29th Annual

Oregon Department of Fish and Wildlife · Marine Resources Program

Pink Shrimp Review

2018

What's Inside

Have Questions?

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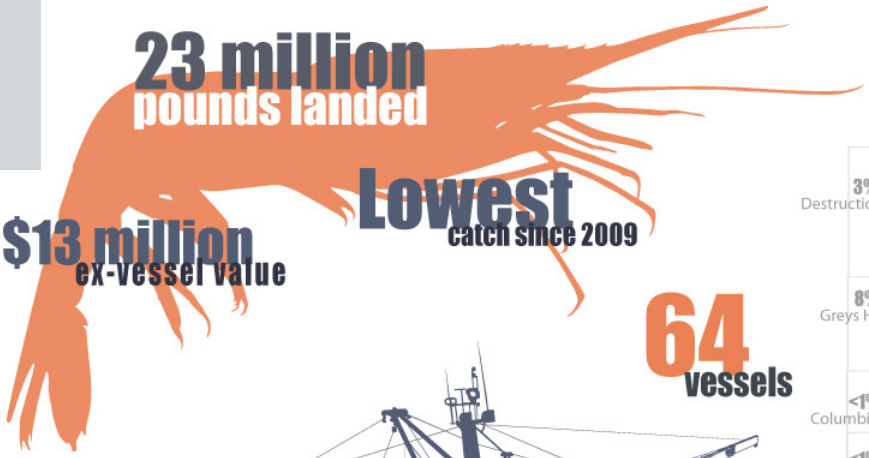
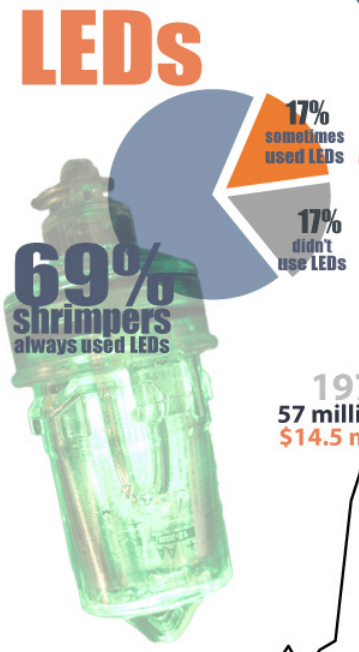
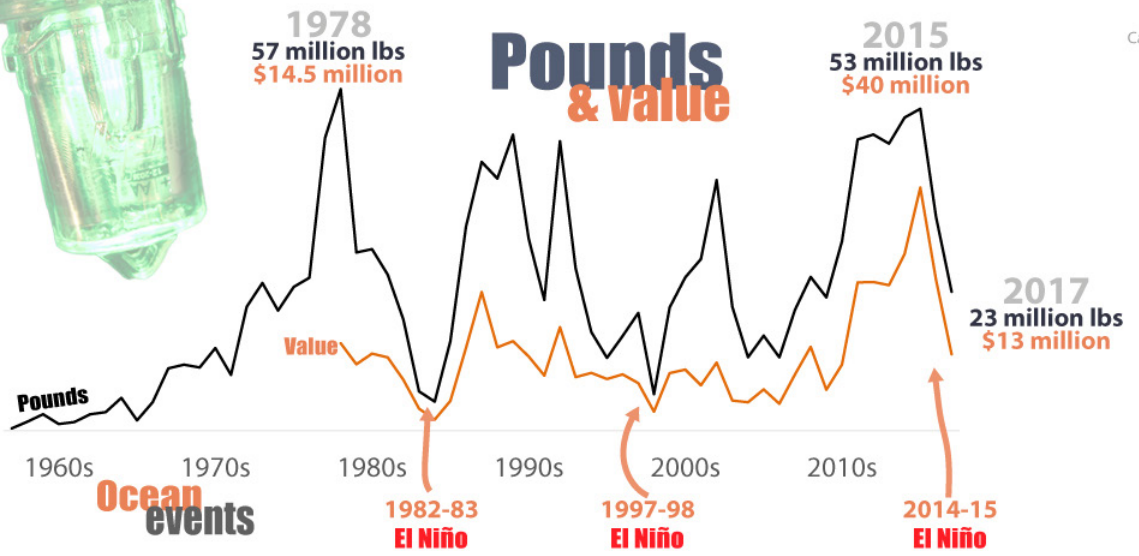
Oregon's 2018 pink shrimp (*Pandalus jordani*) season will open April 1 and extend through October 31. This newsletter provides a summary of the 2017 season, including descriptions of trend in catch, effort, efficiency, and value. Indicators for the 2018 season are described and discussed, along with other key considerations.

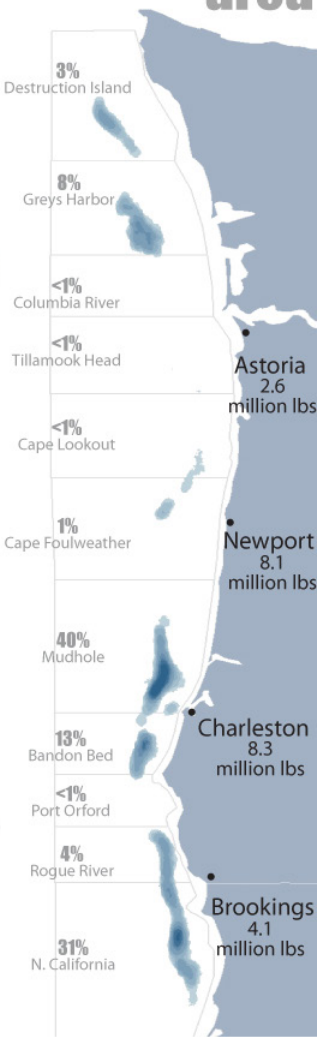
The 2017 pink shrimp season had its ups and downs! In the first month of the 2017 season (April) the industry showed calm and unity in delaying harvest, despite an open season and calm weather to optimize the economic value of harvest. Overall, the season's harvest was characterized by lower catch rates and few shrimp found in the northern portion of catch areas. The 2017 season was valued similarly to the previous 20 year average at 13 million dollars (USD), but certainly lower than the many consecutive booming seasons of the early 2010s.

2017 Season









New for 2018

On January 19, 2018 the Oregon Fish and Wildlife Commission (OFWC) adopted the Pink Shrimp Fishery Management Plan (FMP) and new rules requiring the use of lighting devices (i.e. LEDs) on the footropes of shrimp trawls. Materials for the OFWC exhibit are available here: http://www.dfw.state.or.us/agency/commission/minutes/18/01_Jan/index.asp
Both the adoption of the FMP and the requirement of footrope lighting will be in place for the 2018 season.

Fishery Management Plan

Why do we need a plan?
Adoption of the FMP means that the management objectives are clearly stated and formalized, increasing transparency of management approach.

What does this mean?
A formal FMP is a conventional objective for sustainable fisheries. Building and maintaining an FMP meets Oregon's goals. In addition, an FMP is required for continued MSC certification.

Are there changes?
The FMP raises the sustainability of Oregon's pink shrimp industry. The FMP does not include any "new" rules; however, it does document biological reference points and harvest controls developed and vetted with the fleet in 2014.

Learn more about the FMP:
The full FMP is available at ODFW's pink shrimp "news and publications" site:
http://www.dfw.state.or.us/mrp/shellfish/commercial/shrimp/news_publications.asp

Footrope Lighting (LEDs)

What are the new rules?
Starting in 2018, vessels making shrimp landings into Oregon (or are fishing in Oregon state waters) are required to have lighting devices (i.e. LEDs) on the footrope of each trawl net.
The actual rules are:

Oregon Administrative Rule 635-005-0630;

3) It is unlawful to fish with trawl gear for pink shrimp for commercial purposes unless footrope lighting devices that have been approved by the Department are used in each net. A list of approved footrope lighting devices is available from the Department. Footrope lighting devices must meet the following criteria:

(a) Lighting devices must be operational;

(b) Lighting devices must be securely attached within 6 inches of the forward leading edge of the bottom panel of trawl netting; and

(c) Each trawl net must have a minimum of five lighting devices, spaced 4 feet apart in the central 16 feet of each net.

Regarding "approved footrope lighting devices" we are starting with a list of three devices which have been tested to be effective in bycatch reduction. For 2018, these include:

1) Lindgren-Pittman "LP Electralume light"- Green
2) Catch All Tackle "Deep Drop LED fishing light"- Green
3) Rock-engineering "LED rope light"- Green

In 2017 gear surveys, staff talked to 52 vessel operators who used LEDs, we found that 50 used LP Electralume lights, 1 used Deep Drop LED fishing lights, and 1 used the LED rope light. LP Electralume fishing lights were found to be the most durable and at the best price point.

What do rules do for Oregon?
As a result of the history of cooperative progress between industry and management, Oregon's pink shrimp fishery is regarded as a worldwide leader in sustainability. When the dramatic bycatch reduction of LEDs was discovered in 2014, Oregon shrimpers voluntarily adopted their use. Bycatch rates vary widely by year. However, in most years we expect that the cost of LEDs will be offset by the reduction in bycatch sorting time. It could be that some years have bycatch rates so low that the use of LEDs will simply provide a conservation value which should strongly reduce concerns regarding the effects of bycatch take. In both cases, having each vessel use LEDs will save the fleet money overall, and moving to a requirement reinforces the leadership, sustainability and conservation of Oregon's pink shrimp fishery.

