Doubling fish biomass without increasing food supply or food quality

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To increase the biomass of fish, contemporary ecological theory predicts that either the amount of food or the quality of the food has to increase. In a recent experiment, researchers at Umeå University doubled the fish biomass under identical food supply and food quality by only controlling how much of total food supply that was channelled to juvenile and adult fish, respectively. The results have major implications for the

exploitation (harvest) of fish populations and the coexistence of predatory fish and their prey.

To increase the biomass of a population, contemporary ecological theory says that it has to be supplied with more energy either through an increase in the total amount of food supplied or through supplying food that is more nutritious. When the amount and the energy content of the food is kept constant, a biomass increase can only be achieved by changing to another species that uses the supplied food more effectively. But now, researchers at Umeå University show that the biomass of the Least Killifish (Heterandria formosa) increases even when the amount and the energy content of the food supply are kept constant.

All fish populations contain individuals of different sizes, as do most other species' populations on Earth, for example, insects and amphibians. Least Killifish females can grow up to a length of 41 mm and give birth to free swimming, 5-6 mm long, offspring. How effectively an individual can use a certain amount of food for growth and reproduction depends on its size. In the case of the Least Killifish we know that small individuals are more efficient than large individuals. This difference in efficiency makes the biomass production dependent on how the food supply is channelled between individuals of different sizes. Switching from an equal distribution of food between small and large individuals to a distribution where the less efficient large individuals received two thirds of the food doubled the fish biomass.

The results have major implications for the exploitation of natural resources - for example, fisheries - and under what conditions predator and prey fish can coexist. A predator can only persist if its prey is abundant enough. This means that – compared to an equally distributed food supply – a predator species that preys on the Least Killifish can invade at a lower food supply to the prey fish when a larger proportion of the total food supply is available to large individuals than to small

individuals.

The study was carried out by Birte Reichstein and Lennart Persson at Umeå University in cooperation with André M de Roos at the University of Amsterdam. It was published last week in the journal *Nature Communications* under the title "Ontogenetic asymmetry modulates population biomass production and response to harvest".

More information: "Ontogenetic asymmetry modulates population biomass production and response to harvest." *Nature Communications* Volume: 6:6441. DOI: 10.1038/ncomms7441

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