Science News

Picky Eaters?

Scientist Says Size Matters in Determining Smelt Feeding Preferences

Lindsay Sullivan watching video of delta smelt feeding on copepods
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The decline of delta smelt in the San Francisco Estuary has been linked to several possible factors: pumping facilities, predators, nutrients, contaminants, toxic algae, and changes in temperature and salinity. Another possibility is changes in their food. Since the early 1990's, there have been several changes in the prey (zooplankton) that are available to delta smelt and juvenile striped bass—which are also declining.

Humans eat selectively. "If we have a choice between an apple and a candy bar, most of us will choose the candy bar," said CALFED Science Fellow Lindsay Sullivan. Fish eat selectively too, and the bigger their food, the better. But although their food selection may have something to do with choice, it's more the accessibility of the prey. "Can they see the prey?" Sullivan asked. "If they see it, do they attack it? If they attack it, can they catch it?" For this reason, it is not only important to understand selection, but the processes that control it as well.

Today, the most abundant copepod prey (minute marine crustaceans that serve as food for certain fish) is the introduced *Limnoithona tetraspina* that arrived from Asia probably after being dumped with ships' ballast water. "The reason we're interested in this species is that it's doing really well—about 10 times as well as other copepods—and it's much smaller,"

Sullivan said. “There were concerns that maybe fish didn’t eat *Limnoithona tetraspina* because it’s too small—and maybe not very nutritious.” So she and her colleagues conducted experiments to see if larval fish could eat these tiny, abundant copepods.

Sullivan is studying the prey selection of larval and juvenile plankton-eating fish in the San Francisco Estuary and the relationship of prey to the population success of delta smelt and other fishes. The findings from her experiments were “a little bit surprising.” Both striped bass and delta smelt do eat the smaller *Limnoithona tetraspina*.

“For the first 30 days or so, delta smelt will eat this tiny copepod, but as they start growing and their mouth gets bigger, they want to eat bigger copepods,” Sullivan said. This is called optimal foraging theory. “When we eat, we want the biggest bang for our buck. Fish want to eat the biggest thing they can fit in their mouth. As soon as fish can start eating bigger things, that’s what they want to eat.”

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"Smelt are really small when they first hatch and will eat all the copepods the same. Smelt larvae don’t try to eat - that much, but it’s easy to catch,” she added. “The opposite is true of larger copepods. Larval smelt really want to eat the big copepods, but because of their larger size these copepods are much better swimmers so smelt larvae don’t often catch them. But, as delta smelt (and striped bass) grow, they become better swimmers, their eyes and mouths get larger and they become much better predators. Now, the fish larvae want to eat the bigger copepods and can finally catch them, and they don’t WANT to eat these smaller copepods. Unfortunately for these larvae, mostly what is available to them is small copepods. So they are spending time searching for big copepods, overlooking the smaller copepods and end up eating nothing."

High school volunteer Sean Rohtla collecting copepods for use in experiments
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Her findings partially contradict prevailing views that *L. tetraspina* avoids predation by planktivorous fish because of its small size, and suggests that this small copepod may be an important prey item for newly hatched larval planktivorous fish. However, *L. tetraspina* is most abundant in the part of the year when delta smelt are larger and consuming larger prey items, suggesting that this small introduced copepod could be contributing to their decline.

“The amount of carbon/calories of prey that’s available to these fish hasn’t changed,” Sullivan said, “it’s just in smaller pieces—like offering them one baked potato, or one potato cut into French fries. They'd prefer a baked potato, but they're not getting enough baked potatoes."

Information on prey-consumption patterns and the mechanisms that control them has direct implications for efforts to restore pelagic fish populations, particularly delta smelt. Understanding what fish eat and why might help managers predict (understand) how fish will respond to future changes in prey. It also stresses how important it is to prevent species invasions, particularly for planktonic organisms.

Although her fellowship ended in October, Sullivan received funds from the Interagency Ecological Program (IEP) to continue her work on smelt. “Now that we know delta smelt eat *Limnoithona tetraspina*, we need to know what this means to the diet of delta smelt,” she said. “As a result, my current work focuses on growth of smelt on the different copepods rather than feeding.”

The CALFED Science Fellows program funds postdoctoral and graduate researchers to work with community and scientific mentors on targeted CALFED Science Program research priorities, including collaborative data analysis and Bay-Delta projects. Sullivan, who earned a doctorate in oceanography from the University of Rhode Island in 2006, is an avid plankton biologist and postdoctoral fellow at the Romberg Tiburon Center at San Francisco State University.

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