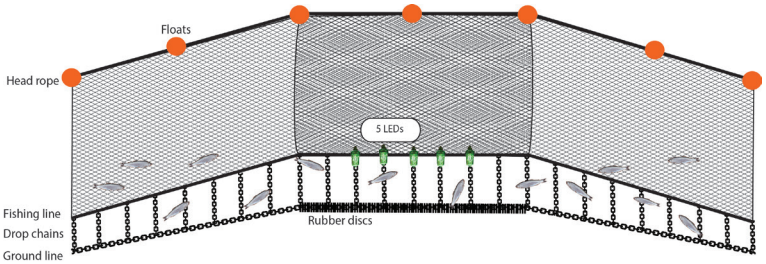
Bycatch of eulachon smelt is dramatically reduced by the use of LEDs.

Are there changes that impact me?
For most shrimpers, we expect little change. While our gear surveys showed a fleet average of 9 LEDs per net, the new requirement is nearly half, at 5 LEDs per net.

This requirement puts Oregon's pink shirmp industry in a good position going forward relative to ESA species take concerns and reduces likelyhood of future bycatch limitations.

Key points to the new LED rule:

1) Operational LEDs **must** be used on every shrimp tow.
2) A minimum arrangement of 5 LEDs, spaced 4 feet apart in the central 16 feet of the fishing line (or bosh line) of each net **must** be used.
3) Beyond this minimum set up, more LEDs may be used.



Light in the center of the footrope "shows the way out" to strong swimming fish.

5 LEDs, spaced 4 feet apart, in the central 16 feet of each net

- *Cost saving bycatch reductions (less sorting)*
- *No change in shrimp catch*
- *Continued leadership in sustainability*

2017 Season Summary

In 2017, Oregon shrimpers were reminded of the variability of the stock. At 23 million pounds, catches were the lowest since 2009. Trips were longer, catch per unit effort (CPUE) and value were both lower. Overall, 2017 was a tough year compared to the recent boom. Persistent warm water conditions, known to reduce shrimp stocks, have been around for a couple years; it seems that those ocean conditions have influenced the pink shirmp fishery.

Landings Data

Here, we summarize landings, effort, efficiency, value, and stock dynamics of pink shrimp from Oregon landings.

To understand fluctuations in fisheries over time, data from landings are useful metrics. For Oregon landings of pink shrimp, we examine the number of pounds harvested, the number of vessels participating, the number of trips and the average landed weight of each year's trips.

A total of 23.1 million pounds of pink shrimp were landed into Oregon in 2017, a further downturn from the recent streak of ~50 million pound seasons (Figure 1). Sixty four vessels participated in the fishery, slightly lower than recent years (Figure 2). Shrimpers made 754 individual trips last year, the lowest since 2010 (Figure 3). At 30,580 pounds, the average landing was also low, compared to recent years landings (Figure 4).

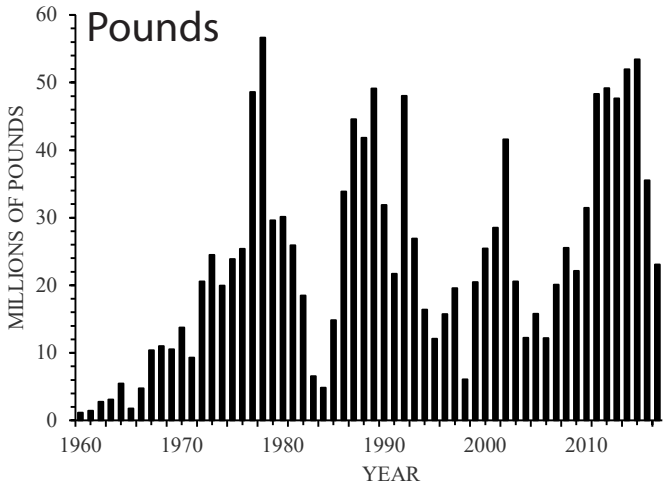


Figure 1. Annual landings (pounds) of pink shrimp into Oregon: 1957-2017

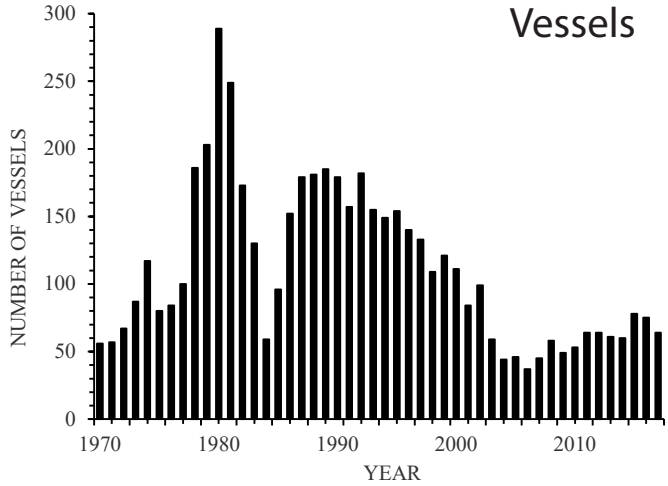


Figure 2. Annual number of vessels landing pink shrimp into Oregon: 1970-2017

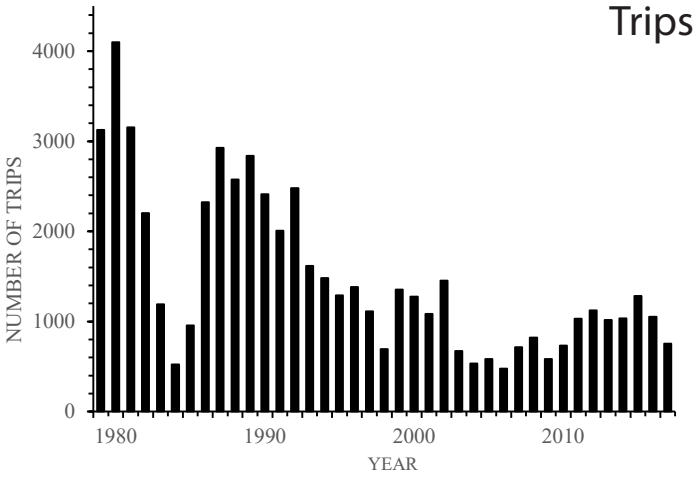


Figure 3. Annual number of trips landing pink shrimp into Oregon: 1979-2017

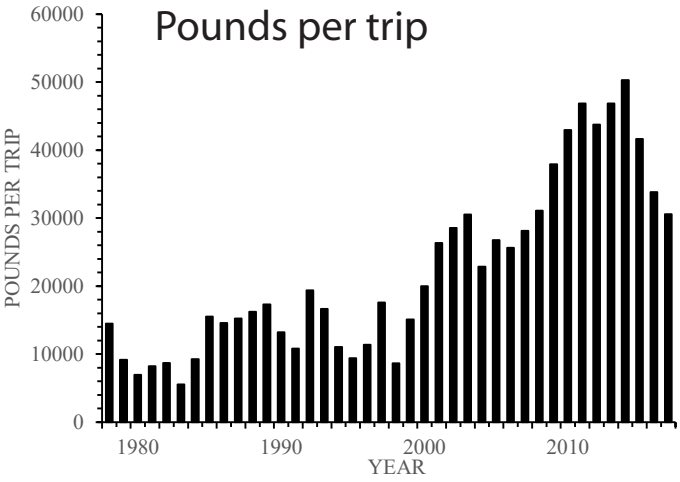


Figure 4. Annual average catch-per-trip (pounds) for pink shrimp vessels landing into Oregon: 1978-2017

2017 Catch Area

A popular section of each year's pink shrimp review has been catch area, describing how much shrimp was caught in each state area each month. Although the 3 dimensional graphs (see Figure 5) are useful in understanding area and month trends, the "heat map" to the right gives a more visual interpretation of these data. The "hotter" the area, the greater the amount of shrimp caught in each area. Something similar would be graphics used in baseball that show where a pitcher throws relative to a strike zone. This heat map can aid in the understanding of: 1) the size of the shrimping area (known to vary based on population); and 2) the hot spots from the previous year.

In 2017, the fleet was primarily focused on southern areas of the stock. Areas in front of Coos Bay and Northern California were the primary producers. Catch in northern areas was unusually low. Shrimp can be hard to find! Some areas which were pretty hot at the end of last year produced little in 2017.

