Bering Sea study finds prey density more important to predators than biomass

January 3 2013

This thick-billed murre is part of a Bering Sea study published in *PLOS ONE* looking at the importance of prey "patchiness." Credit: Photo courtesy Kelly Benoit-Bird, Oregon State University

Marine resource managers often gauge the health of species based on overall biomass, but a new study of predator-prey relationships in the Bering Sea found that it isn't the total number of individuals that predators care about – it's how densely they are aggregated.

It's more than searching for an easy meal, the researchers say. Predators need to balance how much energy they expend in searching for food with the caloric and nutrient value of that which they consume. When prey doesn't aggregate, however, the search for food becomes much more difficult – affecting the health of the predators' offspring and the vitality of their overall population.

Results of the study were published this week in the journal PLOS ONE. The study was part of the Bering Sea Integrated Ecosystem Research Project, which was funded by the North Pacific Research Board and the National Science Foundation.

"We had to think very differently about these interactions, trying to see the world from the predators' point of view," said Kelly Benoit-Bird, an Oregon State University marine ecologist and lead author on the study. "When we first tried to identify good foraging locations for predator species we looked at areas of high prey numbers because it makes sense that they'd be where the food is. But the results didn't match what we might have expected.

"Predator populations that should have been doing well, based on prey numbers or biomass, were in fact not doing well," added Benoit-Bird, an associate professor in OSU's College of Earth, Ocean, and Atmospheric Sciences. "What we discovered is that smaller aggregations of prey are more attractive to predators if they are sufficiently dense."

The findings are particularly important, scientists say, because almost all fisheries management is based on biomass – tons of fish – and not how those fish may be distributed in the sea.

These juvenile pollock are critical prey for many species in the Bering Sea.

Credit: Photo courtesy Kelly Benoit-Bird, Oregon State University

In their study, the researchers looked at the feeding behaviors of three co-occurring species in the Bering Sea, all of which consume juvenile pollock or krill – black-legged kittiwakes, thick-billed murres and northern fur seals. When they attempted to find a spatial relationship between these predators and the pollock using areal biomass and numerical abundance, they found little correlation.

However, when they began finding small patches of prey at certain depths and of sufficient density, the predators were there. And though the scientists know why – feeding efficiency – they aren't sure how.

"To be honest, we aren't really sure how these predators – which may travel many miles – locate the densest aggregations at depths well below the surface – and often at night," said Scott Heppell, a fisheries ecologist at Oregon State University and co-author on the *PLOS ONE* paper. "You wouldn't think murres and fur seals would have that much in common, but in this case they do."

"In a way, they're looking for the same thing that commercial fishing fleets look for – high-quality prey in aggregations dense enough to be economical," added Heppell, an assistant professor of fisheries and wildlife at OSU.

Benoit-Bird likened the predator-prey link to locating a box of popcorn in a darkened movie theater. You may have to search for it, she noted, but if you find the popcorn box, the payoff will be much more significant than what you might get by stumbling upon individual kernels in the dark that are spread throughout the theater – even though the number of kernels is the same.

That payoff is particularly meaningful for nurturing young, the researchers point out. During their two-year study, the research group tagged and observed female fur seals from St. Paul Island and Bogoslof Island as they swam hundreds of kilometers over a period of 1-2 weeks to gorge on nutrient-rich pollock then return to their homes to nurse pups.

They also tagged and observed adult murres and kittiwakes at St. Paul, St. George and Bogoslof Islands. The birds would capture local prey to feed their chicks during the day, but make numerous long flights at night to gorge on energy-rich, deep-water prey before returning to their nests to feed their chicks.

"It is a trade-off strategy," said Benoit-Bird, a 2010 recipient of a MacArthur Fellowship. "They feed themselves in one place and nourish their offspring from another."

This concept of prey "patchiness" can change rapidly, the researchers noted. Pollock aggregated only when the number of individuals in an area reached a certain threshold; below that threshold, they swam as individuals.

"If the population is sufficiently diffuse, the pollock don't aggregate and that could spell trouble for species that prey upon them," Heppell said. "A 10 percent shift in the number of fish could change how the entire stock behaves – and have a major impact on the birds, seals and other predators."

Provided by Oregon State University

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