



Marine Resources

33rd Annual

Pink Shrimp Review

2022

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Have Questions?

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Visit Our Website:

www.dfw.state.or.us/MRP/shellfish/commercial/shrimp

This newsletter provides a summary of Oregon's 2021 pink shrimp (*Pandalus jordani*) season including trends in the fishery, its stock, and information relevant to stakeholders. Oregon's pink shrimp fishery is managed sustainably in cooperation with shrimpers, processors, and scientists.

The 2021 pink shrimp season was difficult, industry overcame adversity to have a successful season. Challenges were substantial. Shrimpers, processors and scientists alike overcome a "host" of issues to achieve a safe, valuable, high-volume season. 2021 catch volume was 46.7 million pounds, tenth highest among the fishery's 65 year history. The ex-vessel value of the fishery was high (23.4 million USD). Price per pound was the lowest since 2010 and when adjusted for inflation, one of the lowest of all-time; however, catching was easy.

2021 Season

46.7 million
pounds landed

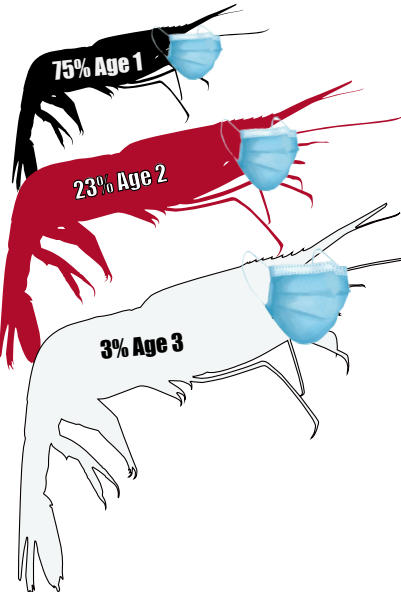
\$23.6 million
ex-vessel value



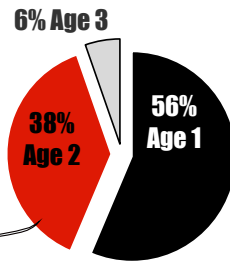
72
vessels

Catch
area

Shrimp age by number



Shrimp age by weight

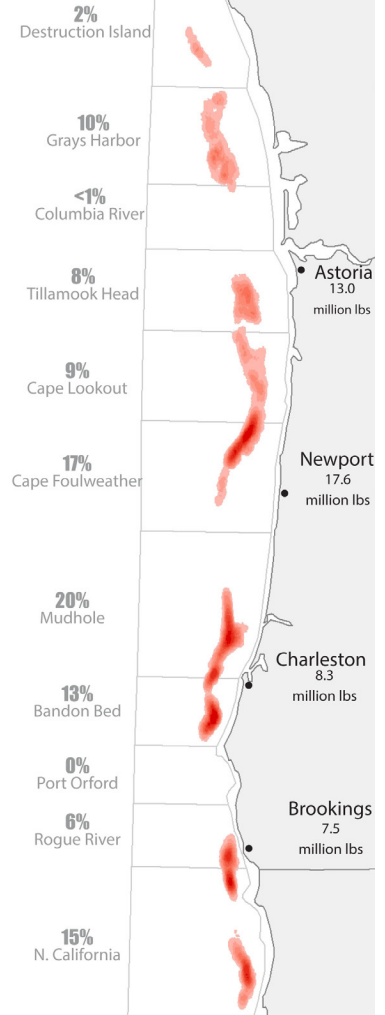


5,714,127,345 shrimp caught

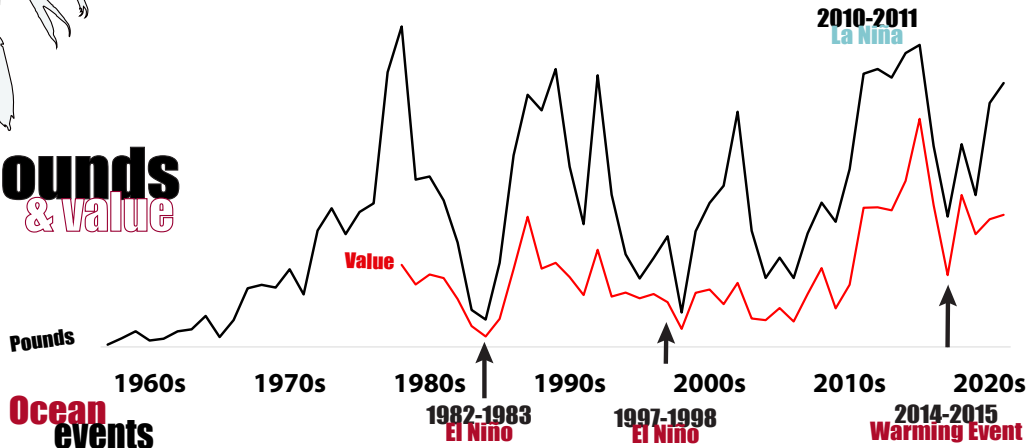
High catch rate
Best since 2014



Low price/lb
Lowest since 2010



Pounds & Value



Ocean events

LED/FLH Fleet Survey

Eulachon smelt (*Thaleichthys pacificus*) are common bycatch to pink shrimp fishing. In 2010, they were listed as “Threatened” under the Endangered Species Act (ESA). Working together, scientists and industry have made great strides in reducing eulachon bycatch. Principal factors in effective bycatch reduction for eulachon are 1) proper use of LED fishing lights and 2) proper use of Bycatch Reduction Devices (BRDs); however, fishing line height (FLH) also affects catch rates of both shrimp and bycatch (Hannah and Jones 2003). Maintaining proper use of these methods assures that the shrimp fleet is minimizing eulachon bycatch.

We surveyed the fleet on their use of these critical bycatch reduction methods. It was a great opportunity to share information.

Results

We asked:

1. How many LEDs do you use?

On average, shrimpers used 7 LEDs per net, 2 more than required by rule. Prior to LED rule adoption the average was closer to 10. In 2019, research showed that 5 LEDs worked better than 10 or 20 (Lomeli, Groth et al. 2019) and a rule was adopted accordingly. The fleet has done a great job adapting to the science and rules to allow maximum bycatch reduction.

By port, shrimpers in Brookings used the most LEDs and Astoria the fewest (Figure A).

2. How are LEDs placed along footrope?

Most shrimpers used the maximum of 4 foot spacing required by rule (for the central portion of the net), however some used wider spacing and more LEDs. Our research has shown that the 5 LEDs at 4 foot spacing in the central portion of the fishing line minimized bycatch, with no benefit from extra LEDs. In addition, we have found that LEDs placed in other areas of the net (headrope, BRD, wings, etc.) may have a negative effect, likely since they attract fish (Hannah, Lomeli et al. 2015).