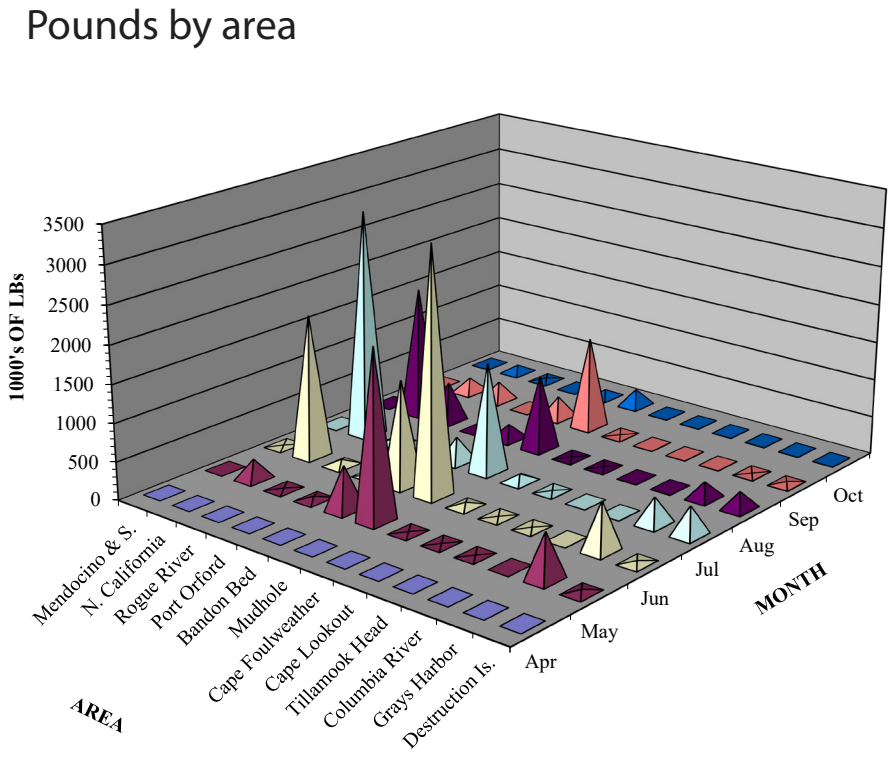


Figure 5. Estimated weight of pink shrimp caught in each area by month that were landed in Oregon during 2017.

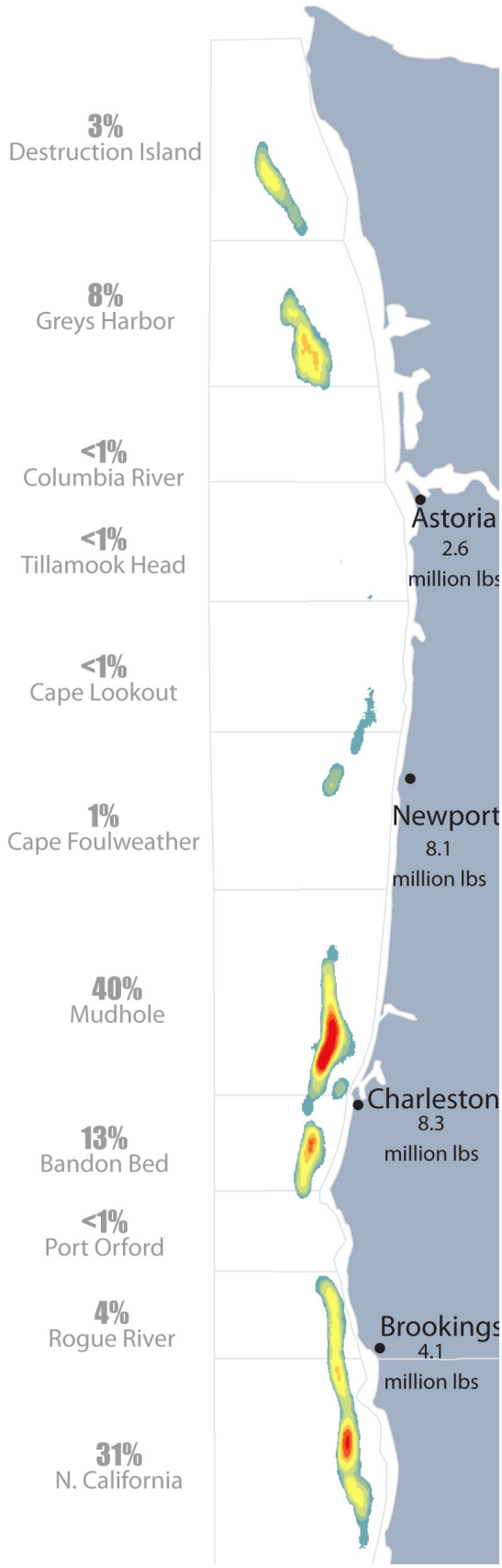


Figure 6. Heat map of pink shrimp catch by state statistical areas for 2017 Oregon deliveries, and amount of pounds delivered to each port.

Effort (hours fished)

Effort in 2017 was similar to recent years, but lower than historic numbers (Figure 7). Hours of effort are displayed in units of Single Rig Equivalent Hours (SREH), meaning that single rig hours are counted 'as is' and double rig hours are multiplied by 1.6 (as double rig is known to be approximately that much more efficient). Effort by area and month mirrored the trend in catch, focusing near Coos Bay and in Northern California (Figure 8).

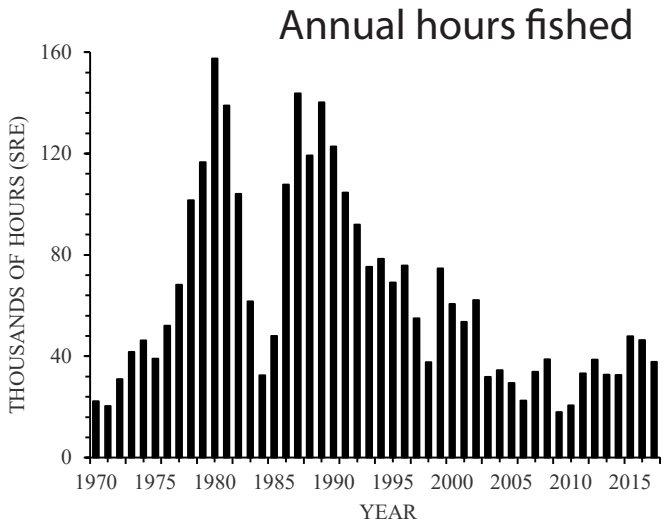


Figure 7. Annual hours (1000s of SRE) spent trawling for pink shrimp that were landed in Oregon, 1968-2017.

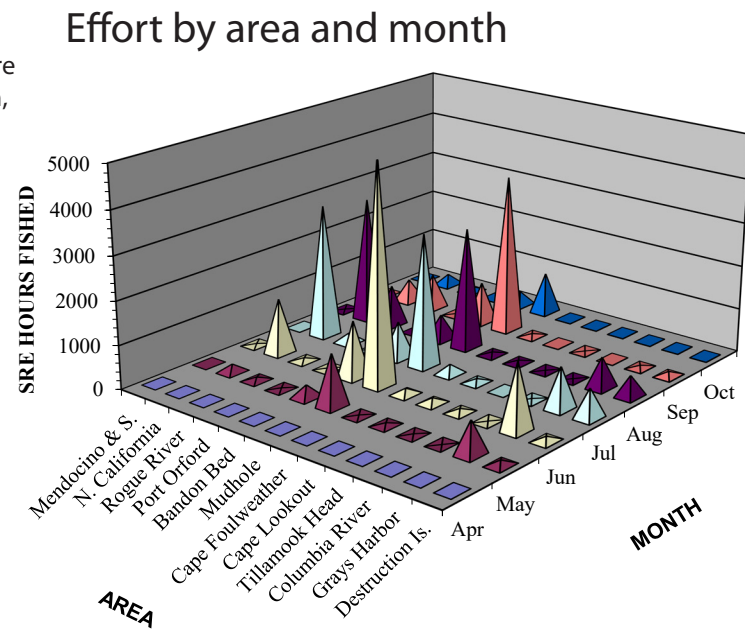


Figure 8. Estimated total hours (SRE) spent trawling for pink shrimp in each area by month during 2017.

Efficiency (CPUE)

Annual efficiency for 2017, expressed in catch per unit effort (CPUE) decreased to numbers similar to those in the early 2000s (Figure 9). CPUE is calculated by dividing the amount of catch by hours (using SREH). Lower CPUE in 2017 indicates overall lower abundances than recent record years of the early 2010s. CPUE tapered off steadily from the beginning of the season (Figure 10).

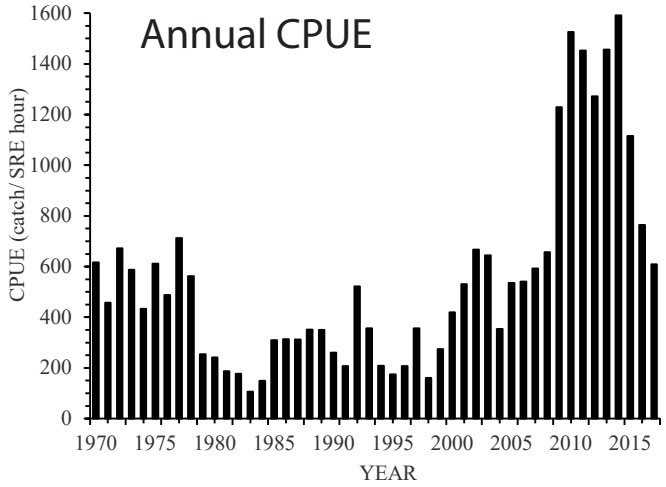


Figure 9. Annual average pounds of pink shrimp caught per hour (SRE) for vessels landing pink shrimp in Oregon; 1968-2017.

