Illuminating Innovations in Fisheries Technology Reduce Bycatch

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Coastal gillnet fisheries are some of the most common fisheries throughout the world, and they play an important role in the food security, economics, and culture of coastal communities. Yet gillnet fisheries are often problematic because of their nonselective impact on the marine environment; they incidentally capture many nontarget species. Recent studies have shown that sea turtles, in particular, are often caught at high rates in coastal gillnet fisheries. For example, gillnet fisheries along the Pacific coast of Baja California, Mexico, inadvertently kill hundreds of loggerhead turtles each year, and off the coast of northern Peru, gillnets catch hundreds of green sea turtles each year.

Such bycatch can be a severe barrier to the recovery of sea turtle populations. Yet recent experiments with net illumination are yielding encouraging results in reducing sea turtle interactions without affecting target catch species. For the past several years, we have been working in collaboration with Mexican fishers, conservation nongovernmental organizations (NGOs), and the Mexican government to develop various technological solutions that gillnet fishers could adopt to reduce sea turtle bycatch. Because we know that visual cues play important roles in sea turtle ecology and behaviors, we focused on developing visually based bycatch reduction strategies by adapting the fishing lights that are commonly used in longline fisheries, such as chemical lightsticks and battery-powered LED lightsticks, to illuminate gillnets.

In our experiments with gillnet illumination, the average rates of green sea turtle interactions with the nets were reduced by up to 65 percent. The most important finding, however, has been that net illumination *did not* significantly affect total target catch rates or the total catch value of gillnet fisheries that employ this bycatch reduction technology. This finding is critical, because for any bycatch reduction technology to have a chance of being successfully implemented, it must have limited impact on the market value of the fisheries.

Targeted fish species and bycatch species such as elasmobranchs (sharks and rays), sea turtles, and others all have different visual sensitivities that can translate to different behavioral responses to different types of light and, ultimately, to different catch rates. For example, many pelagic and coastal fish species have eye structures that prevent ultraviolet (UV) vision, whereas sea turtles' eyes are sensitive to UV light (wavelengths less than 400 nm). This difference suggests that UV light may be used selectively to communicate with sea turtles.

To examine how various wavelengths of light might affect the overall catch composition of gillnets, we have begun to test the effects of net illumination with short, medium, and longer wavelengths using UV, green, and orange lightsticks, respectively. Experiments with UV-illuminated nets showed that sea turtle interactions were reduced without changing total target catch rates. More interesting, these nets decreased the catch rates of some fish species while increasing the catch rates of others. They also decreased the catch rates of some elasmobranchs—scalloped hammerhead sharks (*Sphyrna lewini*) in particular. Green- and orange-illuminated nets had different effects on these fish and elasmobranch species. These findings suggest that using different wavelengths of illumination can change the selectivity of the net to fit the needs of a fishery by reducing selected bycatch species, and thereby address specific conservation goals.

We have now begun to transfer this technology to other gillnet fisheries. Experiments are ongoing in Peru, Baja California Sur (Mexico), Brazil, Chile, and Indonesia. Exciting results from Peru suggest that net illumination may reduce bycatch of sea turtles and other species. Early results from experiments in Baja California Sur are equally promising with regard to reducing loggerhead bycatch. Experiments in Brazil, however, suggest that net illumination may not work in some fisheries, which underscores the fact that incidental capture of sea turtles in gillnet fisheries is complex, and solving the problem may require a multitude of mitigation measures and strategies. Nonetheless, bycatch reduction technologies will be important tools in the growing toolkit available to resource managers as they work to improve the balance between species protection and fishing interests. ■

THIS PAGE: Researchers and fishermen collaborate in Mexico to test the use of lightsticks on gillnets to reduce turtle bycatch. © JOHN WANG

AT LEFT: A leatherback entangled in a gillnet off of Trinidad. © BRIAN SKERRY