3. How high is your fishing line off the bottom?

As Fishing Line Height (FLH) is lowered, bycatch increases. Since LEDs allow bycatch escapement under the net, FLH may have an even stronger effect on modern bycatch exclusion rates. The fleet appears to have adjusted to this, recognizing that higher FLHs

mean less sorting of bycatch and more time fishing.

Mean FLH was 20 inches, a good height for minimizing bycatch and not affecting shrimp catch. However, this varies greatly depending on the footrope style (Hannah and Jones 2003). Modifying shrimp nets to catch fewer eulachon and not affect shrimp catch is a high priority goal of scientists and industry. While LEDs are highly effective, modifications of the net’s groundline has a strong effect on eulachon bycatch and is an area where more research is needed (Hannah, Jones et al. 2011). In the meantime, we are interested in feedback on your experiments!

By port, the lowest average FLH was in Astoria, while shrimpers in Brookings used the highest (Figure B)

4. Why do you change the FLH?

Most often people change FLH when bycatch is higher. Many skippers look for signs that the footrope is positioned correctly and adjust droppers accordingly.

5. How many LEDs are working?

While we were collecting this survey data, we also poked around to see how many LEDs were working and to understand how they are operating and the details of working with them. We found 73% of the LEDs in place working, nice job! Maintaining functioning LEDs is required by rule and critical to clean fishing, which allows more time towing and less time picking.

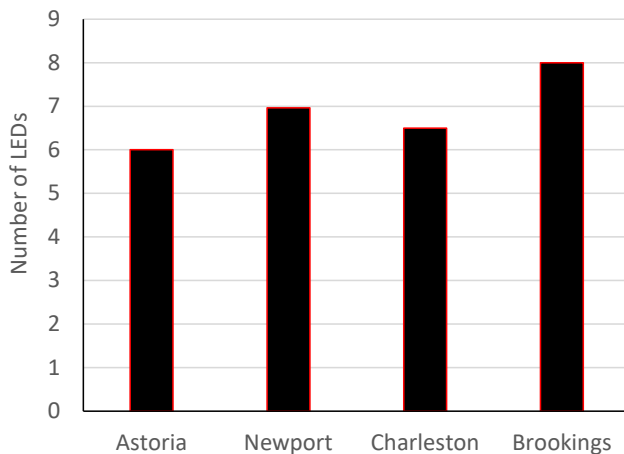


Figure A. Average number of LEDs used by port.

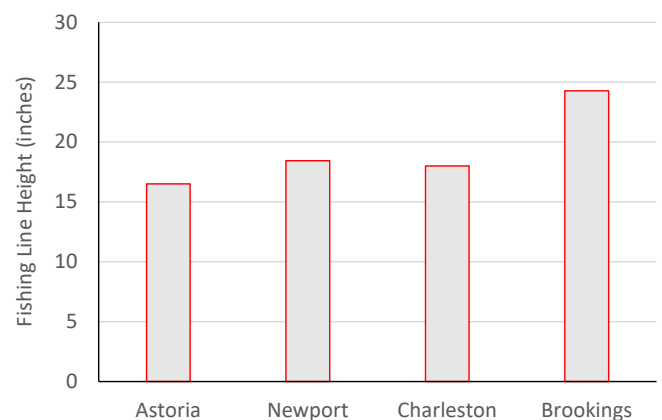


Figure B. Average Fishing Line Height (FLH) by port.

2021 Season Summary

Landings Data

In 2021, total catch of pink shrimp in Oregon was very high (46.7 million pounds), 10th highest among the 65 year history and highest volume since 2015 (Figure 1).

Seventy-two vessels landed shrimp into Oregon in 2021 (Figure 2) and made 988 individual trips (Figure 3). These rates were similar to recent years.

On average, 47,237 pounds were landed per trip, a little higher than previous years (Figure 4). Good recruitment of age one shrimp made catch easy, but finding legal shrimp in the first part of the season was challenging.

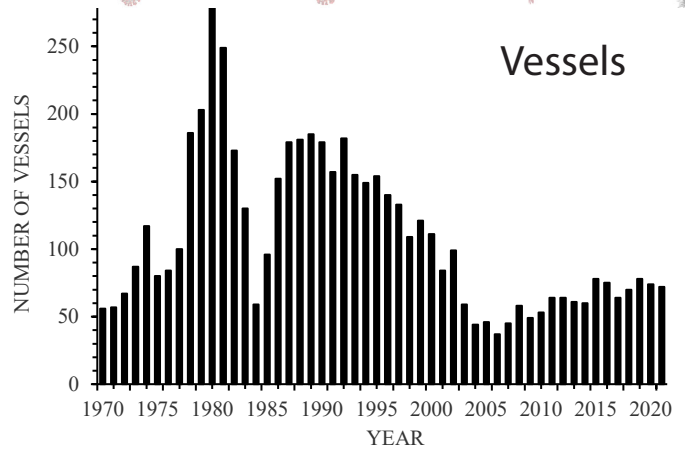


Figure 2. Number of vessels landing pink shrimp into Oregon, by year: 1970-2021.

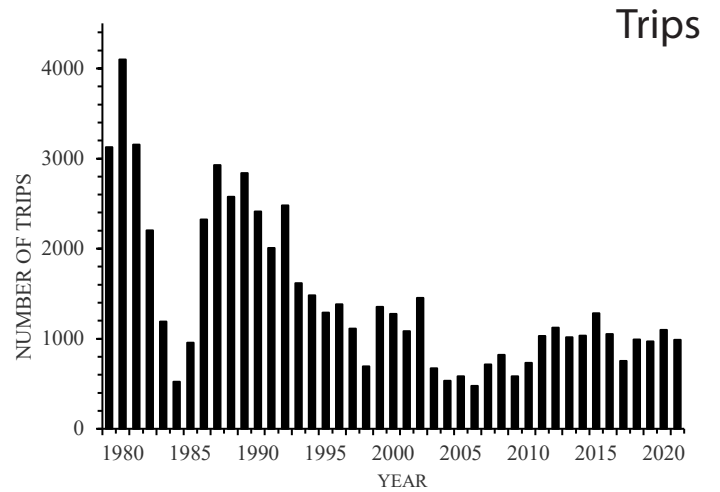


Figure 3. Number of trips landing pink shrimp into Oregon, by year: 1979-2021.