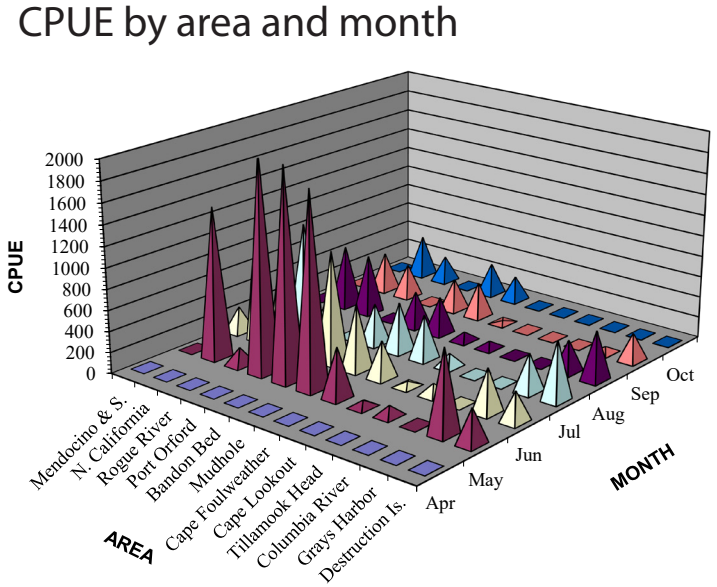


Figure 10. Estimated average pounds of pink shrimp caught per hour (SRE) by area and month for vessels landing pink shrimp in Oregon during 2017.

Value

The value of Oregon's pink shrimp fishery in 2017 was low compared to the recent boom, but at 13 million dollars (ex-vessel value USD), was only 1 million dollars off the previous 20 year average (Figure 11). A continued emphasis on quality product, delivered to markets that demand sustainable fishery products, aided the continued high price per pound of Oregon pink shrimp. Average price for 2017 was 55 cents per pound (Figure 12).

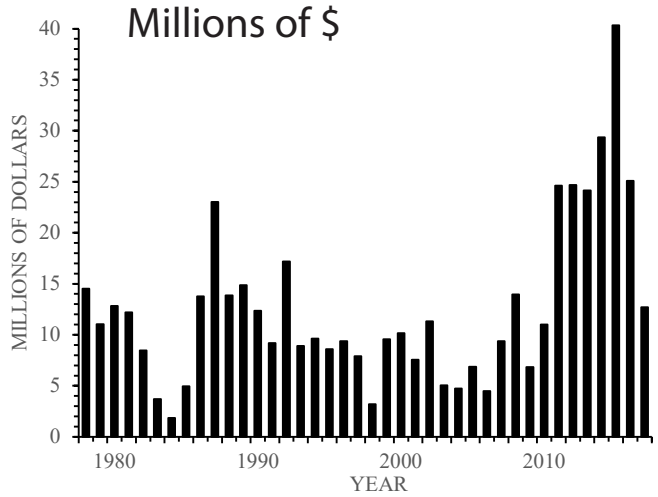


Figure 11. Annual ex-vessel (dollars) of pink shrimp landed into Oregon: 1978 through 2017.

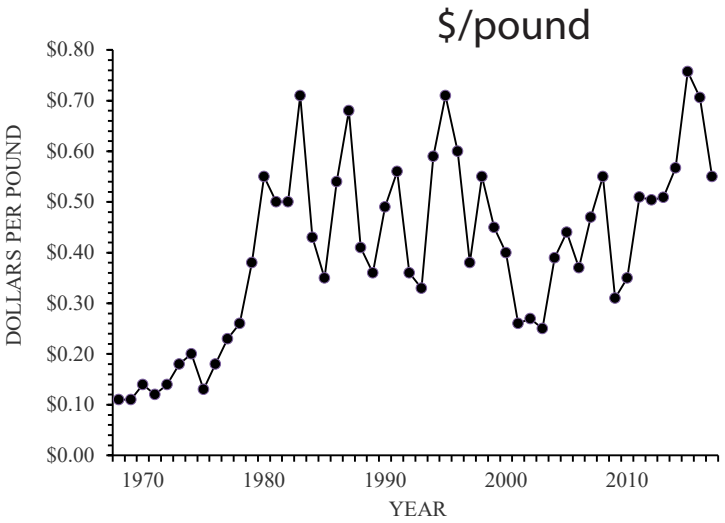


Figure 12. Annual average ex-vessel price-per-pound of pink shrimp into Oregon: 1968-2017.

Age and Size

Using data from biological samples, we assess the age and size composition for shrimp delivered in Oregon by month and area. Pink shrimp live short lives and grow quickly; catch is typically composed of 3 year classes (age 1, 2 and 3).

In 2017, 1 year old shrimp were dominant, many 2 year old shrimp were caught, very few 3 year old shrimp were found (Figure 13).

Given that the 2016 shrimp season ended with good catches of low count shrimp, many expected early 2017 to be heavily comprised of two year olds and low count; instead catches were mixed with age one and two, though counts were lower than last year, averaging 131 shrimp/lb (Figure 14).

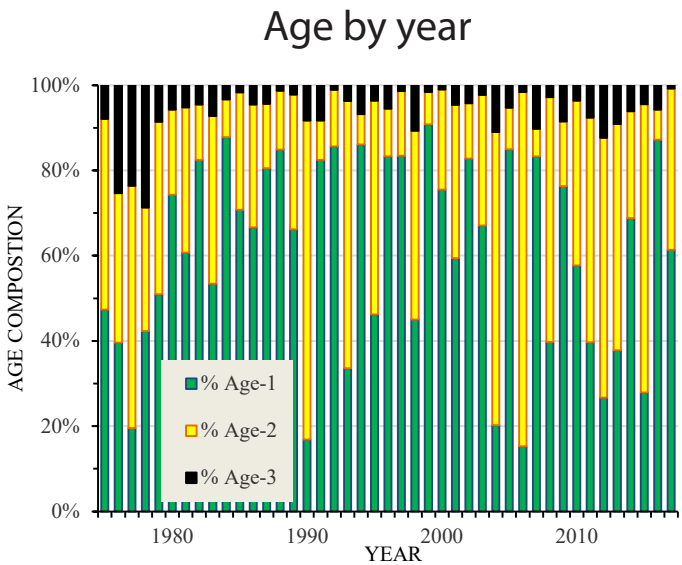


Figure 13. Annual percent age composition of pink shrimp landed into Oregon: 1975-2017.

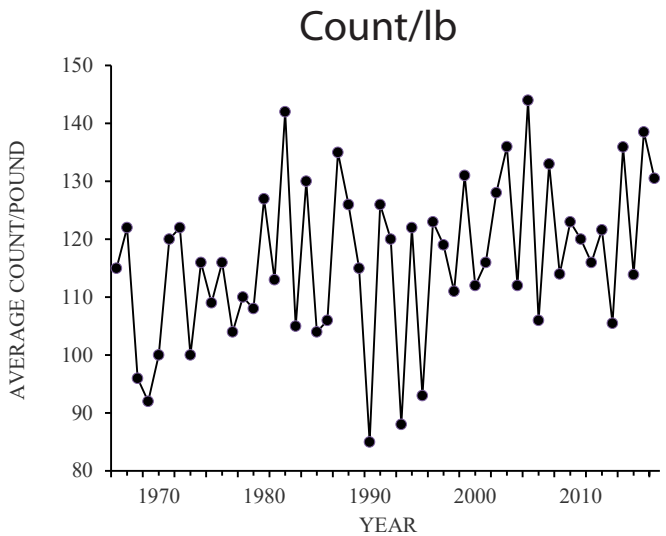


Figure 14. Annual average (catch weighted) count-per-pound (count) of pink shrimp landed into Oregon: 1966-2017.

2018 Indicators

Given the fishery statistics from 2017, we expect the 2018 season to be of moderate volume (in the context of historic average); but, we do expect count issues could arise early on in the season, depending on fishing effort. Age 2 and 3 volumes are not expected to be on par with recent years based on the low catch rates at the end of 2017. If age 1 shrimp become the target of the fishery earlier, count issues could arise. Worth noting, is that count issues could have occurred in 2017; instead, the fleet made responsible actions to always deliver legal loads in Oregon.

To understand what the pink shrimp stock may look like in the next year, two elements must be considered:

1) **Abundance** (how many shrimp) and,

2) **Age/size distribution** (percentage of year class)

Abundance

Pink shrimp abundance is difficult to predict. By comparing long-term shrimp population data to environmental data, we can forecast future shrimp catches. The number of shrimp larvae which survive and recruit to the fishery have been found to be a result of the oceanographic conditions in the year they are born.

Ocean conditions affect survival of pink shrimp larvae. If the upwelling season (period of north winds) is early and strong, larval survival/retention is good, and results in a strong year class. If the upwelling season is late and/or weak, waters are warmer and have less nutrients; the result is a weak year class.

