



FISH RECRUITMENT

Quillback Rockfish
Photo: Doug Batson

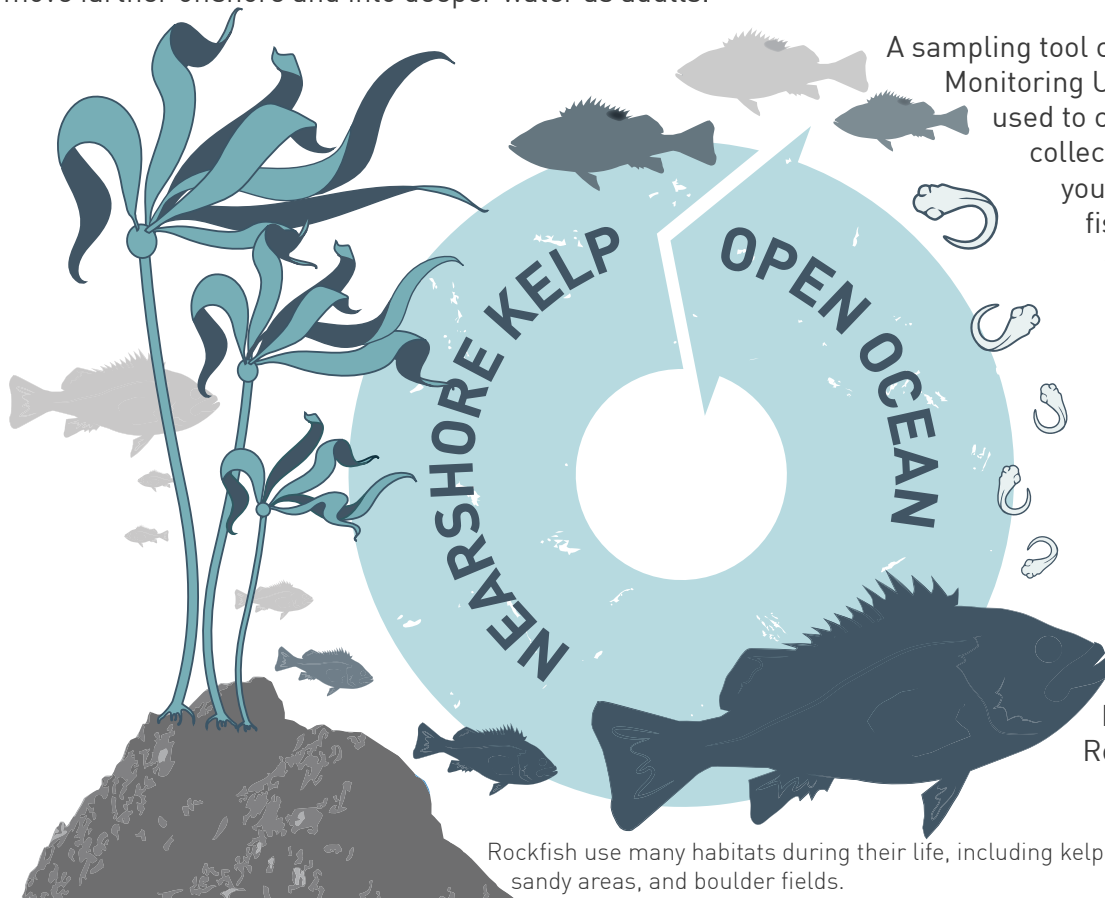


Why Study Juvenile Fishes in Marine Reserves?

Marine fishes can use many different habitats during their life. Marine reserves that include habitats used by both juvenile and adult fishes can help protect species when they are young and old. Nearshore waters contain valuable nursery grounds for many fish species, such as Splitnose Rockfish and Bocaccio. As they grow, these fish will eventually move farther offshore as adults. We are just beginning to understand which species use nearshore habitats along the Oregon coast during their early life. Tracking how many juveniles use these nearshore habitats is also helpful for understanding changes in adult populations into the future. Eventually, this information can help design, place, and manage marine reserves for maximum benefits.