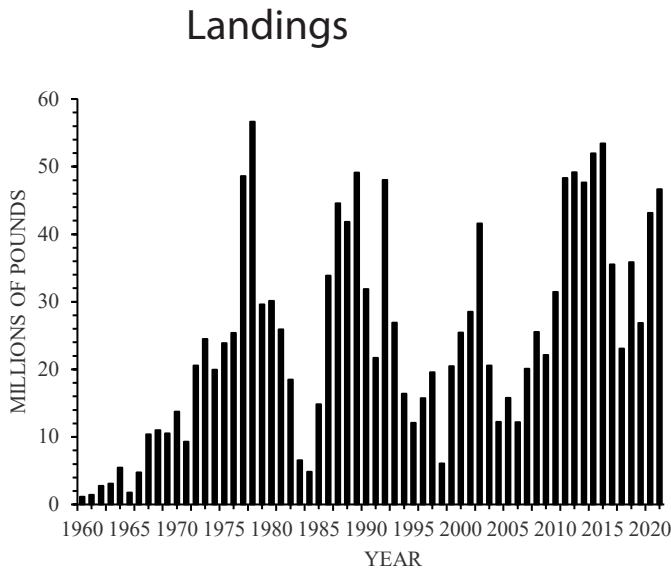


Figure 1. Landings of pink shrimp into Oregon by year: 1957-2021.

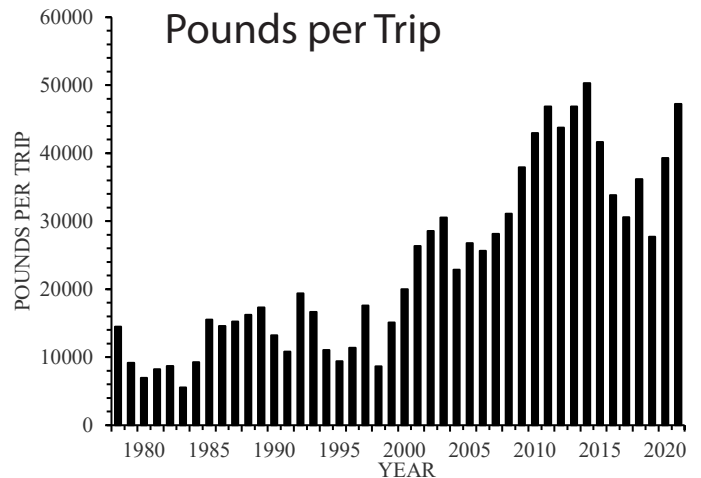


Figure 4. Average catch-per-trip (pounds) for pink shrimp vessels landing into Oregon, by year: 1978-2021.

2021 Catch Area

Catch in 2021 was highest in central and southern areas of Oregon, but very good throughout the region and the season. Catch increased throughout the season due to some less common circumstances (high percentage age one shrimp, market issues, etc.) (Figure 5). Figure 7 shows a heat map of Oregon landed pink shrimp catch along the coast.

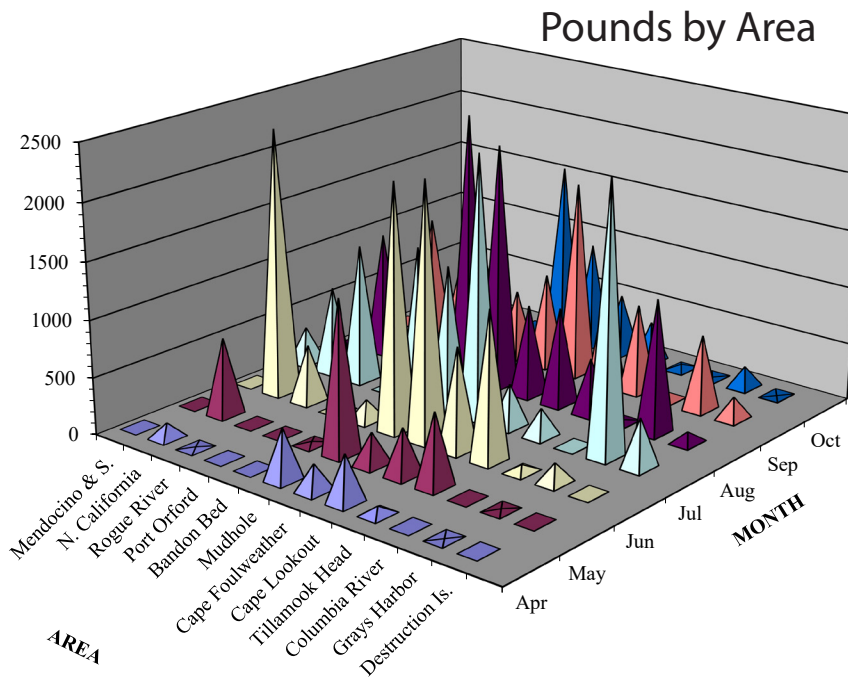


Figure 5. Total pounds of pink shrimp caught in each area and month landed into Oregon, 2021.

Trips were short in 2021! Vessels averaged 21 hours (in double rig equivalent hours) of tows per trip for landings this year, similar to the high efficiency years in the early 2010s (Figure 6). Overall, the amount of time fishing per trip has reduced over time, thanks to some good years and improved fishing technology.

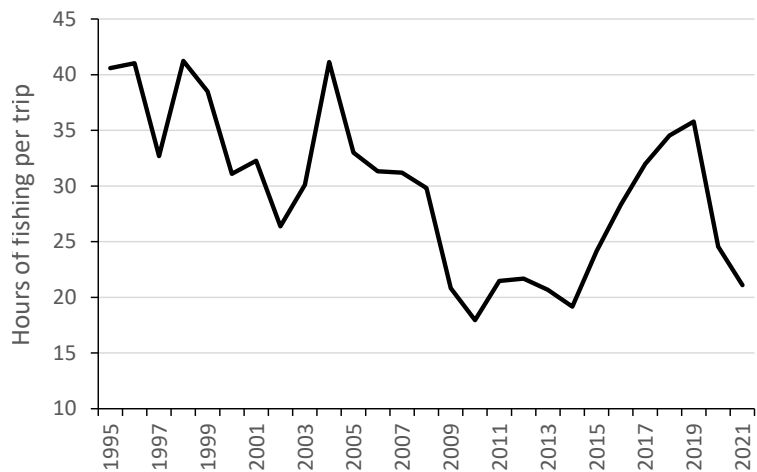


Figure 6. Hours (expressed in Double Rig Equivalent (DRE)) of fishing per trip into Oregon, 1995-2021.

