the waters of the Exclusive Economic Zone.

A violation of this subsection is punishable under RCW 77.15.500, Commercial fishing without a license—Penalty.

Permit

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

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

(16) A violation of subsection (14) or (15) of this section is punishable under RCW 77.15.750.

WAC 220-340-030

Shellfish harvest logs.

(1) It is unlawful for any vessel operator engaged in the commercial harvest of crawfish, sea cucumber, sea urchin, scallop, shrimp other than ocean pink shrimp, or squid to fail to obtain and accurately maintain the appropriate harvest log available from the Washington department of fish and wildlife. It is unlawful for any license holder engaged in commercial sand shrimp fishing or operator of mechanical clam digging device to fail to obtain and accurately maintain the appropriate harvest log available from the Washington department of fish and wildlife.

(2) It is unlawful for any harvest vessel operator or license holder engaged in harvest as described in subsection (1) of this section, to fail to maintain the required harvest log: Aboard the vessel; at the harvest site; when crawfish, sea cucumbers, sea urchins, shrimp other than ocean pink shrimp, squid, scallops, clams, or sand shrimp are aboard during transit of a harvest vessel; or are in possession of the license holder.

(3) It is unlawful for the vessel operator or license holder, engaged in harvest as described in subsection (1) of this section, to fail to submit harvest logs for inspection upon request by department of fish and wildlife officers or authorized employees.

(4) It is unlawful for any vessel operator or license holder, engaged in harvest as described in subsection (1) of this section, to fail to comply with the following methods of logbook submittal and time frames related to harvest logbook submittal:

(a) Within ten days following any calendar month in which fishing occurred, required completed harvest logs must be received by the department; however, vessel operators or license holders may submit logs directly to authorized department employees.

(b) Vessel operators or license holders responsible for submitting logs to the department, as described in subsection (1) of this section, must maintain a copy of all submitted logs for a period of three years following the harvest activity. Copies of harvest logs, which are required to be maintained, must be available for inspection upon request by department of fish and wildlife officers and authorized employees.

(c) Original harvest logs must be maintained and submitted in ascending consecutive order of log serial number.

(5) It is unlawful for any vessel operator or license holder, engaged in harvest as described in subsection (1) of this section, to fail to send completed harvest logs to the appropriate following mailing address, except as provided for in subsection (4)(a) of this section.

For Shrimp Harvest Logbooks:

ATTN: SHRIMP HARVEST MANAGER

Washington Department of Fish and Wildlife
48 Devonshire Road
Montesano, WA 98563

Washington Ocean Shrimp Trawl Fishery Permit – EXAMPLE ONLY



State of Washington
Department of Fish and Wildlife

48 Devonshire Road, Montesano, Washington 98563-9618 (360) 249-4628 FAX (360) 664-0689

WASHINGTON OCEAN SHRIMP TRAWL FISHERY PERMIT

PERMIT NO. 17-575-xxx

This permit is issued under the authority of RCW 77.15.750 by the Washington Department of Fish and Wildlife (Department) to **LICENSE HOLDER**, owner of Ocean Delivery License Number **XXXXXX** to fish for pink shrimp (*Pandalus jordani*) in waters of the Pacific Ocean with shrimp trawl gear using the designated vessel **VESSEL NAME**. The following conditions apply:

1. This permit is non-transferable and must be possessed aboard the vessel at all times the vessel is engaged in the fishery, including sale of catch.
2. 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.
3. Owners and/or operators of commercial shrimp trawl fishing vessels are required to participate in the National Marine Fishery Service West Coast Groundfish Observer Program, to carry and accommodate a Federal fishery observer when asked, and to comply with all Federal rules and regulations pertaining to the observer program (50 CFR 660.314 and 50 CFR 600.746.)
4. At the option of the Department, WDFW personnel must be allowed on board the vessel and given unimpeded access to observe fishing operations and/or collect biological data from the catch.
5. Owners and/or operators of commercial shrimp trawl fishing vessels are required to follow protocols established by the Department for shrimp trawl research and monitoring programs.

6. Owners and/or operators of commercial shrimp trawl fishing vessels must have a valid WDFW Special Gear permit to fish with or test any trawl gear or equipment or fin fish excluding devices that do not meet legal requirements as specified in WAC 220-340-500.
7. Owners and/or operators of commercial shrimp trawl fishing vessels must maintain and submit an accurate, legible logbook provided by WDFW for all pink shrimp trawl fishing that occurs off shore Washington and landed into Washington. Logbooks must be submitted by the 15th day of the month following the fishing activity. Logbooks may be mailed to: WDFW Shrimp Trawl Manager, 48 Devonshire Road, Montesano, WA 98563.
8. Owners and/or operators of commercial shrimp trawl fishing vessels who intend to process shrimp at sea by freezing their catch must notify the department of their intent to do so by calling 360-480-2563, and:
 - a. Prior to each landing of shrimp processed at sea by freezing, WDFW personnel must be notified a minimum of 24 hours in advance by calling 360-480-2563.
 - b. From each landing, a sample of up to 25 pounds of whole shrimp processed at sea by freezing and a sample of up to 25 pounds of fresh shrimp, must be provided upon request to WDFW personnel. The samples must be from the same tow and preferably from the last day of fishing.
9. Fishing without a valid permit or violating conditions of a permit is punishable under RCW 77.15.750 Unlawful use of a department permit — Penalty.
10. This permit expires December 31, 2017.

Ron Warren
Assistant Director
Fish Program

Date

Appendix B. Limited Entry Program

RCW 77.70.230

Ocean pink shrimp—Delivery license—Requirements and criteria—Continuous participation.