The recruitment model (Figure 15) compares the number of shrimp caught from a given year class. For example, the "2014" year class is composed of:

Age 0's caught in 2014 = 5,392,593 shrimp PLUS,
Age 1's caught in 2015 = 765,176,665 shrimp PLUS,
Age 2's caught in 2016 = 213,262,023 shrimp PLUS,
Age 3's caught in 2017 = 12,634,321shrimp

Total = 996,465,602 shrimp caught from the 2014 year class
This "back calculation" technique allows us to determine the total number of shrimp which recruited in any certain year.

Oceanographic conditions in 2015 were expected to be bad for shrimp; however, the resulting year class was quite good. In contrast, oceanographic conditions for 2016 and 2017 were on par with a moderate expectation.

The "***recruitment index***" is a measure of how many shrimp from any particular year class were in the catch. Each year class is tracked for 4 years, added together, then matched to the corresponding "environmental variable" from the year of larval release.

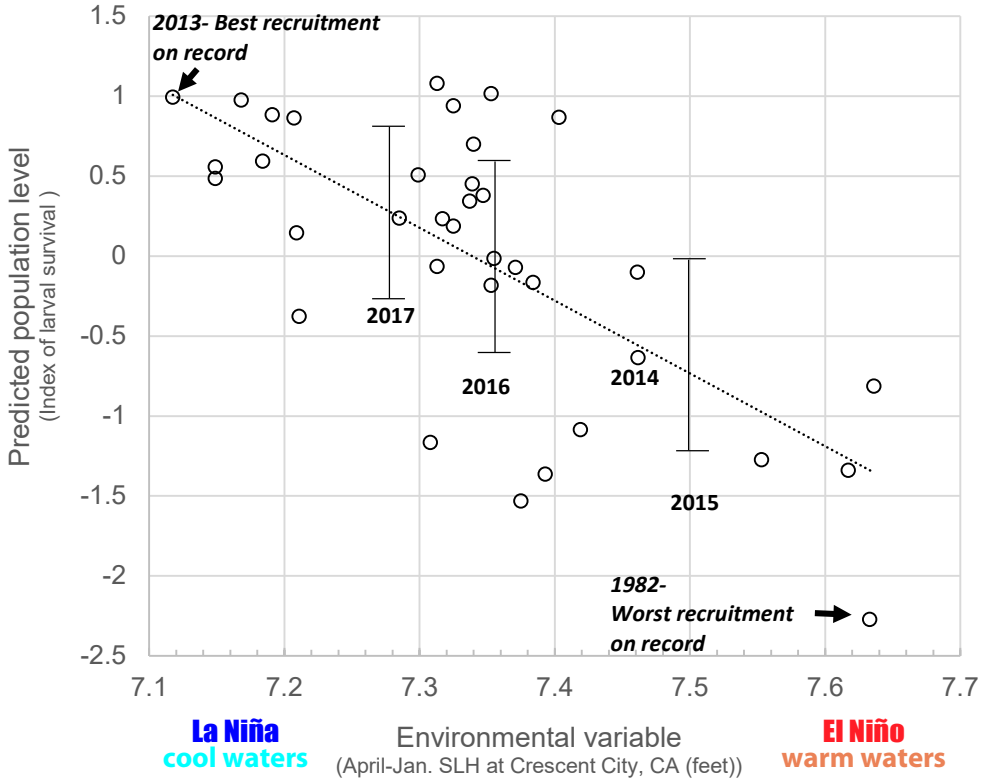


Figure 15. Pink shrimp recruitment model.

Each dot on this graph represents a year (dating back to 1979).

Vertical lines labeled with year represent the range of recruitment expected, given the environmental conditions in the year they are released as larvae.

The "***environmental variable***" used is sea level height (SLH) from April to January in Crescent City, CA. Why sea level height? Sea level height varies based on wind direction and intensity (which also determine upwelling strength); upwelling strength and timing is highly correlated to the survival of newly hatched shrimp.

Age/size Distribution

Crustaceans lack hard structures for ageing, such as ear bones (otoliths) used in fish ageing; thus other means must be used to determine their age. Pink shrimp simultaneously release eggs, grow quickly, and live short lives. These three attributes allow for age assignment using statistical (multimodal distribution) analysis. In this way, ages of shrimp are determined by bulk measurement of their size over time. Size measurements, carapace lengths (CL), are taken, aggregated, then compared to other time periods to determine age and growth. As pink shrimp stocks are of mixed ages, they must be separated using statistical analysis and a biological understanding.

Measurements of shrimp size are aggregated by time and area, then analyzed to understand population trends. Each graph tells a story; in the example to the right (Figure 16), there are many age 1 shrimp, then a few age 2 and 3. While a single graph is like a picture, comparing changes in these graphs over time gives a bit of a moving picture. The horizontal (X) axis of these graphs indicates the size of the shrimp (larger as you move to the right); the vertical (Y) axis shows the relative amount of each size group (not total abundance). The "lumps" of these graphs are caused by the central tendency of each age group; thus changes to relative amount of ages can be tracked along multiple graphs. Arrows track year classes and indicate rate of growth as they move to the right. These graphs look a little complex at first, but once understood, it becomes easy to visualize (Figure 17 and 18).

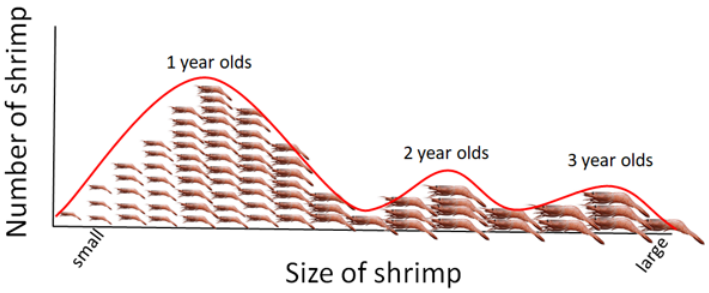


Figure 16. Hypothetical multimodal size distribution of shrimp

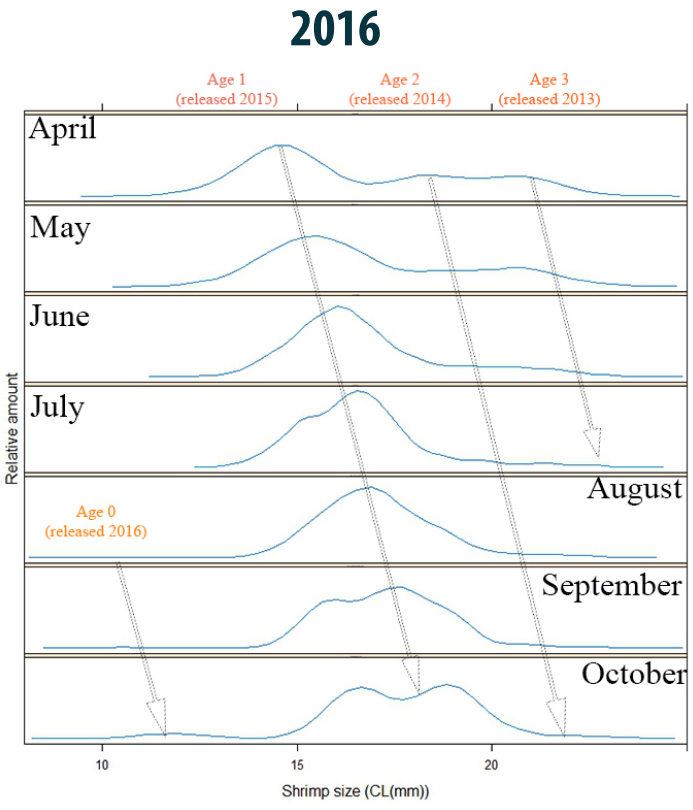


Figure 17. 2016 Oregon pink shrimp size distributions by month. Notes: Age 0 shrimp are first detected in samples in August (given their small size, any detection of age 0 shrimp is a good sign); age 1 shrimp were a huge part of 2016 catch, not surprising given the high proportion of age 0 in October 2015; age 2 shrimp were a small part, given the weak recruitment of 2014; typically, few shrimp live until age 3: given the big recruitment of 2013, there were still a fair amount in the first months of the 2016 season, easing count per pound issues.

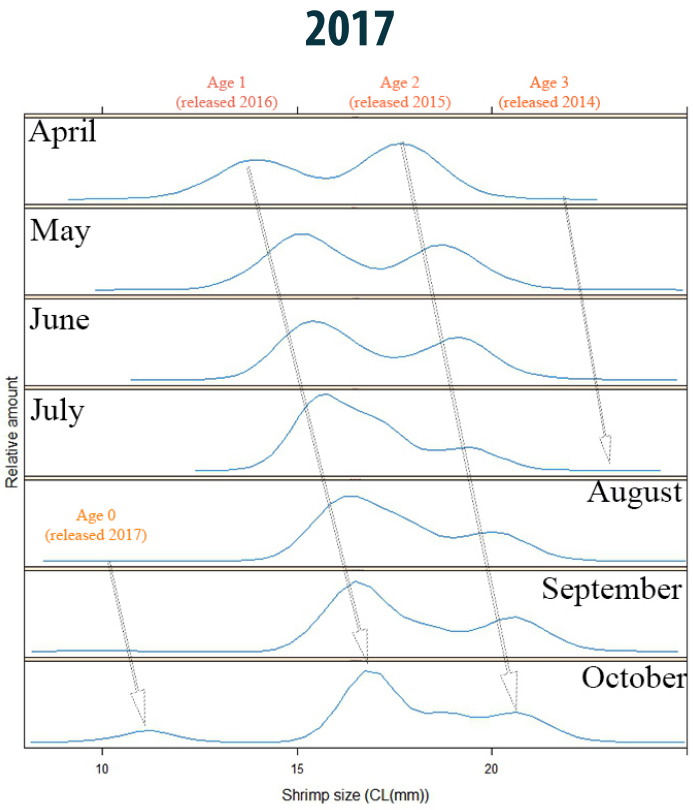


Figure 18. 2017 Oregon pink shrimp size distributions by month. Notes: Age 0 shrimp (released as eggs only a few months prior) were detected first in samples in August, age 1 shrimp began as the minority of the catch but became the primary catch by fall. Age 2 shrimp catch started strong as expected, but tapered off quickly. Few age 3 shrimp were found.