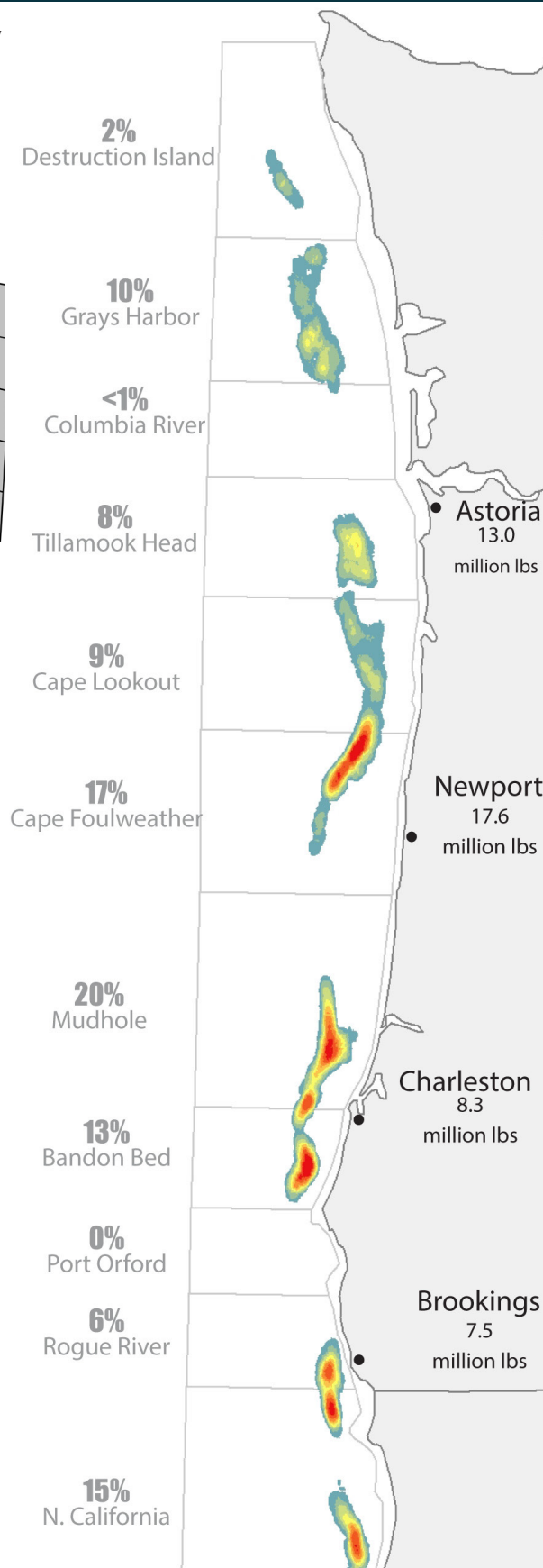


Figure 7. Heat map of pink shrimp catch by state statistical areas for 2021 Oregon landings, and amount of pounds delivered to each port.

Effort (number of hours the fleet fished) continued to be low when compared to historical rates. In 2021, effort was at its lowest level since 2014 (Figure 8).

Due to the amount of small shrimp found in the spring, effort started out low. However, summer was filled with quick successful trips. Compared to recent years, shrimp populations were strong in the central coast, attracting more effort (Figure 9).

Hours of effort are displayed in units of Single Rig Equivalent (SRE) hours, meaning that single rig hours are counted 'as is' and double rig hours are multiplied by 1.6.

Effort by Area and Month

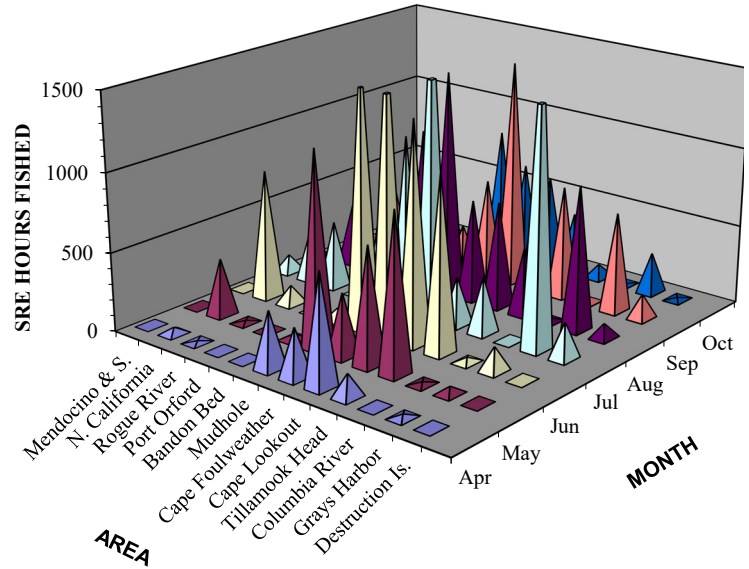
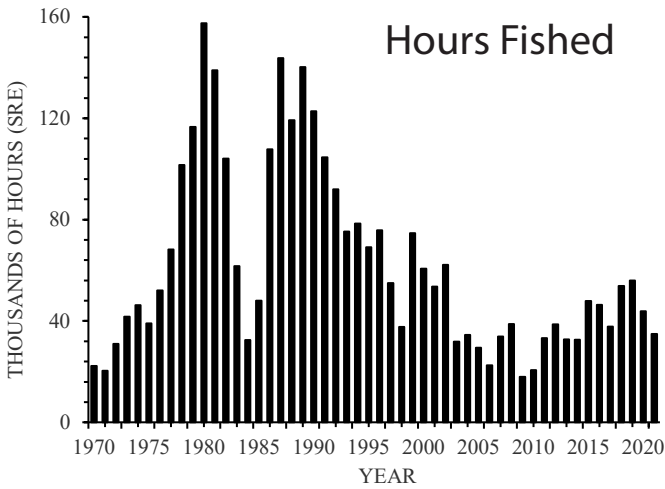


Figure 8. Total hours (SRE) fished for pink shrimp landed into Oregon, by year: 1968-2021.

Figure 9. Total hours (SRE) fished for pink shrimp landed into Oregon, by area and month, 2021.

Efficiency

Efficiency, expressed in Catch Per Unit of Effort (CPUE) was 1,338 lbs of shrimp/ hour SRE (836/hour in double rig terms). This was triple the efficiency of just two years ago and one of the best in history. (Figure 10).

With a strong stock of age one and two shrimp, CPUE peaked mid-summer after age one shrimp were of a good size (Figure 11).

CPUE by Area and Month

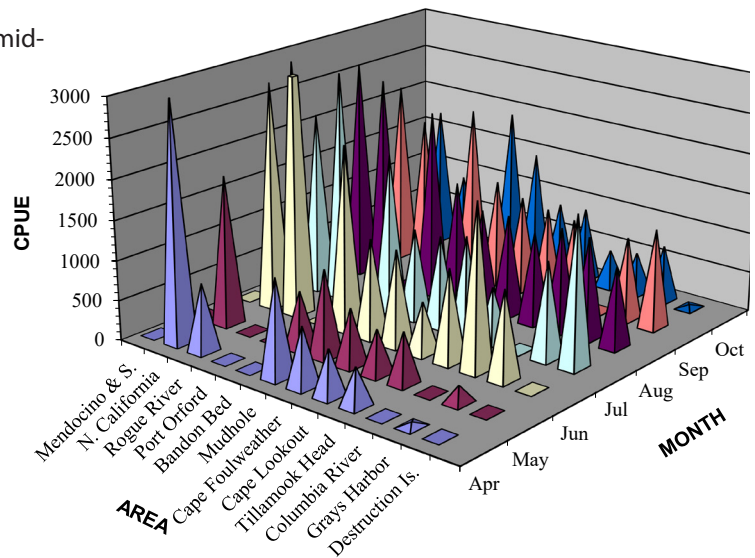
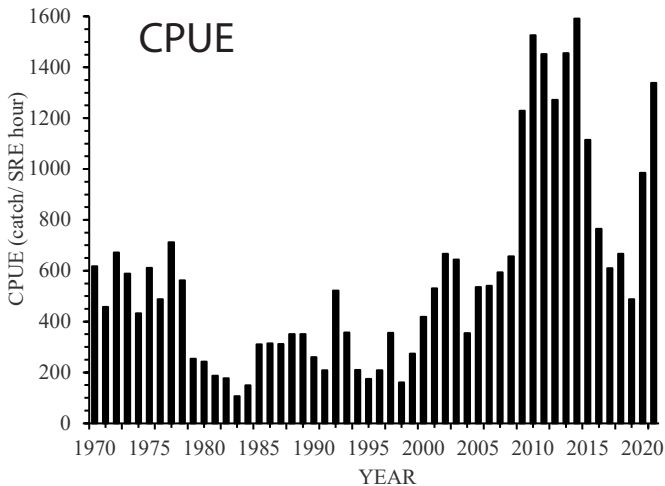