How Do We Study Such Tiny Creatures?

Juvenile fish can spend days to months in the plankton before settling to shallower, nearshore waters. This process is called recruitment. Juveniles recruit to kelp and other habitats they encounter. As they grow, many species eventually move farther offshore and into deeper water as adults.



A sampling tool called a SMURF (Standard Monitoring Unit for the Recruitment of Fishes) is used to collect juvenile fish. Although these collectors are made out of plastic fencing you might find in any garden, juvenile fish see them as a refuge in the wide ocean. Through a collaborative effort between Oregon State University (OSU) and Oregon Department of Fish and Wildlife (ODFW), SMURFs are set near the seaward edge of marine reserves and comparison areas, allowing scientists to sample the juvenile fish (less than 2 inches long) that are coming into the nearshore to settle. Currently, SMURFs are in use at two reserves off Oregon, at both Otter Rock and Redfish Rocks Marine Reserves.

Rockfish use many habitats during their life, including kelp forests, nearshore sandy areas, and boulder fields.

Juveniles of these species have been collected to-date:



Black Rockfish



Black-and-Yellow Rockfish



Bocaccio



Cabezon



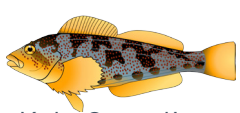
China Rockfish



Copper Rockfish



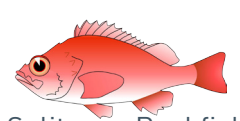
Gopher Rockfish



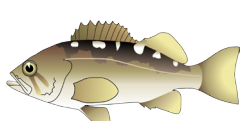
Kelp Greenling



Quillback Rockfish



Splitnose Rockfish



Yellowtail Rockfish

Not pictured: Tiger Rockfish

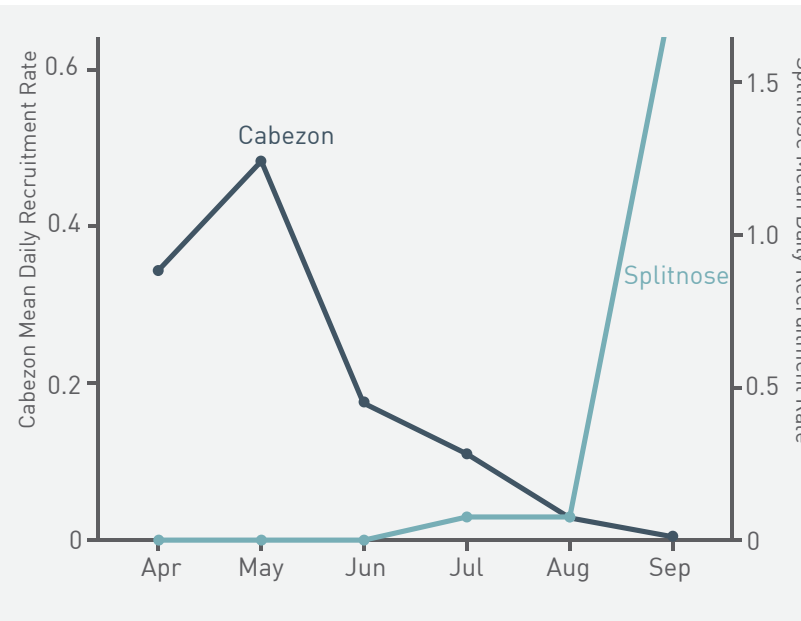
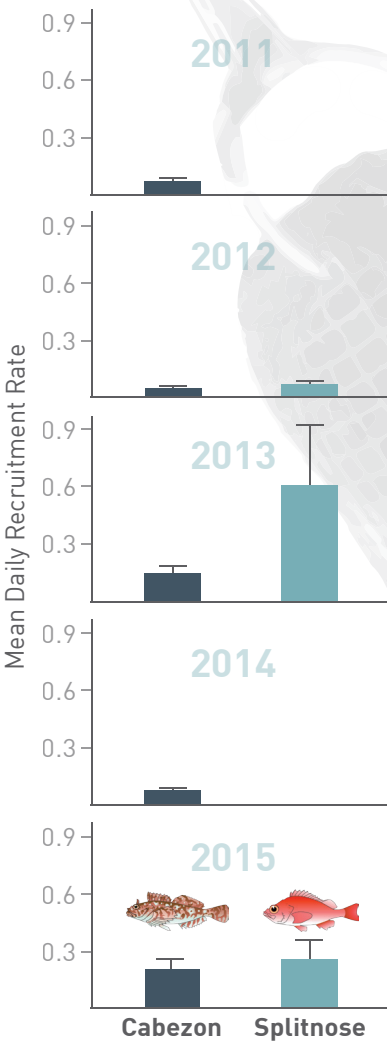
The advantage of a continuing, long-term data set is that it allows scientists to see how population replenishment changes over time, at different sites along the coast, and for different species. Over the past five years, a number of different recruitment trends have been observed in the fishes collected in SMURFs at the two marine reserves.