2018 Forecast

In 2018, pink shrimp stocks will be comprised of 3 year classes; these were released as larvae from 2015 to 2017. Prediction from the recruitment model (Figure 15) showed that conditions for larval survival in 2015 were expected to be very weak, instead, it has been strong. 2016 and 2017 year classes are expected to be moderate and so far both have lived up to expectation (Table 1).

That said, the 2017 season did not end strong, so consider these are simply mathematical projections with variance.

Table 1. Review of current pink shrimp year classes, based on prediction and observation.

Larval release year	Age in 2017	Prediction (recruitment model)	Observation (age/size distribution)
2015	3	Weak	Moderate-strong
2016	2	Moderate	Moderate
2017	1	Moderate	Moderate

Regulation info

VMS and declarations required:

The National Marine Fisheries Service (NMFS) permanently requires shrimp vessels to have an approved and operating Vessel Monitoring System (VMS) on-board. For VMS-related information, please consult the NMFS "Compliance Guide for the Pacific Coast Groundfish Fishery Vessel Monitoring Program" at the following website: www.westcoast.fisheries.noaa.gov/fisheries/management/vms.html or call NMFS OLE at 206-526-6133.

Additionally, NMFS requires shrimpers to file a declaration report before the vessel is used to fish in any Rockfish Conservation Area (RCA). Shrimpers need to declare before leaving for their first shrimp trip of the season. Only one declaration is required for the season, providing that the vessel doesn't engage in another fishery during the season. For details about declaration procedures, please visit the NOAA Fisheries Office for Law Enforcement website: www.nmfs.noaa.gov/ole/index.html. Declarations may be made via phone by calling 1-888-585-5518.

NEW FOR 2018- Footrope lighting devices:

On January 19, 2018 Oregon Fish and Wildlife Commission (OFWC) adopted new regulations for footrope lighting devices (see page 2 of this document for details).

Key regulations that apply to **Oregon** pink shrimp deliveries

		Fishing off CA*	Fishing off OR**	Fishing off WA***
Areas	0-3 miles	No fishing	OR permit needed	No fishing
	3-200 miles Key closed areas	Delgada Canyon, Tolo Bank, other closed areas (see CA regs)	Nehalem Banks, Daisy Bank, Stonewall Bank, Heceta Bank, Coquille Banks	Grays Canyon (see WA regs)
Mesh size		Minimum 1-3/8"	No minimum	
BRD		≤ ¾" spaced rigid grate		
LEDs		**5 LEDs in central 16 feet of each net, spaced 4 feet apart (More LEDs may be used)**		
Count per pound		≤160 shrimp/ pound		
VMS/ RCA declaration		Required		
Season		April 1- October 31		
Groundfish by-catch****		Groundfish: 500 lb/day, multiplied by the number of days of the trip, not to exceed 1,500 lb/trip. The following sublimits also apply and are counted toward the overall 500 lb/day and 1,500 lb/trip groundfish limits: lingcod 300 lb/month (minimum 24" size limit); sablefish 2,000 lb/month; canary, thornyheads, and yelloweye rockfish are PROHIBITED. All other groundfish species taken are managed under the overall 500 lb/day and 1,500 lb/trip groundfish limits and do not have species specific limits. The amount of groundfish landed may not exceed the amount of pink shrimp landed.		

*CA Regulation details: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=142654&inline, pages 102-105.
**OR Regulation details: http://www.dfw.state.or.us/OARs/05.pdf, pages 28-32.
***WA Regulation details: http://wdfw.wa.gov/fishing/commercial/shrimp/license_permit_requirements.html
**** NMFS published groundfish limits: http://www.westcoast.fisheries.noaa.gov

Research Priorities

Here, we address three research areas, in priority order: shrimp population dynamics, non-target catch, and ecosystem effects. Note that although we address each priority every year, we don't necessarily have planned activities for all three every year. In interpreting the 2018 plan presented below, it should be noted that regardless of what priority is assigned to any particular research plan component, the completion of work in any given year will always depend on staff and equipment availability and the amount and type of funding available.

First, aside from these three research areas, we updated a website that features an index of all the ODFW involved shrimp work over the years: http://www.dfw.state.or.us/mrp/shellfish/commercial/shrimp/news_publications.asp

Priority 1: Shrimp Population Dynamics

Our documentation and analysis of pink shrimp population dynamics is the highest priority goal of our program. Understanding changes in the shrimp population and comparing it to past populations, environmental data and other factors is critical to our ability to detect and address overfishing. Oregon's pink shrimp program has a thorough, long term dataset on our shrimp populations, which is central to our ability to assure that fishing is sustainable.

Accomplished in 2017:
We calculated annual indices on the number of shrimp from each age class at each area. Working with industry, staff collected and entered data from **8,413** shrimp tows, collected **181** biological samples and measured **20,408** shrimp in 2017. These data, and resulting calculations are required to understand environmental and fishing effects to the stock.

We located and entered individual length to weight data and obtained similar samples for the purposes of understanding changes in length/weight relationships.

We secured and organized more than 50 years of physical logbooks, sample and research data into dry storage, located outside the tsunami zone.

Planned for 2018:
Our first priority, as always, is to work with industry to obtain and analyze fishery logbooks and biological samples.

We intend to update recruitment models for shrimp, following up on work found in ODFW info reports 2014-05 and 2016-03.

In a research grant successfully obtained through Oregon Sea Grant and led by Oregon State University (OSU) professor George Waldbusser, ODFW staff are partnered to better understand the response of pink shrimp larvae to differing levels of ocean acidification and temperature. Just prior to the 2018 season opening (March 2018), we may be looking to fill a small contract (a day trip) with a shrimp vessel to obtain live, egged shrimp; please contact ODFW if you are interested.

Lastly, as time allows, we will continue to assemble past biological sample data in raw formats and make the information available on ODFW's data clearinghouse: https://nrimp.dfw.state.or.us/DataClearinghouse

Priority 2: Non-target Catch

Given the use of fine mesh netting in this trawl fishery, bycatch is of chief concern. Oregon's fishery has been a worldwide leader in bycatch reduction (see the infographic on page 11) often with bycatch rates lower than 2%!

Accomplished in 2017:
ODFW partnered with a Pacific States Marine Fisheries Commission (PSMFC) led Bycatch Reduction Engineering Program (BREP) grant, which aimed to determine the effectiveness of varying levels of light on shrimp footropes to bycatch rates. This work drove the determination of the appropriate number of LEDs to use in regulation.

ODFW, in cooperation with WDFW and CDFW, applied for a Section 6 National Oceanographic and Atmospheric Administration (NOAA) grant to provide LEDs and develop education materials regarding the effective use of LEDs and distribute bycatch identification information.

Planned for 2018:
In another PSMFC led BREP grant, ODFW will partner to answer the question "what is the overall effectiveness of LED use?". Essentially this will mean fishing one side with LEDs and one side with no LEDs with the BRD removed from both sides.

Priority 3: Ecosystem Effects

Research on ecosystem effects is our lowest research priority, simply because our research program is small, and the issue of ecosystem effects of west coast fisheries is large and complex (large spatial scales, effects from multiple fisheries, a generally poor understanding of many species that are not the focus of major fisheries, etc.).

Accomplished in 2017:
In 2017, ODFW began planning to revisit Remote Operated Vehicle (ROV) habitat evaluation in the vicinity of the Nehalem Banks trawl closure area. Since its closure in 2006, ODFW has performed two visual studies (2007 and 2013) of the site and adjacent areas to understand recovery rates of epibenthic fauna. Given the past six year increment, we hope to perform this work again near 2019, depending on funding availability.

Planned for 2018:
We will continue to look for grant money for this project.

Sustainability

MSC News

In April 19-20, 2017, staff met with the MRAG America's (the reviewing contractor) review team to address Marine Stewardship Council (MSC) reassement for Oregon's pink shrimp fishery as it relates to recertification. The review team re-assessed the fishery using the newest MSC criteria and reviewed how the fishery met the core MSC principles.

On February 13, 2018, MRAG Americas assessment team recommended that Oregon's pink shirmp fishery meets the requirements for a well-managed and sustainable fishery. This means Oregon's pink shrimp fishery is MSC certified "sustainable" for the next 5 years. Annual audits track the fishery each year, but the recertification process occurs at 5 year increments. This is the fisheries 2nd recertification; it was first certified in 2007.