Figure 10. Average CPUE (SRE) for Oregon pink shrimp landings, by year: 1968-2021.

Figure 11. Average CPUE (SRE) by area and month for Oregon pink shrimp landings, 2021.

Value

Ex-vessel value was high in 2021 (23.4 million USD), anchored by high volume. The fishery value was the 8th highest value of all time, a little less than a million dollars more valuable than 2020 (Figure 12).

At \$0.50 per pound, the average price was the lowest since 2010 (Figure 13). Values are nominal (i.e. not adjusted for inflation).

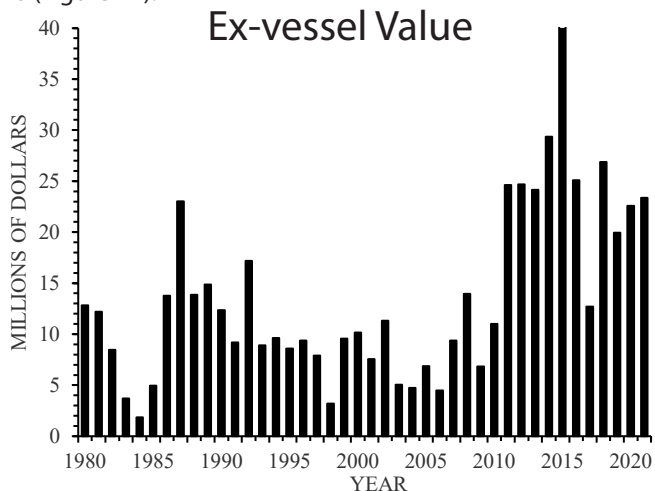


Figure 12. Ex-vessel value (USD) of pink shrimp landed into Oregon, by year: 1978-2021.

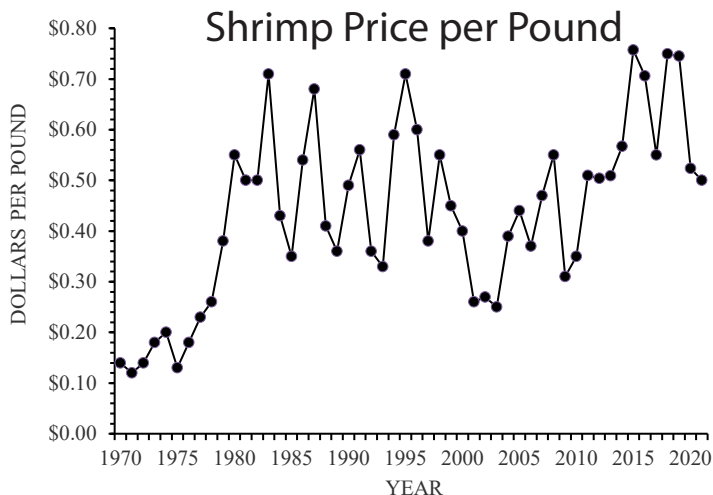


Figure 13. Average ex-vessel price-per-pound of pink shrimp landed into Oregon, by year: 1968-2021.

Age and Size

Pink shrimp live short lives and grow quickly; catch is typically composed of 3 year classes (age one, two and three). In most years, catch depends heavily on age one shrimp.

By number of (individual) shrimp, 74.2% were age one, 23.4% were age two, and 2.4% were age three (Figure 14).

By weight, older shrimp (age two and three) made up about 44% of the catch (Figure 15), despite only being about 26% of the catch by numbers.

Mean count per pound was 122. Pretty good, just a bit above the long-term average (Figure 16). The best (lowest) CPP came from southern areas, later in the season. Around 5% of samples had CPP higher than 160, all coming in April, May and June.

Weight of Shrimp by Age

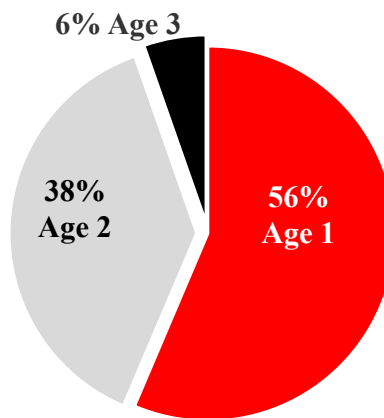


Figure 15. Weight of pink shrimp, landed into Oregon, 2021.

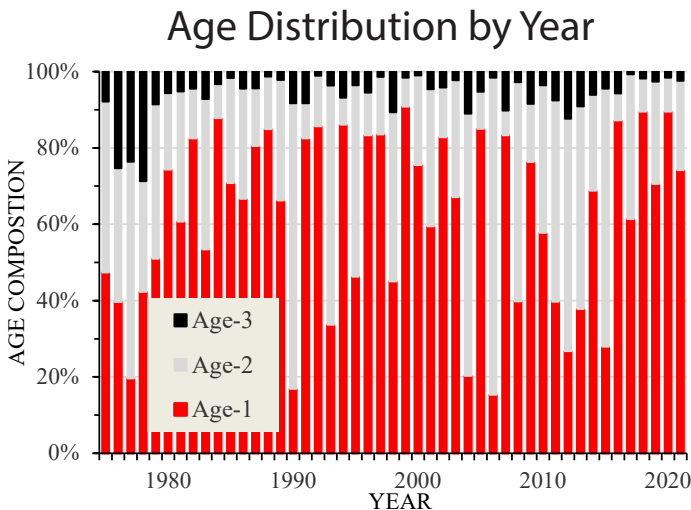


Figure 14. Age composition of pink shrimp landed into Oregon, by year: 1975-2021.