Different Species, Different Patterns

Juvenile fishes can look and behave very differently than adults. Some species that live in deep water as adults, such as Splitnose Rockfish, spend time in nearshore shallow water as juveniles. Different species can also have very different recruitment patterns. For example, Cabezon tend to have moderate recruitment that is relatively steady from year to year. Other species, like Splitnose Rockfish, have boom and bust cycles. For example, in 2013 a single SMURF collected 241 Splitnose Rockfish!



Splitnose Rockfish
Photo: Dani Ottman



In years of higher recruitment, species-specific patterns begin to emerge. For example, this figure shows that Cabezon have high recruitment in late spring (April-May) that drops off as the summer progresses. Conversely, Splitnose Rockfish show low recruitment in late spring but have very high rates in late summer.

Different Years, Different Patterns

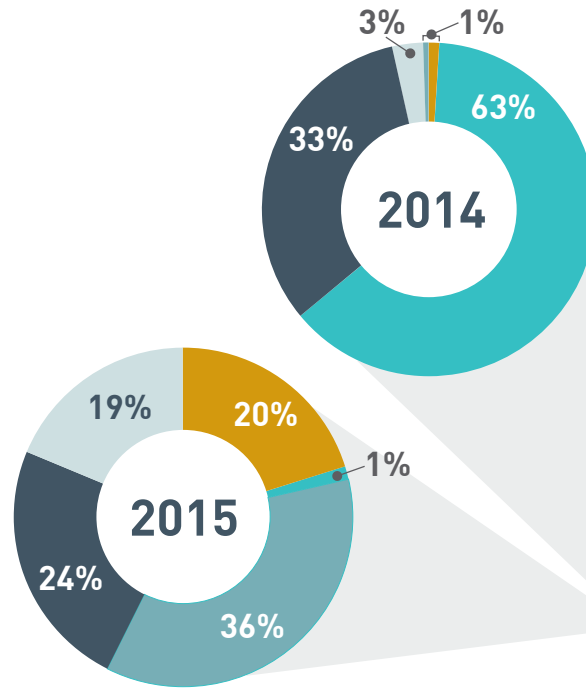
Patterns of juvenile recruitment vary over time. This may be due to ocean conditions such as temperature, currents, and upwelling. Recruitment in Otter Rock Marine Reserve in 2014 looked very different from the pattern observed in 2015. That's because the samples in 2014 were largely juvenile Black/Yellowtail Rockfish* and Cabezon. However, 2015 was a big recruitment year for many species. In terms of total numbers, 2015 was a big recruitment year for many species in Otter Rock. Numbers of Cabezon, Tiger Rockfish, and Copper/Quillback Rockfish* collected were the highest for each species compared to any of the previous five years. Understanding how environmental fluctuations affect recruitment allows us to evaluate why yearly differences occur.