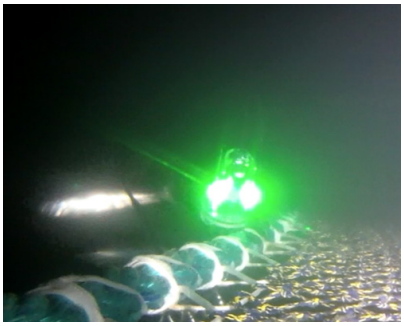
See more on Oregon's pink shrimp MSC status at: https://fisheries.msc.org/en/fisheries/oregon-and-washington-pink-shrimp/

Shrimp Presentations

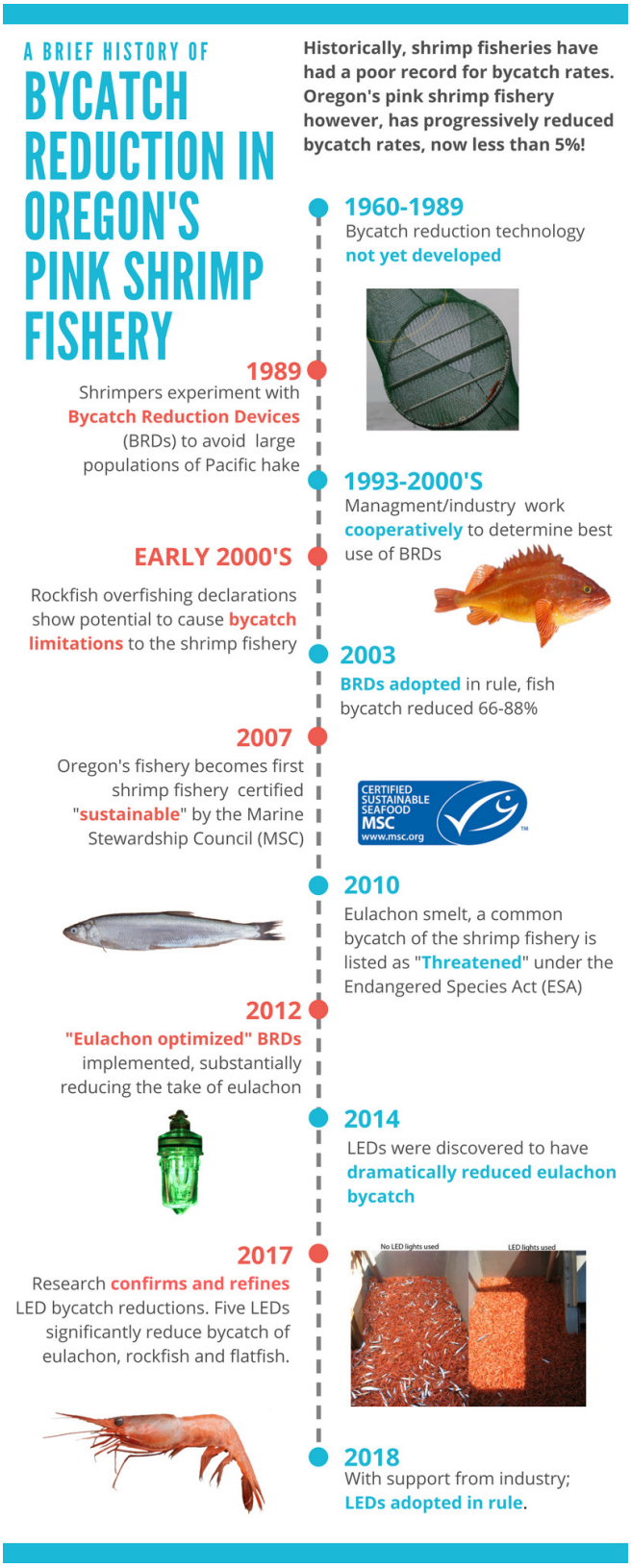
In 2017, staff and industry delivered presentations related to Oregon's pink shrimp fishery. At the International Cold Water Prawn Forum (ICWPF), Oregon Trawl Commission (OTC) commissioner and Owner of the F/V Carter Jon, Nick Edwards, gave an outstanding presentation describing the efficient and sustainable methods employed by Oregon shrimpers.

Nick Edwards presenting on Oregon's shrimp fishery at ICWPF

ODFW staff presented at the ICWPF regarding management of the fishery, which helped organize materials and presentation for Oregon Fish and Wildlife Commission (OFWC) in January 2018. For both staff presentations, we used a great video supplied by Bryson Burns (Captain, F/V Coho) to help illustrate the behavior of eulachon around LEDs. Thanks Bryson!


Eulachon swimming away from a shrimp net
Photo credit: Bryson Burns, F/V Coho.

As a result of these presentation needs, we worked on infographics for the fishery; an example, to the right.



Other Topics

Enforcement News

Fishing inside state waters:
Oregon State Police successfully enforced a case where three vessels were shrimping inside state waters (three miles) without an Oregon pink shrimp permit. As a reminder, when fishing in Oregon state waters, all Oregon pink shrimp regulations must be followed, even if not delivering within Oregon. Worth noting is that no state water areas in California or Washington are currently open to shrimp trawling.

Count per pound issues:
In 2017, markets demanded large shrimp and the age 2 shrimp (those released as larvae in 2015) was unexpectedly strong. Shrimpers worked carefully to deliver big shrimp. As a result, no count per pound issues were encountered in 2017. Oregon State Police made a number of spot checks and always found compliance. 97% of ODFW biological samples counted out lower than 160 shrimp/pound. Nice work!

Low Bycatch Year

Bycatch in 2017 was generally very low. In particular, populations of eulachon smelt were quite reduced from recent years. Like shrimp, eulachon populations are strongly affected by recent environmental conditions.

2017 PSMFC and ODFW research aimed to quantify effects of varying levels of light on eulachon bycatch; however, it was pretty hard to find any eulachon. Many thanks to the fleet and to the NOAA observer program for helping us zero in on some eulachon to test light configurations.

During 2017 gear surveys, we did hear concerns of the need to use LEDs when bycatch rates are low. ***However, it is most important to reduce fishing mortality rates at times when stocks are depressed.*** In this way, one would expect that, fish bycatch is less concerning when fish populations are high than when they are low. It is important to note, that even at these very low bycatch rates, LEDs were clearly effective!

2017 Split shrimp hopper, not much bycatch, but signifcantly less with LEDs

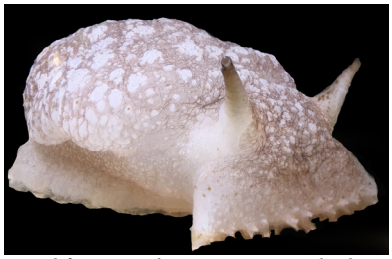
Get Involved!

Getting involved in the management of the pink shrimp fishery is a great way to give back and assure an orderly fishery into the future. Permit review boards exist for each limited entry fishery; typically they review statutes and make recommendations on how they should be applied to specific cases. The workload in the pink shrimp fishery is typically light, but it is important to have the skilled and invested judgement of active permit holders and public at large.

The shrimp/scallop permit review board is made up of 5 members (3 permit holders and 2 at-large members). Currently, all three permit holder positions are open and one at-large member position is open. Terms are two years and may be renewed once. All hearings are via phone. Contact Linda Lytle, ODFW License Services Manager, for details at (503) 947-6112.

California Sea Slugs

With recent warm waters, a giant slug, previously uncommon this far north has been showing up in shrimp hoppers.


California sea slug, more common lately

Pleurobranchaea californica, or the California sea slug is a type of sea slug that is found in deeper water (30-1200 ft.) ranging from southern Oregon to southern California. Unlike their shelled cousins, sea snails, the more than 3,000 species of sea slugs have evolved without an external shell. The California sea slug has adapted by secreting sulfuric acid over the top of its body to protect its exposed gills and reproductive organs. This adaptation is what gives the group their nick-name, side-gilled slugs, named after the large gill structure on the right side of their body (see photo above). Topping out at over 10 inches long, California sea slugs are considered one of the largest of their kind, and are known to be insatiable and opportunistic predators, feeding on other invertebrates, small fish including sole and sanddabs, and even each other. They find their meals on or near the ocean floor, usually in sandy or muddy habitat. Using powerful suction, they slurp their prey into their cylindrical mouth while small teeth work to quickly grind and swallow. California sea slugs use thick mucus and countless tiny "hairs", called cilia, on the bottom of their foot to move around the sea floor. Mounted on the top of their head are two black antennae-like structures, often mistaken as eyes these are instead thought to sense water currents. For animals with relatively simple brains and indiscriminating palettes, California sea slugs have been successfully trained in a laboratory setting to avoid poisonous prey after just one trial (see the video http://jeb.biologists.org/content/216/17/3231.long).

Pyrosomes

In 2014, beach walkers, fishermen, and researchers alike began noticing something strange washing up on beaches and getting tangled in fishing gear: Translucent pink tubes, ranging in length from your finger to your forearm that were gelatinous, but firm, and covered in bumps. These strange creatures were quickly identified as pelagic tunicates known as pyrosomes (*Pyrosoma atlanticum*).