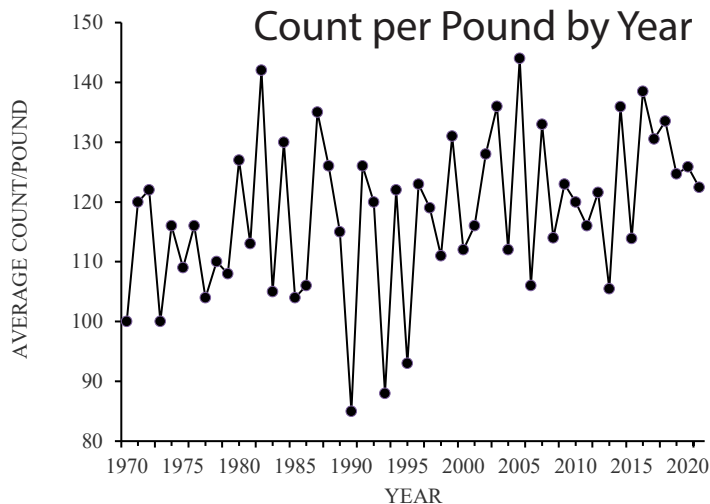


Figure 16. Average count per pound of pink shrimp landed into Oregon, by year: 1966-2021.



2021 Indicators

Here we describe some of the indicators which provide a forecast of what to expect next season.

"Smooth seas never made a skillfull sailor"
Franklin D. Roosevelt



Environmental Conditions

By comparing past pink shrimp population levels to past environmental condition, we can forecast future pink shrimp abundance based on current environmental conditions. Pink shrimp recruitment has a strong relationship to oceanographic conditions during their larval period (Figure 17). Specifically, sea level height (SLH) at Crescent City, CA during the pink shrimp's larval period has shown a strong link to recruitment levels in Oregon; the lower the sea level, the greater recruitment.

2021 year class: The environmental conditions which larval pink shrimp experienced in 2021 were excellent, though not quite as good as 2020. When compared to the past 43 years it was in the 76th percentile. Age one recruitment is typically the largest component of the fishery, by number.

Why sea level? While it may not matter to a pink shrimp if there are a few extra inches of water above their head or not, the average height of the sea does correlate to environmental conditions that are known to affect pink shrimp larvae (larval transport, food supply from upwelling, etc), thus providing a single indicator.

2020 year class: The excellent environmental conditions of 2020 delivered a good recruitment class. Over 3 billion age one shrimp were caught last year in Oregon alone (6th best on record). In 2022, this year class will be age two and are expected to be a strong component of catch. Age two shrimp are a major component of catch, especially by weight since they are twice the size of age one shrimp at the beginning of the season.

In 2022, pink shrimp catch will be composed of three year classes (those born in 2019, 2020, and 2021).

2019 year class: In 2022, we're hopeful that a good proportion of the catch will be these three year old shrimp. Historically, there are few three year olds left to catch, but they are so large that they have an unequal part of the catch by weight.

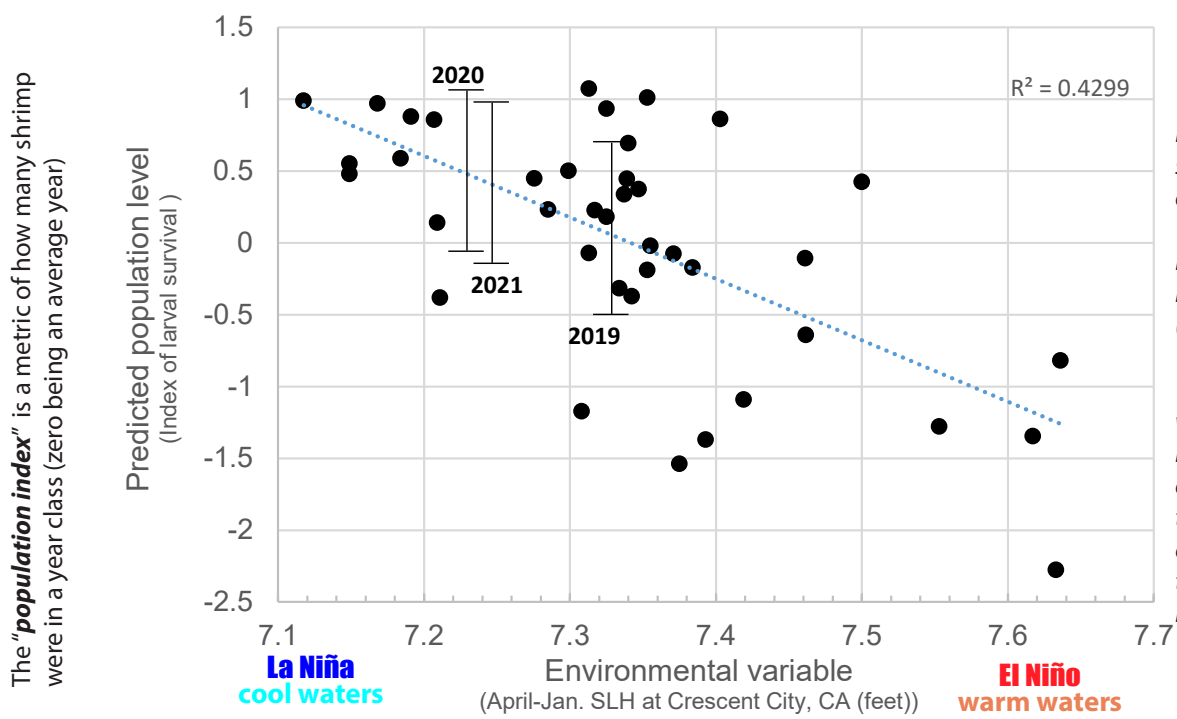


Figure 17. Pink shrimp population/ environmental model.

Each dot on this graph represents a year (1979-2018).

Vertical lines labeled with year represent the range of population 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.

Crustaceans lack hard structures for aging, such as ear bones (otoliths) used in fish aging, thus other means must be used. 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 aggregated then compared to other time periods to determine age and growth.

Each graph tells a story; in the example below (Figure 18), there are many age 1 shrimp, then a few age 2 and 3. While a single graph is like a snapshot, comparing changes in these graphs over time tells a story. 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 amounts of age classes can be tracked along multiple graphs. Arrows track year classes and indicate rate of growth as time goes on. These graphs look a little complex at first, but once understood, it becomes easy to visualize (Figure 19).

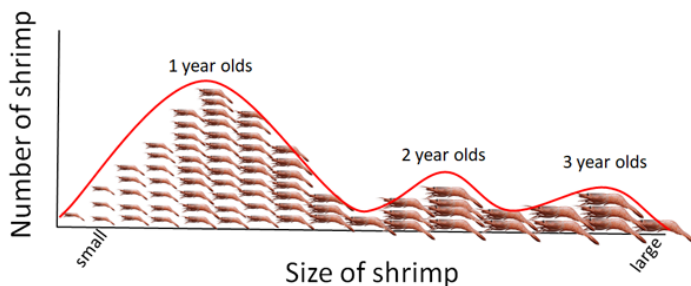


Figure 18. Hypothetical multimodal size distribution of pink shrimp.

