

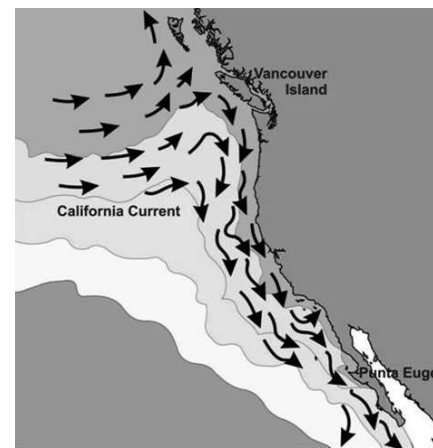
Copepod populations

Variations in the abundance and composition of copepod populations in the northern portion of the California Current reflect changes in ocean circulation patterns.



Copepods are the most abundant marine “zooplankton” – animals that drift with ocean currents. A vital part of the food chain, copepods are food for small fish and other crustaceans that make up the diet of larger fish, marine mammals and seabirds. Because they are transported by currents, copepods are good indicators of the types of source waters transported into the California Current (see map, right).

While copepod populations largely reflect short-term variability in ocean circulation patterns, long-term monitoring can provide an indication of climate-driven changes in ocean transport of source waters. In addition, rising ocean temperatures due to climate change may amplify periodically recurring warm conditions such as during El Niño events and alter seasonal copepod species composition in coastal waters. Changes in copepod populations can be reflected along the entire marine food chain.

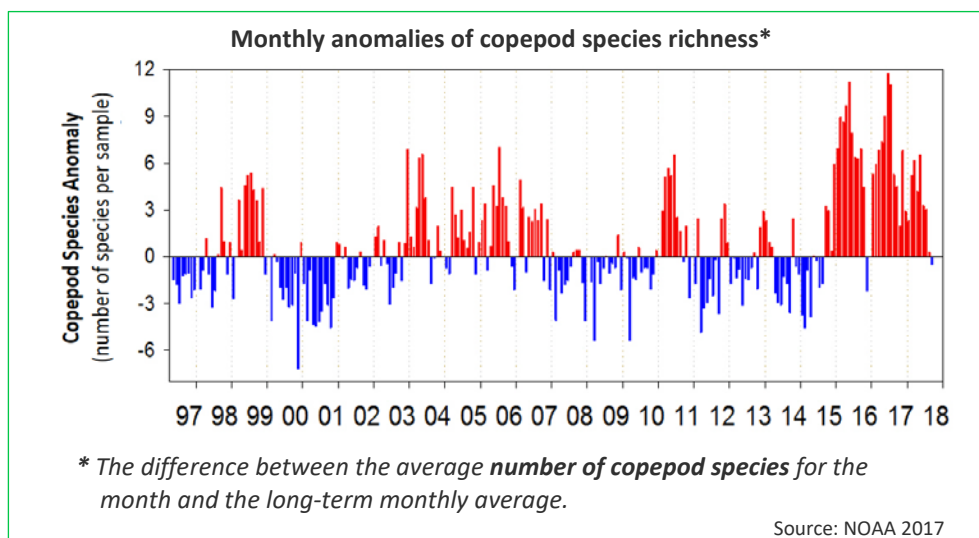


The California Current moves southward along the west coast of North America, from southern British Columbia to Baja California.

Source: NOAA 2017

What does the indicator show?

Copepod species richness, measured as the number of copepod species present in a sample, has fluctuated in the northern California Current during the last 22 years. The samples were collected off the coast of Newport, Oregon, about 190 miles north of Crescent City, California. The graph below presents *monthly copepod species anomalies*, which show whether more (red bars) or less (blue bars) copepod species than average were present. The red bars indicate that copepods were transported by waters originating from the south or from offshore; these warm waters carry a greater variety of species. The blue bars indicate that copepods were transported chiefly from the north, where colder waters contain fewer, but more nutritious species.





As shown in the graph, copepod species richness was low from 1999 until 2002 and generally high from 2003 until 2007. This was followed by a mixed pattern over several years. During much of 2015 through the summer of 2017, species richness was the highest observed in the 22-year time period, and large populations of southern copepod species dominated the coastal waters. This was due to the intrusion of warm water from a North Pacific “marine heat wave” that began in late 2013. The heat wave interacted with a warm-water El Niño event developing in the Pacific Ocean in 2015, resulting in an unusually long period of warm water conditions.

Why is this indicator important?

Tracking copepods in the northern California Current provides information about changes that can impact the marine food chain. Although waters originating from the north contain fewer copepod species, these organisms are high in fat content and appear to be essential for many fishes to grow and survive the winter. The southern copepod species are generally smaller, with low fat reserves and less nutritional value. Poor feeding conditions for the small fish that are prey for juvenile salmon during the recent marine heat wave described above led to dramatic declines in salmon populations. Copepod species richness has proven to be a useful predictor for salmon abundance and has also been linked with seabird nesting success in central California.



*Copepods are a large and diverse group of small (1 to 2 millimeters) crustacean species, found in aquatic environments. (Photograph shows *Calanus marshallae*)*

Inset photo: Russ Hopcroft

For more information about this and other climate change indicators, visit:

<https://oehha.ca.gov/climate-change/report/2018-report-indicators-climate-change-california>

