

## The pelagic (open water) food web (from the Encyclopedia of Puget Sound)

The marine habitat of Puget Sound can be divided up into nearshore, benthic (associated with the sea floor), and pelagic (open water) habitats. This article focuses on the pelagic habitat within the Puget Sound. This article was prepared as part of the 2015 Puget Sound Fact Book produced by the University of Washington Puget Sound Institute.



Spiny

Dogfish (*Squalus acanthias*), a species typically found in Puget Sound marine waters. Image courtesy of NOAA.

### Summary

There is not just one Puget Sound food web. Terrestrial, freshwater, and marine habitats and species are connected in complex webs of interaction driven by water flow, proximity, and animal movement. The marine environment is further divided up into unique nearshore, soft-bottom, rocky and open water habitats, all of which contain unique species but are also connected to each other, by shared prey resources, or common predators, or animal movement. The Puget Sound is strongly influenced by bottom-up forcing, meaning that the animals in Puget Sound are sensitive to changes at the bottom of the food web (Harvey et al., 2010). The Puget Sound supports more than 250 fish species (Pietsch & Orr, 2015), 38 marine mammal species (Gaydos & Pearson 2011), 172 bird species (Gaydos & Pearson 2011), and a highly diverse community of invertebrate species (Harvey et al., 2010). The marine habitat of Puget Sound can be divided up into nearshore, benthic (associated with the sea floor), and pelagic (open water) habitats. This section focuses on the pelagic habitat within the Puget Sound (<http://www.eopugetsound.org/articles/habitats-puget-sound-watershed>).

### Cross-system

1. The animals and plants in the pelagic zone together represent an estimated 25-30% of the total biomass in the Puget Sound marine ecosystem; the rest is contained in bottom-associated plants and animals (Harvey et al., 2010).
2. There are 252 fish species in the Salish Sea ecosystem (Pietsch & Orr, 2015, Pietsch pers. Comm. 6/10/2015).

3. Over 50% of the biomass in Puget Sound is estimated to be in benthic invertebrates: bottom-dwelling animals like geoducks, clams, mussels, crabs, octopuses, sea stars, and the small crustaceans that are the standard fare for most seabirds and fish in the Sound (Harvey et al., 2010).

### **Zooplankton**

4. Zooplankton, tiny marine crustaceans, are a critical link between primary producers, or plants and algae that trap energy from the sun, and larger species like fish, mammals and birds. Many of the most important species in Puget Sound rely upon zooplankton, including salmon, forage fish like herring, surf perch, and sand lance, hake, Pollock, and shrimp (Harvey et al., 2010). Yet, no comprehensive zooplankton monitoring program exists in Puget Sound. Each Puget Sound basin has its own unique zooplankton and bacteria community (Moore et al., 2014). Copepods are typically the most dominant zooplankton type in Puget Sound (Keister & Tuttle, 2013).

### **Phytoplankton**

5. The spring bloom, which is the peak of primary production during the year, happens in Central Puget Sound in late April/May of each year, and is dominated by diatoms (Moore et al., 2014). The spring bloom is followed by a peak in zooplankton grazing in June (Moore et al., 2014). Diatoms are the most abundant and diverse group of primary producers in Puget Sound (Moore et al., 2014).
6. Toxins in Puget Sound shellfish, and associated beach closures, have been increasing in frequency and magnitude since the 1950s (Trainer et al., 2003).

### **Forage fish**

7. Forage fish, including Pacific herring, are preferred prey for over 30 mammals, birds, fish and invertebrate species, including Chinook salmon, harbor seals, lingcod, and rockfish (Duffy et al., 2010; Harvey et al., 2010; Lance et al., 2012).
8. In the last 40 years Pacific herring and surf smelt abundance has decreased 99% in Central and South Puget Sound (Greene et al., 2015). Jellyfish are 9 times more abundant than they were 40 years ago in some Puget Sound basins (Greene et al., 2015). Jellyfish can make up to 90% of the catch in Puget Sound surface trawls, and are most abundant in central and south basins (Rice et al., 2012). Jellyfish compete with adult forage fishes while consuming larval and juvenile stages of fish (Purcell & Arai, 2001).
9. Pacific sand lance and three-spine stickleback, two forage fish species, have increased in Puget Sound in the last 40 years (Greene et al., 2015).
10. In Puget Sound more than 200 miles of shoreline are utilized as spawning beaches for surf smelt and more than 140 miles of shoreline are utilized as spawning beaches for sand lance (U.S. Geological Survey, 2015)

### **Other Fish**

11. A number of formerly abundant bottomfish in Puget Sound – walleye pollock, Pacific cod, Pacific hake – were depleted by heavy fishing in the 1970s and 1980s and have not recovered, though fishing has been restricted for decades (Gustafson et al., 2000). These species are very common in the diets of harbor seals and sea lions (Lance, et al., 2012, Harvey et al., 2010), which populations have been steadily increasing over that same time period (Jeffries et al., 2003).

12. The most common sharks in Puget Sound are the bluntnose six-gill shark (*Hexanchus griseus*), the Pacific spiny dogfish (*Squalus acanthias*) and the spotted ratfish (*Hydrolagus colliei*) (Griffing et al., 2014).
13. The Puget Sound has 28 species of rockfish (*Sebastes* spp.) (Palsson et al., 2009). Rockfish are known to be some of the longest lived fish of Puget Sound. Maximum ages for several species are greater than 50 years. The rougheye rockfish can live up to 205 years (Palsson et al., 2009).
14. As of 2009 there are 30 marine/estuarine invasive species in Puget Sound: 5 plants, 3 macro algae, and 22 invertebrates. Fifteen of these species are known to occur or are established in Puget Sound (Eissinger, 2009).

### **Other organisms**

15. Harbor seals vary their diet by location and season: during the winter and spring months seals in the north favor Pacific herring (*Clupea pallasii*), Pacific sand lance (*Ammodytes hexapterus*), Northern anchovy (*Engraulis mordax*) and walleye pollock (*Theragra chalcogramma*), while in summer and fall months they eat primarily salmon (Lance et al., 2012).
16. The endangered Southern Resident Killer Whale (SRKW) observed most commonly in Puget Sound feeds overwhelmingly on Chinook salmon (Ford et al., 1998).
17. The most common Puget Sound squid, Pacific squid, average eight inches in length from mantle to tentacle tip (WDFW, 2015). The much larger Humboldt squid (*Dosidicus gigas*) – 7 feet long and 100 lbs. – is occasionally observed in Puget Sound (WDFW, 2015).
18. Giant Pacific octopuses (*Enteroctopus dofleini*), the largest species of octopus in the world (Conrath and Connors, 2014), are major benthic predators in Puget Sound (Scheel and Anderson, 2012). Their preferred prey seems to be cancer crabs (*Cancer productus*) (Scheel and Anderson, 2012). The largest giant Pacific octopus on record was said to weigh close to 600 pounds (Morris et al., 1980). However, more typical weights for this species range from 50 to 100 pounds (NOAA Fisheries, 2015b; High, 1976).

<https://www.eopugetsound.org/articles/pelagic-open-water-food-web>