From the Greek words pyro (meaning 'fire'), and soma (meaning 'body'), pyrosomes get their name from their luminescent abilities. At night these animals migrate to the surface of the water, and can be seen glowing a bluish-green color when disturbed. Pyrosomes are colonial tunicates; this means that each pyrosome is actually a collection of individuals called zooids stacked side by side to form a cylinder, closed on one end and open on the other. Each zooid is facing the same direction, with their siphons pointing inward, toward the center of the cylinder. Through the zooids combined pumping of water into the center of the cylinder, the pyrosome is propelled through the water column (Barnes, 1982). In fact, the pyrosome is the only animal known to propel itself by continuous jet propulsion. As it moves, oxygen and phytoplankton are pumped through the zooid, providing the air and food it needs to live. While little is known about their overall impact on plankton and the role it may have in the food web, evidence suggests that pyrosomes are effective at feeding and have fast metabolisms (Perissinotto et al. 2007). This may be bad news for other species that also feed on plankton or have planktonic stages in their life cycle.

A pyrosome coming up the sorting belt

Fish species that feed on pyrosomes, such as Rockfish and Sablefish, may not actually be getting very much nutrition, because pyrosomes are thought to have a very low fat content. Some scientists have described them as "the popcorn of the sea", plentiful but nutritionally inadequate.

While pyrosomes are widespread throughout the world, they are most common in warmer waters. Pyrosomes inhabit waters off Australia, Spain, Africa, the Philippines, and Japan, as well as, South Carolina, Florida, Hawaii, and California. Pyrosomes have been seen by reserachers in Oregon before; however, observations have usually occurred over 100 miles offshore. There isn't a consensus on what brought pyrosomes to Oregon, but one theory is that abnormal ocean conditions, combined with stagnant wind, lead to the ability of offshore water to reach the coastline, bringing pyrosomes with it. Their appearance in the nearshore also coincided with the arrival of the warm water "Blob" that persisted in the eastern Pacific Ocean from late 2013 to late 2016. However, long after "The Blob" disappeared, pyrosomes continued to not only hang around, but thrive. In February and May 2017, researchers with OSU and NOAA were pulling up unprecedented numbers of pyrosomes in each tow. Fishermen along the west coast were encountering them in their nets and on their lines so much so that it has impeded fishing. In Oregon, once upwelling ramped up in June and July, observations of pyrosomes became patchy and they appeared to move off shore and were limited to deeper water (Personal communication, Hilarie Sorensen, University of Oregon).

Pyrosomes clogging a BRD
photo: Corey Rock, F/V Kylie Lynn

The jury is still out on whether or not pyrosomes are here to stay. Considering how many there were and how far north they occurred, it is probably safe to say that we haven't seen the last of the pesky pyrosome. However, the departure of "The Blob" and the return of southerly currents (and upwelling) may send them back to wherever they came from.

References:
Barnes, Robert D. (1982). Invertebrate Zoology. Philadelphia, PA: Holt-Saunders International ISBN 0-03-056747-5.

Perissinotto, R., Mayzaud, P., Nichols, P. D., & Labat, J. P. (2007). Grazing by Pyrosoma atlanticum (Tunicata, Thaliacea) in the south Indian Ocean. Marine Ecology Progress Series, 330, 1-11.

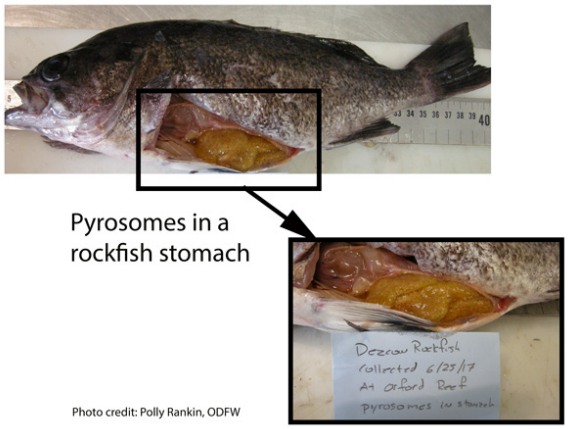
An informative piece on pyrosomes from NOAA:
www.fisheries.noaa.gov/feature-story/researchers-investigate-explosion-number-pyrosomes-alaska

A similar relative:

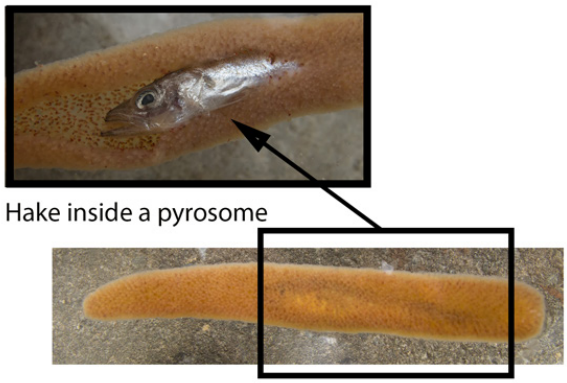
Another suddenly common tunicate, the Pelagic tunicate, *Thetys vagina*, was found in shrimp hoppers. This one looks a little like an alien

Man Bites Dog

One of the greatest aphorisms must be "man bites dog"; it refers to how interesting the outlying condition is compared to the normal one. If a dog bites a man, it is not a news story, it happens often…however, if a man bites a dog, something is weird; now you have a story people are interested in!
To this end, pyrosomes were found in the stomachs of all types of fishes in regular sampling activity during the past few years. For example, the below Deacon rockfish was found with a belly full of pyrosomes by ODFW research biologist Polly Rankin.



Much stranger though, was the find captain Jeff Boardman (F/V Miss Yvonne) made when he found this pyrosome stuffed with a fish. It turned out to be a hake, which must have hit the bullseye when swimming past a pyrosome (pyrosomes don't eat fish, just a wierd chance occurance)… It does speak to the number of hake and pyrosomes in such a large ocean! Thanks for getting this to us Jeff.



2017 Gear Survey

Staff interviewed skippers from 57 of the 64 vessels that delivered shrimp to Oregon in 2017 regarding the dimensions and types of gears they used. Over the years, we've done this a number of times, it helps us compare methods and efficiencies over time. It allows us to hear your concerns and opinions regarding gear. Also, it's nice to spend some time getting ODFW staff educated on what is happening in fishing gear.

In addition, this survey helped new shrimp staff and those with new responsibilities get a better picture of what's going on out there. It was nice to talk gear in 2017, thanks for your time.

"Albino" Shrimp

Each year, there seems to be a few "albino" Dungeness crab brought in and shown off in port.

"Albino" Dungeness crab

Not to be out done, pink shrimp are also found in this unpigmented form. This "albino" pink shrimp was found by an eagle eye among the great unloading crew at the Charleston Hallmark Fisheries dock in 2015.

"Albino" pink shrimp (below) next to a normally colored pink shrimp.

About this Newsletter

This annual newsletter is created primarily for Oregon's pink shrimp industry. We wish to thank the hard-working fishermen, plant staff, vessel owners and other industry members for their continued cooperation and assistance.

In addition, 2017 field work was especially aided by Scott Adams at Hallmark Fisheries Charleston and NOAA's observer program (Ryan Shama and Jason Jannot).

Last, we thank Kelsey Adkisson who facilitated the design of the front page infographic and last year's overall re-design. We also thank Sheila Carlstrom, who provided skilled editing to this and many other shrimp documents in 2017.

Please cite this newsletter as follows:
Groth, S., M. Blume, K. Lawrence, J. Smith, and C. Good. 2018. 29th Annual Pink Shrimp Review. Oregon Department of Fish & Wildlife, Marine Resources Program, Charleston, OR. 15 p.

Who We Are

ODFW's mission is to protect and enhance Oregon's fish and wildlife and their habitats for use and enjoyment by present and future generations.

The pink shrimp fishery project is managed with the following long term objectives:

1. Maximize biomass yield from the ocean shrimp fishery, consistent with detecting and addressing any significant growth or recruitment overfishing that develops, and,

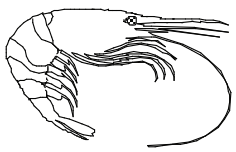
2. Operate the fishery, to the extent possible, under a stable regulatory environment that allows vessel operators maximum flexibility in deciding where, when and how to fish for ocean shrimp, and,

3. Through collaborative research with vessel operators and the sharing of research findings, develop and implement measures to minimize direct bycatch mortality, the unseen mortality of animals that escape capture and any adverse effects on seafloor habitat from the operation of the fishery.

The pink shrimp project is spread out among the major ports of Oregon to:
1. Collect fishery dependent data (biological samples and logbooks)
2. Assist and communicate with shrimpers.

Oregon's pink shrimp project is funded in part by a grant/cooperative agreement from the National Oceanic and Atmospheric Administration (NOAA). The views expressed herein are those of the authors and do not necessarily reflect the views of NOAA or any of its sub-agencies. This project was financed in part with Federal Interjurisdictional Fisheries Act funds (75% federal, 25% state of Oregon funds) through the U.S. National Marine Fisheries Service (grant # NA15NMF4070412).

Good Luck Shrimping in 2018!



Questions?

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