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Predator Versus Prey

A sex-changing fish called California sheephead (Semicossyphus pulcher) plays a vital role in the food web of kelp forests along the Pacific coast. Commonly found in the waters from Baja California to Point Conception — although they can sometimes be found as far north as Monterey Bay — sheephead feed on sea urchins, whose grazing habits can wreak havoc on community composition in kelp forests.

A new study by UC Santa Barbara research biologist Jenn Caselle uses data from three decades of research to document differential exploitation and recovery of sheephead populations in the Santa Barbara Channel in response to marine reserves and fishing regulations. Her research on sheephead appears today in the Proceedings of the Royal Society B: Biological Sciences.

“It’s a really iconic species in our local kelp forests and it’s fascinating because it’s big, it’s beautiful and it changes sex,” Caselle said. Born female, sheephead morph into males at various stages in the lifecycle as determined by environmental conditions and pressures. “There’s a lot going on with this species, and its effect on the kelp forest food web is essential,” she added

Caselle and lead author Scott Hamilton, previously a postdoctoral researcher and now a faculty member at Moss Landing Marine Laboratories near Monterey, show that as sheephead increase in size — particularly when they surpass the minimum size limit of the fishery — they are able to eat bigger urchins, and more of them, as revealed by analysis of their gut content.

“That’s probably because large sheephead can physically handle the urchins,” Caselle said. “We call it gape size, meaning their mouth is big enough to get around them.”

The researchers began their work in 2007 by investigating sheephead population dynamics and life histories in response to fishing pressure. They also have done studies on species’ movements and whether marine protected areas could help sheephead recover from overfishing.

The current paper combines previous findings with new work using visual surveys and path analysis to quantify the direct and indirect effects of sheephead on sea urchins and macroalgal assemblages. The research illustrates the context-dependent ecological role of sheephead in Southern California kelp forests. When predators such as sheephead are fished, not only does abundance diminish, Caselle noted, but size structure is also reduced because fisheries usually target bigger individuals.

“The main point of our work is not necessarily about fishing reducing abundance; it’s about how fishing reduces size structure,” she said. “If you have a species whose predation rate depends on that size, you can have strong trophic effects without even thinking about abundance changes.”

The way in which fishing alters size-structured food web interactions has implications for the structure and function of kelp forest ecosystems. “Our argument emphasizes that management strategies protecting large sheephead — such as marine reserves or increases in the minimum size limit — may help alleviate overgrazing in temperate kelp forest systems,” Caselle concluded.

“The reduction in size structure can have important effects on prey structure as well, apart from reductions in numbers,” she added. “Sheephead are very important players in the kelp forest. By keeping urchins in check, they maintain healthy kelp, which in turn provides habitat for many, many other species.”

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About UC Santa Barbara

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