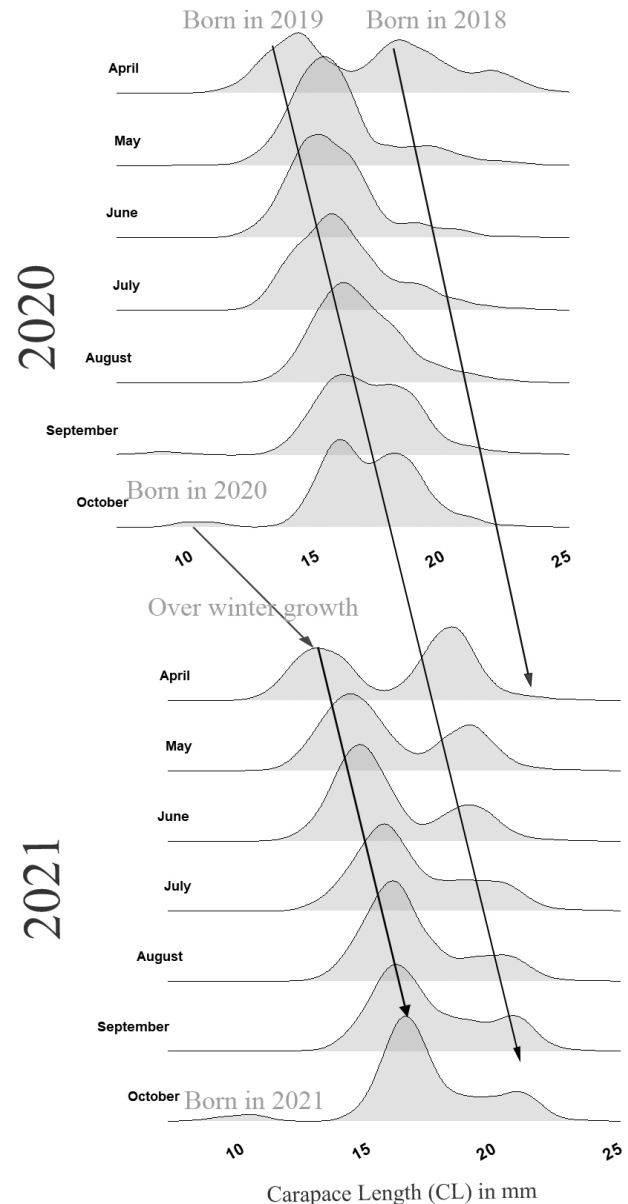


Figure 19. Pink shrimp size distributions by month (2020 and 2021) from Oregon landings.

Forecasting Methods

We forecast next year's catch in two different ways.

1. Forecast from environmental data:

We examine environmental conditions over the past few years then weight a forecast of each year depending on expected contribution of each year class (e.g. age 1 shrimp are typically the primary component of catch; therefore, environmental data from that year are more heavily weighted, whereas environmental conditions from three years ago are less heavily weighted).

2. Forecast from sampling data:

In this forecast, we look at last year's catch of each age class, rank them according to previous generations of shrimp, then weight each rank to project what next season might be like.

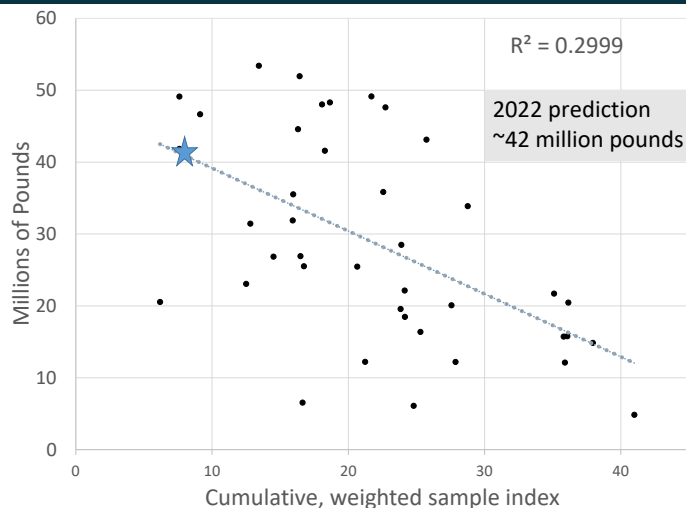
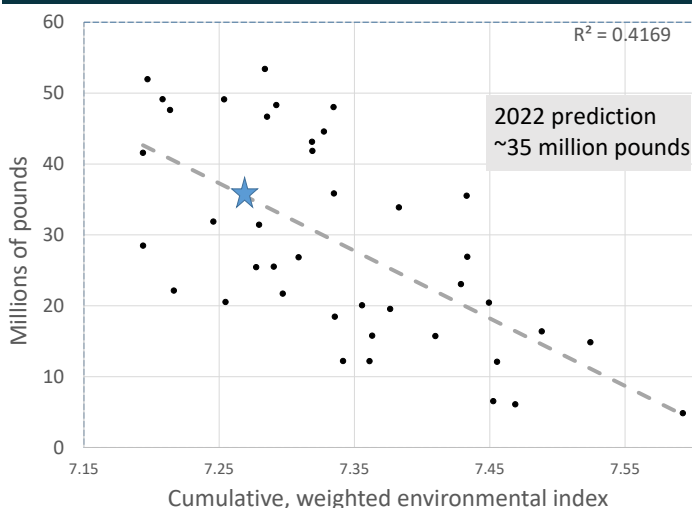


Figure 20. Cumulative, unified forecast of Oregon pink shrimp catch based on environmental factors.

This new cumulative, unified forecasting is based on the typical percentage of weight contribution of each age class to the current years catch. The environmental model predicts 2022 to be a 33 million pound season (Figure 20), while the sampling data model predicts a 42 million pound season (Figure 21).

Figure 21. Cumulative, unified forecast of Oregon pink shrimp catch based on sampling data.

To give some context of the variability expected, for last year's ~46.7 million pound season, the predictions were 35 (environmental model) and 38 million pounds (sampling model), so, it's definitely a guess. The error from last year was likely related to a stronger than expected age one year class, their strong growth, and later fishing.

Regulation Info

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 Bank, Daisy Bank, Stonewall Bank, Heceta Bank, Coquille Bank	Grays Canyon (see WA regs)
Mesh size		Minimum 1-3/8"	No minimum	
BRD		≤ 3/4" 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 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=191712&inline>, pages 125-129.

**OR Regulation details: <https://www.dfw.state.or.us/OARs/index.asp>

***WA Regulation details: <https://wdfw.wa.gov/fishing/commercial/shrimp#>

**** [NMFS groundfish limits](#)

Research Priorities

Here, we address three research areas in priority order: 1) shrimp population dynamics, 2) non-target catch and 3) ecosystem effects. Although we address each priority every year, we don't necessarily have planned activities for all three every year.

