THINK GLOBALLY, ACT REGIONALLY: PREDICTING FUTURE FISHING EFFORT TO REDUCE BYCATCH INTERACTIONS

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As sea turtle bycatch receives greater attention, novel approaches to mitigation have arisen. One of the more practical ideas to emerge of late is the use of data on fishing effort and sea turtle distribution patterns to identify areas of potential overlap for targeted conservation efforts. Since this approach does not require observer data on bycatch, it is being proposed as a possible method for use in data-poor regions or with little-studied species. However, investigators have yet to consider the proper scale and method to best predict fishing effort. I address these shortcomings by exploring the effects of scale on prediction accuracy using a variety of different datasets on fishing effort. Moreover, I consider the influence of various predictor variables on prediction accuracy, including past fishing effort and oceanographic variables. Preliminary results suggest that fishing effort predictions are most accurate at intermediate spatial scales, and that certain environmental factors enhance prediction accuracy. The implications for conservation are that overlap between sea turtles and fishing effort should be addressed at the regional, rather than global scale.

MARINE DEBRIS INGESTION BY *CHELONIA MYDAS* IN SANTA CATARINA COAST, SOUTHERN BRAZIL

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In all continents, marine debris ingestion by sea turtles has become a major concern, especially in levels that can lead the animals to death. Since 2005, Projeto Tamar has been monitoring Florianópolis Island and most of the coastal area of the state of Santa Catarina, southern Brazil, receiving and rehabilitating stranded and incidentally captured sea turtles. Santa Catarina coast is an important foraging ground for juvenile green turtles (*Chelonia mydas*), a globally endangered species. The present study shows preliminary data on anthropogenic debris found in the digestive tract of 19 carcasses of *C. mydas* washed ashore on the coastal area of Santa Catarina between October 2009 and July 2010. Necropsies were performed in the rehabilitation facilities of the Tamar station in Florianópolis. All anthropogenic debris found in the esophagus, stomach, small and large intestines during necropsy were separated, washed and dried at 50°C. After that, all litter items from each part of the gastrointestinal tract of the turtles were separated into six categories (soft plastics, hard plastics, nylon, other plastics, latex, textile and other/unknown), counted and weighed. The individuals' sex and probable cause of death were also determined. Out of the 19 turtles analysed, 10 were females, 9 were males, and 17 (89%) presented marine debris in at least one portion of their digestive tract. If only esophagus and stomach had been analysed, marine debris would be found in 13 (68%) individuals. The mean + standard deviation CCL of the studied animals was 0.369 ± 0.082 meters (range: 0.250 – 0.665 m). Mean number of items found in the 17 turtles analysed was 367 ± 850 items (range: 7 – 3593 items) and mean weight was 25 ± 64 grams (range: 0.13 – 269.60 g) per animal. In terms of number of debris items found, 98% were plastic (70% hard plastics; 16% soft plastics; 8% nylon; 4% other plastics) and only 2% belonged to the other three categories. Plastics accounted for 96% (89% hard plastics; 4% soft plastics; 2% nylon; 1% other plastics) of the overall weight of the debris found in the turtles, followed by latex (2%), textile (1%) and other/unknown (1%). No significant differences were found in litter quantities and weight between males and females (except for the male that presented 3593 debris items weighting almost 270 g), nor correlation among CCL and litter quantities and weight. Concerning the portions of the digestive tract, large intestine showed higher litter content than esophagus (t-test; $p<0.04$) and small intestine (t-test; $p<0.04$). Five of the necropsied turtles (26%) probably died as a result of the debris ingestion. The results obtained in this study are compatible with data in the literature. Based on the results found, it is important to notice that research papers

which only evaluate the contents from esophagus and stomach may be underestimating the amount of debris ingested and the proportion of sea turtles contaminated.

HOOKING POSITION AS A FUNCTION OF HOOK SIZE, BAIT TYPE, AND TURTLE SIZE IN LOGGERHEAD TURTLES (*CARETTA CARETTA*) INCIDENTALLY CAPTURED IN THE U.S. ATLANTIC PELAGIC LONGLINE FISHERY

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Pelagic longline fisheries target large pelagic fish including swordfish, tunas, and sharks throughout the world's oceans. Incidental bycatch in pelagic longline fisheries is known as an important source of sea turtle injury and mortality. In July 2004, the National Marine Fisheries Service (NMFS) issued a Final Rule mandating increased reporting of bycatch, instituting careful handling and release gear requirements and outreach programs, and requiring changes in fishing gear in the U.S. Pelagic Longline Fleet. Most notably, the fishery was required to use circle hooks (size 16/0 no offset, or 18/0 maximum 10° offset outside the Northeast Distant Waters (NED); 18/0 or larger, maximum 10° offset inside the NED) after August 2004. The previous industry standard was a smaller (9/0) J-hook baited with squid. Reductions in bycatch rate and hooking position were expected due to hook shape and increased size based on results from experimental studies conducted in the NED fishing area (Watson *et al*. 2005). Specifically, a reduction in the number of deeply ingested hooks was targeted with the required gear changes. This investigation examines the hooking positions of incidentally hooked loggerhead turtles observed in the U.S. Pelagic Longline Fleet since January 2005. Specifically, we are interested in whether loggerheads deeply ingest a significant proportion of large circle hooks, or whether, as expected, more hookings occur in the beak or mouth. Hooking position may have implications for gear removal success and subsequent survival. Deeply ingested hooks cannot be removed using the required careful release gear, but external hooks and those in the mouth or beak are accessible for removal. We investigate whether there are patterns in hooking position as a function of circle hook size and bait type (squid or finfish). We also investigate whether the potential for deep ingestion increases as turtle size increases using observer data encompassing a large geographic area where a wide size range of turtles was encountered. Data collected by highly trained fishery observers are used to characterize the fishing gear used and hooking position. The fishery has a Pelagic Observer Program (POP), in place since 1992, to document finfish bycatch and quantify interactions with protected species (Beerkeircher *et al*. 2004). The observers document the nature of the hooking interaction, including specific hooking position and amount and type of gear remaining at release. Once the observer determines that the turtle has been hooked, they designate the hooking position as hooked location unknown; internal, unknown; swallowed, visible to insertion point, partial hook visible, or not visible; beak/mouth, upper, lower, side, if mouth: tongue, glottis, roof of mouth, jaw joint, other; external, unknown; beak/head/neck; carapace/plastron; front flipper/shoulder/'armpit'; and rear flipper/groin/tail. Data from these categories are pooled where appropriate and summarized considering hook size, bait type, and turtle size.

LESSONS LEARNED FROM 10 YEARS OF FISHERIES BYCATCH RESEARCH*

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Incidental capture of unwanted species, or bycatch, in artisanal and commercial fishing operations has been shown to result in population-level impacts on threatened and endangered marine animals. In response to high interaction rates with sea turtles, the Hawaii-based longline shallow-set (swordfish) fishery was closed for two years and is now subject to strict management measures. Given the ecological concerns, as well as the enormous economic toll such a closure placed on U.S. commercial activities, NOAA was highly motivated to seek solutions to identify mitigation measures that would allow fishing operations to continue while simultaneously not posing a risk to sea turtle populations. Thus