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ASK DR. PAULY

What are Forage Fish?

To explain the importance of forage fish, first we must go back to the basics of who eats whom, on land versus in the ocean. On land it is very easy. We either eat plants, or animals that have eaten plants, or a mixture of the two.

Re-expressed in term of trophic levels, i.e., steps in the food chain, this means that we have trophic level 1, which are plants. Then we have trophic level 2, things that eat plants, and level 3, animals that eat plant-eating animals (e.g., cows, eating grass). So, for example, if you have a diet of 90 percent vegetable matter (fries, salads, the onions on hamburgers), plus 10 percent meat, you have a trophic level of 2.1.

In the sea, the equivalent of grass and corn and other edible plant matter are microscopic algae known as phytoplankton. The plant-eating marine herbivores, the equivalent of deer and cows on land, are tiny zooplankton, usually less than one-tenth of an inch, and we don't eat them. They are eaten instead by small schooling fishes such as sardines, herring, and anchovies. We call these forage fish because they serve as food for larger

animals in the ecosystem, for example, cod and tuna among fishes, sea lions and humpback whales among marine mammals, and sea birds such as pelicans and gannets.

Since forage fish have trophic levels usually around 3 (because they mainly consume herbivorous zooplankton), the larger fish preying on them, such as cod or tuna, have a trophic level of about 4, and people whose diet consisted only of such fish would have a trophic level of 5. Accordingly, somebody who eats only tuna sashimi would have a diet corresponding on land to a diet of super-dragons, which would themselves have been feeding on dragons, which would have consumed wolves, lions and other carnivores feeding on gazelles, caribou cattle and other plant-eaters.

Each transition from one trophic level to the next causes a loss of energy; there are fewer calories in a pound of chicken than in the corn that the chicken ate. This loss rate is about 90 percent per trophic level, and thus, the lower the trophic level that we eat at, the more food we have. With land-based foods, this makes a strong case for vegetarianism. With regard to seafood, this makes a strong case for us to consume forage fish rather than the fish that consume the forage fish.

And there are other benefits to eating forage fish. Because they don't live long, forage fish do not accumulate as many pollutants (such as dioxin) and heavy metal (such as mercury) as fish higher in the food chain, and they contain more omega 3-fatty acids, which originate from the phytoplankton.

People in many European countries, such as Spain, Italy, France and Germany, consume forage fish including sardines, anchovies and herring, as do people in Africa and Asia, where they are often a staple food. In the U.S., people are no longer familiar with fish such as sardines, though they were two generations ago, during the heyday of the California sardine fishery of John Steinbeck's Cannery Row fame.

Forage fish need to be re-introduced to consumers in the U.S. and in some other countries, where the seafood demand can no longer be met by the now-depleted fish of higher trophic levels. Sardine, herring, and similar fish are healthy, still relatively cheap and they can be exploited such that enough is left in waters to feed other species, like marine mammals and seabirds, as established recently by a panel of experts¹.

In fact, if we consume small fish, we can have our fish and eat it too, which is more than we can say for cake. 🐟

¹ Pikitch, E., P.D. Boersma, I.L. Boyd, D.O. Conover, P. Cury, T. Essington, S.S. Heppell, E.D. Houde, M. Mangel, D. Pauly, É. Plagányi, K. Sainsbury and R.S. Steneck. 2012. Little Fish, Big Impact: Managing a Crucial Link in Ocean Food Webs. Lenfest Ocean Program, Washington, DC. 103 p.