Different Reserves, Different Patterns

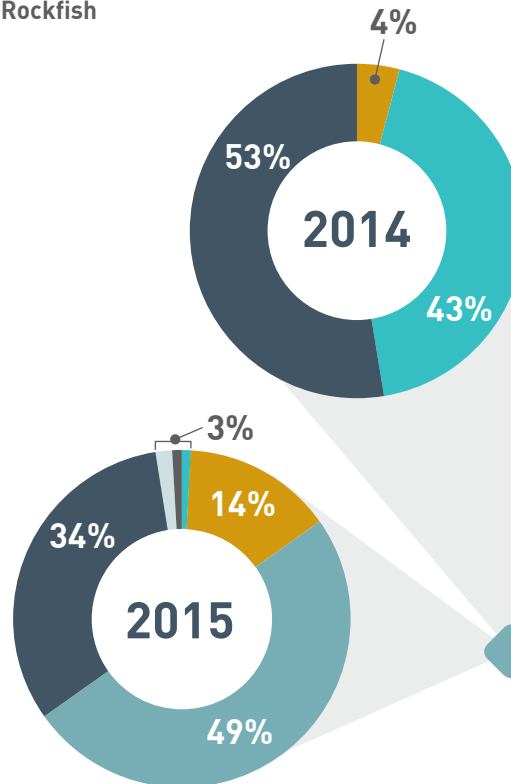
Each of Oregon's reserves has unique oceanographic and seafloor habitat characteristics. From the first five years of data, patterns of juvenile fish settlement to these sites show the same species are found at both Otter Rock and Redfish Rocks. Yet, the composition of the total sample was different. For example, Tiger Rockfish were almost a quarter of the total number of fish sampled at Otter Rock Marine Reserve (2015, above), but that is a smaller portion of those collected at Redfish Rocks Marine Reserve. Since each reserve is unique, the composition of species that settle there is also unique. These data show Oregon's marine reserves provide nursery habitat for commercially and ecologically important species.

*Rockfish are often grouped together because they are very difficult to visually distinguish. Genetic testing is often required to differentiate between species. For example, Black/Yellowtail Rockfish and Quillback/Copper/Gopher/China/Black-and-yellow Rockfish, of which Quillback/Copper Rockfish are the primary species that have settled to SMURFs.

Otter Rock



Redfish Rocks



 **Marine Reserve**



Why Siblings Matter

Some fish hatch directly from eggs into the open ocean, while fishes like rockfish hatch inside their mother, who releases them a few days later. From the moment they are released from their mother, Splitnose Rockfish have a long way to go. They can spend up to a year in the open ocean before settling to nearshore habitats as juveniles. Although for many years scientists have believed that these related juveniles get separated in the vast ocean, recent results indicate that juvenile rockfish can travel and settle together.

Understanding whether “sibling” rockfish (those released from the same mother) end up in the same area as juveniles, and possibly as adults, can help us understand whether we’re effectively protecting the genetic diversity of a species inside marine reserves. Genetic tools are being used to explore whether siblings settle together.



Tiger Rockfish
Photo: Dani Ottman

It Takes a Village

This project is a great example of research collaboration between OSU, ODFW Marine Reserves Program, Oregon Coast Aquarium, and other local partners. Drs. Kirsten Grorud-Colvert and Su Sponaugle at OSU lead sample processing and data analysis and advise graduate students such as Daniel Ottmann (see above sibling research project) who conduct research in the field and in the lab. The ODFW Marine Reserves Program builds and maintains the SMURFs and participates in field sampling. The Oregon Coast Aquarium and numerous volunteer vessels, captains, and snorkelers assist in field operations each year. These data can also be compared with SMURFing studies in central and southern California, conducted by the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO).