Priority 1: Shrimp Population Dynamics

Our documentation and analysis of pink shrimp population dynamics is the highest priority 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. ODFW's pink shrimp program has a thorough, long term dataset of shrimp populations, which is central to our ability to assure it is fished sustainably.

Accomplished in 2021:

We made several analyses associated to effects of early season fishing, participated in meetings, and answered questions.

We calculated annual indices on the number of shrimp using fish ticket, logbook and biological sample data. ODFW biologists entered data for 8,511 shrimp tows and measured 28,655 shrimp.

We completed the raw data entry of biological sampling from 1981-2021, the complete dataset is up to 906,169 shrimp! Additionally, we were able to age shrimp in the database all the way back to 1991. Charleston office staff has done a great job on this project and have gotten all the way back to 1975 so far.



Charleston ODFW staff who worked on biological sample data over the last 3 years.

*The 27th biggest shrimp in our database spanning >40 years and 906,169 shrimp!
Caught this year by Jeff Boardman aboard the F/V Miss Yvonne.
A load of these would be 32 CPP!*



Planned for 2022:

We plan to continue ageing historic biological samples, given the value of this long term dataset complete with age data.

We will continue to work closely with WA and CA to improve sampling and fishery effort analysis.

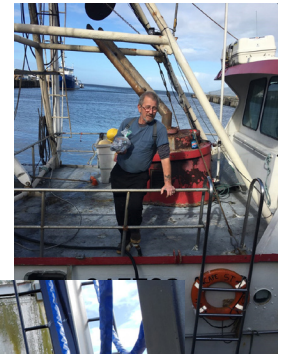
Priority 2: Non-Target Catch

Accomplished in 2021:

ODFW published a report, summarizing the findings of various shrimp gear surveys titled "Recent Advances in Trawl Gear Employed by Oregon's Ocean Shrimp (*Pandalus jordani*) Fishery" as an ODFW Science Bulletin.

We worked to assure proper use of LED fishing lights by conducting surveys and sharing information with the fleet.

We awarded the five skippers with the best logbooks in each port with 10 LEDs. We really appreciate all the skippers recording this data and are especially appreciative when its easy to obtain and easy to enter. Thanks to all shrimpers on this!



Skilled shrimpers receive LEDs

Planned for 2022:

We plan to work with the fleet to improve bycatch data recorded on fishery logbooks .

Priority 3: Ecosystem Effects

Accomplished in 2021:

An accomplishment of our collaborator! Oregon State University's Michelle Nguyen completed her master's degree evaluating the potential effects of future ocean conditions on pink shrimp. A quick story on this here: <https://ceoas.oregonstate.edu/feature-story/thinking-pink>

Planned for 2022:

The Nehalem Banks ROV project (evaluating shrimping and habitat effects) is prioritized in MRPs 2022 budget.

Sustainability

Enforcement News

In the 2020 and 2021 seasons there were six cases where Oregon State Police (OSP) identified that shrimp landings exceeded the 160 count per pound limit. One of these cases occurred in April, three in May, and two in June. In several of the cases, the captain was issued a citation and a portion of the landing was seized. OSP and ODFW diligently monitor count per pound of pink shrimp landings.



Oregon State Police (OSP) counting and weighing pink shrimp to determine if a shrimp delivery is legal (<160 shrimp/lb).

Please carefully monitor the count per pound of your tows, especially during the first few months of the season when small, age one shrimp are abundant, so that your landings do not exceed the 160 count per pound average.

When and where are small shrimp an issue?

Typically, small shrimp are common in the first three months of the season, because of the very small size of age one shrimp at that time. Further, shrimp grow more slowly at more northern latitudes and consequently, small shrimp tend to be more prevalent, especially in the spring (Figure 22).

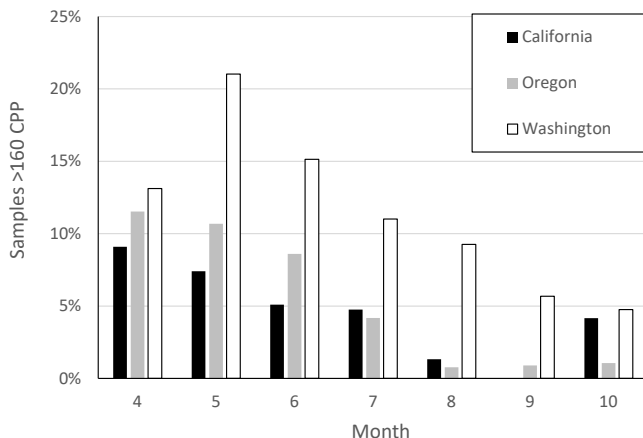


Figure 22. Percent of biological samples greater than 160 count per pound (CPP) landed into Oregon, by month and catch area, 1981-2021

Season Issues

After much discussion and consideration, ODFW decided not to recommend a change of season start date to our commission at this time. We heard that interstate consistency and need for stability coming out of COVID are high priority for the fleet right now.

This means that the season will start April 1, 2022.

Shrimp and Ice

Notifications were sent to each of the active 2021 Oregon shrimp dealers (processors) regarding net weights of shrimp and methodology for deducting ice weights.

Each dealer is required to have a department approved sampling plan for calculating net shrimp weight from the gross weight of shrimp and ice, according to [OAR 635-006-0205](http://OAR.635-006-0205).



Shrimp and ice sampling

Literature cited

Hannah, R. W. and S. A. Jones (2003). "Measuring the height of the fishing line and its effect on shrimp catch and bycatch in an ocean shrimp (*Pandalus jordani*) trawl." Fisheries Research 60: 427-438.

Hannah, R. W., et al. (2011). "Trawl net modifications to reduce the bycatch of eulachon (*Thaleichthys pacificus*) in the ocean shrimp (*Pandalus jordani*) fishery." Fisheries Research 110(2): 277-282.

Hannah, R. W., et al. (2015). "Tests of artificial light for bycatch reduction in an ocean shrimp (*Pandalus jordani*) trawl: Strong but opposite effects at the footrope and near the bycatch reduction device." Fisheries Research 170: 60-67.

Lomeli, M. J. M., et al. (2019). "The efficacy of illumination to reduce bycatch of eulachon and groundfishes before trawl capture in the eastern North Pacific ocean shrimp fishery." Canadian Journal of Fisheries and Aquatic Sciences 77(1): 44-54.

New reports available:

Bancroft, M.P., and S.D. Groth. 2021. [Recent Advances in Trawl Gear Employed by Oregon's Ocean Shrimp \(*Pandalus jordani*\) Fishery. Science Bulletin 2021-03](#). Oregon Department of Fish and Wildlife, Charleston.

Oregon Dept of Fish and Wildlife:
PO Box 5003
Charleston, OR 97420