A person shall not commercially deliver into any Washington state port ocean pink shrimp caught in offshore waters without an ocean pink shrimp delivery license issued under RCW 77.65.390, or an ocean pink shrimp single delivery license issued under RCW 77.70.260. An ocean pink shrimp delivery license shall be issued to a vessel that:

(1) Landed a total of at least five thousand pounds of ocean pink shrimp in Washington in any single calendar year between January 1, 1983, and December 31, 1992, as documented by a valid shellfish receiving ticket; and

(2) Can show continuous participation in the Washington, Oregon, or California ocean pink shrimp fishery by being eligible to land ocean pink shrimp in either Washington, Oregon, or California each year since the landing made under subsection (1) of this section. Evidence of such eligibility shall be a certified statement from the relevant state licensing agency that the applicant for a Washington ocean pink shrimp delivery license held at least one of the following permits:

(a) For Washington: Possession of a delivery permit or delivery license issued under RCW 77.65.210;

(b) For Oregon: Possession of a vessel permit issued under Oregon Revised Statute 508.880; or

(c) For California: A trawl permit issued under California Fish and Game Code sec. 8842.

RCW 77.70.240

Ocean pink shrimp—Delivery license—Requirements and criteria—Historical participation.

An applicant who can show historical participation under RCW 77.70.230(1) but does not satisfy the continuous participation requirement of RCW 77.70.230(2) shall be issued an ocean pink shrimp delivery license if:

(1) The owner can prove that the owner was in the process on December 31, 1992, of constructing a vessel for the purpose of ocean pink shrimp harvest. For purposes of this section, "construction" means having the keel laid, and "for the purpose of ocean pink shrimp harvest" means the vessel is designed as a trawl vessel. An ocean pink shrimp delivery license issued to a vessel under construction is not renewable after December 31, 1994, unless the vessel lands a total of at least five thousand pounds of ocean pink shrimp into a Washington state port before December 31, 1994; or

(2) The applicant's vessel is a replacement for a vessel that is otherwise eligible for an ocean pink shrimp delivery license.

RCW 77.70.250**Ocean pink shrimp—Delivery license—License transfer—License suspension.**

After December 31, 1994, an ocean pink shrimp delivery license may only be issued to a vessel that held an ocean pink shrimp delivery license in 1994, and each year thereafter. If the license is transferred to another vessel, the license history shall also be transferred to the transferee vessel.

Where the failure to hold the license in any given year was the result of a license suspension, the vessel may qualify if the vessel held an ocean pink shrimp delivery license in the year immediately preceding the year of the license suspension.

Ocean pink shrimp—Single delivery license—Fees.

The owner of an ocean pink shrimp fishing vessel that does not qualify for an ocean pink shrimp delivery license issued under RCW 77.65.390 shall obtain an ocean pink shrimp single delivery license in order to make a landing into a state port of ocean pink shrimp taken in offshore waters. The director shall not issue an ocean pink shrimp single delivery license unless, as determined by the director, a bona fide emergency exists. A maximum of six ocean pink shrimp single delivery licenses may be issued annually to any vessel. The fee for an ocean pink shrimp single delivery license is one hundred dollars. The application fee is one hundred five dollars.

Appendix C. Non-pink shrimp landings.

Non-pink shrimp landings (pounds) in the Washington coastal pink shrimp trawl fishery.

	ROCKFISH	LINGCOD	FLATFISH	GROUNDFISH	FORAGE FISH	CEPHALOPOD	OTHER SHRIMP
1970	1,860	2,100					
1971	15,325	9,132	2,678	127			
1972	21,125	13,905	9,094	1,330			
1973	302,442	4,795	14,046	1,387			
1974	345,648	54,218	16,545	9,110			
1975	447,063	25,618	3,813	2,739			
1976	548,977	8,846	14,968	4,886			
1977	586,761	11,628	11,127	31,479			
1978	943,230	52,420	63,677	54,474		20	
1979	1,622,088	72,334	67,273	61,844		210	
1980	1,655,076	78,883	66,274	18,186		576	
1981	1,287,246	70,086	74,204	35,485		247	
1982	626,291	57,484	86,015	63,307			
1983	1,007,956	145,546	107,764	125,379		145	
1984	417,373	49,348	12,140	9,603		196	
1985	365,279	59,348	45,761	29,590		313	
1986	1,215,396	100,766	129,140	63,988		1,652	
1987	888,787	110,656	138,335	64,659		871	
1988	1,258,732	31,648	40,267	38,268		672	20
1989	1,106,764	29,234	14,634	17,586		95	
1990	780,289	15,657	91,418	40,904		654	
1991	809,685	9,323	52,680	12,454		799	
1992	732,730	7,045	19,725	77,908	62	1,353	
1993	1,349,176	28,796	71,742	282,085		2,213	
1994	536,376	42,634	127,387	73,054	290	1,039	7
1995	412,900	62,375	146,030	73,036		435	
1996	483,335	34,190	81,866	80,742		271	
1997	119,899	6,871	20,866	15,812			
1998	97,912	1,349	17,508	17,061		20	
1999	57,045	5,140	33,510	9,828		133	
2000	85,164	5,168	27,623	24,547		57	
2001	40,340	2,370	4,747	8,455		85	
2002	37,300	3,332	6,148	4,696		898	
2003	200			192			
2004	118	5		2			
2005	45		52				
2006	4	7					
2007							
2008							
2009			40				
2010							
2011			32				
2012							
2013							
2014			8				
2015							
2016							
2017							



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