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Fish Predators of Northeast Pacific Jellyfish: What are we missing?

Richard D. Brodeur[1], Troy W. Buckley[2] and Richard E. Hibpshman[3]

[1] NOAA Northwest Fisheries Science Center, Hatfield Marine Science Center, Newport, OR, 97365, USA rick.brodeur@noaa.gov, [2] NOAA Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle, WA 98115, USA, [3] Joint Institute for the Study of the Atmosphere and Ocean, University of Washington, 7600 Sand Point Way NE, Seattle, WA 98115, USA

Summary

Pelagic coelenterates (Cnidaria and Ctenophora) and thaliaceans (salps and appendicularians) have been considered important consumers or predators in marine food webs for many years but have only been recognized as being important prey for many species in the last 20 years. Although gelatinous zooplankton are known to be important components of the diets of large predators such as sea turtles and ocean sunfish for a long time, they are also important in the diets of pelagic migratory species such as mackerel and salmon. We summarize data obtained from Northeast Pacific fish fauna based on extensive food habits surveys of pelagic and demersal nekton ranging from the Bering Sea to the California Current. We have identified a number of previously unknown predators of jellyfish from several geographic regions. We also show that the occurrence of coelenterate prey is generally much higher in stomachs of several fish species examined fresh at sea compared with that found in stomachs of the same species examined in the laboratory following preservation. Differences were less pronounced with the more durable salp prey.

Methods

In order to estimate the importance of jellyfish in the diets of juvenile and adult fishes along the west coast of North America, we synthesized data from previously published studies or, when possible, from unpublished data sets analyzing multiple species in specific geographical areas. Our aim in this study was to examine multispecies diet surveys from pelagic and demersal fishes for occurrences (or percent by weight when available) of gelatinous prey. We recognized that gelatinous prey are quickly digested in the stomachs of fish predators compare to other prey (Arai et al. 2003), in many situations the identify of the gelationous prey could only be ascertained at broad categories (Cnidaria, Ctenophora, Thaliaceans, and Appendicularians).

Starting in 1981, collections have been made of groundfish stomachs as part of the Resource Ecology and Ecosystem Modeling Task at the Alaska Fisheries Science Center (AFSC, unpublished material; http://www.afsc.noaa.gov/REFM/REEM/Data/Default.htm). Stomach samples preserved in the field were returned to the lab for analysis and account for the majority of our database. A small number of samples are analyzed at sea in as quantitative a manner as possible. Geographic coverage of the data was categorized into five broad regions: Bering Sea, Gulf of Alaska, Aleutian Islands, Chukchi and Beaufort Seas, and West Coast (California, Oregon, Washington and British Columbia).Starting in 2003, stomach collections from the West Coast Groundfish Bottom Trawl Survey conducted by the Northwest Fisheries Science Center, U.S. National Marine Fisheries Service from the U.S.–Mexico border north to U.S.-Canada border covers the depth range of 50–1,200 m. We analysed diet data from two large-scale pelagic fish surveys. The first is from a purse seine survey conducted by Oregon State University in 1979-1984 which covered the area from Cape Flattery, WA to Cape Blanco, OR (43º 00'N) from May through September Pelagic fish sampling occurred with large pelagic trawls in June and August of both 2000 and 2002 between Newport, OR (44º 39'N) and Crescent City, CA (41º 54'N).

For the stomach contents data from Alaskan waters we used two different methods of stomach content analysis on the same species within the same year and region in several instances. The first involved processing stomachs at sea when the fish first arrived on deck in a process called Stomach Content ANalysis at Sea (SCANS) and the other involves preservation at sea and normal detaile analysis under a microscope in the laboratory. Our sampling require somewhat different methods due to constraints imposed by time, conditions, equipment and references available to the analyst.

Results

We summarized diet information on over 333,000 demersal and pelagic fish stomachs comprising more than 100 different predators. In the Bering Sea, we identified 16 predators on coelenterates and 14 on thaliaceans, with sablefish, walleye pollock, sculpins, prowfish, Atka mackerel, snailfish and grenadiers the most important predator groups. In the Aleutian Islands, 16 and 18 predators were identified for the two jellyfish groups with the same species as in the Bering Sea with the addition of several rockfish species. A total of 15 and 24 predators, respectively, were found in the Gulf of Alaska, with many of the same species being dominant with the addition of dogfish and several midwater lanternfishes. Finally, of the 14 predators examined from trawl surveys, 4 had consumed coelenterates and 2 larvaceans, with new observations for Pacific hake and arrowtooth flounder. Dominant pelagic consumers of coelenterates include dogfish, rockfish, hake, medusafish, and saury and consumers of thaliacians included salmon (especially chum salmon), walleye pollock, and sablefish.

Differences between the laboratory and SCANS seem to exist mostly in the lower detection of Coelenterates in the stomach contents. SCANS were significantly higher for sablefish in the GOA (2007 and 2009), prowfish, dusky rockfish and dark rockfish from the Aleutian Islands (Table 1). Thaliaceans are higher in the lab analysis of walleye pollock from the GOA in 2009 but higher in the SCANS analysis of Atka mackerel in 2007.

Discussion

In an extensive survey ranging over much of the west coast of North America, we identified numerous pelagic and demersal predators on both coelenterates and thaliaceans, some of which had never before been identified. Most of our diet data came from laboratory analyses some time after the collections but a limited comparison between field and laboratory analysis showed that many of these easily digested prey may be overlooked following extended periods of preservation. Dissolution of coelenterate tissues during the preservation process is likely the main factor in the differences observed. We suggest that many existing estimates of predation on quickly-digested gelatinous forms may be underestimates of the true predation rate and these rates may need to be adjusted in ecosystem modeling and food consumption studies. Biochemical (stable isotopes or fatty acid signatures) or genetic methodology may be used to overcome some of the undereporting of gelatinous tissue in fish predator stomachs.