Marine Turtle Newsletter 112:4-8, © 2006

Marine Turtle Newsletter

Sea Turtles and Fishery Interactions in Brazil: Identifying and Mitigating Potential Conflicts

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Projeto TAMAR/IBAMA (TAMAR) has been actively involved in sea turtle conservation in Brazil for the past 25 years and currently operates a network of 21 research stations in 9 states distributed along 1,100 km of coastline. TAMAR's combination of research efforts has successfully reduced the number of threats facing the five species of sea turtle that nest or forage along Brazil's coast and oceanic islands (Marcovaldi & Marcovaldi 1999).

Research aimed to minimize sea turtle interactions with the coastal fisheries has been a priority for Projeto TAMAR/IBAMA since 1990 (Marcovaldi *et al*. 2002; Thomé *et al*. 2003), and in the two high seas fisheries - longline and driftnet - since 2001. During this 11 year period, TAMAR has empirically implemented mitigation actions according to local needs, and realized that these efforts needed to be taken on a larger scale, supported by standardized information. In order to achieve this goal, a federal plan entitled "Brazilian National Action Plan to Reduce Incidental Capture of Sea Turtles in Fisheries" (herein referred to as "Action Plan") was created in 2001 and its stated methodologies and objectives are described at Marcovaldi *et al*. (2002). The current article aims to provide an update on the Action Plan and how its objectives are being met in conjunction with TAMAR's regional leadership and research stations, as well as institutional partners such as universities, NGO's, and the fishing industry (e.g. fishermen, vessel owners). Specifically, this report provides an initial assessment of sea turtle interactions with Brazil's coastal and high seas fisheries. By characterizing the fisheries (e.g. effort, region, season), it will be possible to identify threats to sea turtle species at different life history stages in a manner that will allow for best management practices to reduce sea turtle-fisheries interactions. This work represents the first in a number of steps required to determine the rates of incidental capture of sea turtles in fisheries, thereby allowing us to identify the relative and actual threats of specific coastal and high seas fisheries on long term sea turtle population trends in the waters off Brazil in the South Atlantic Ocean. Future efforts will target fisheries where mitigation efforts and awareness-campaigns for fishermen will have the greatest impact to reduce sea turtle mortality.

In order to implement strategies defined in the Action Plan (Marcovaldi *et al*. 2002), the term

"fishery" is defined by parameters such as characterization of gear, boat, target species, spatial and temporal distribution, organizational aspects (e.g. associations), offloading locations, institutional interfaces, fishermen, relevant legislation, and fishing effort. Fisheries data have been collected during interviews with fishermen at major points and by at-sea observers for the pelagic fisheries. Information on fisheries via interviews has been collected consistently since 1990 for coastal fisheries, and by onboard observers for the pelagic fisheries since 2001. To obtain fishing effort and other characteristics of each fishery, data from government agencies or from published research were used. The various forms of data collected have been stored in a national TAMAR data base.

We have identified 18 different fisheries that interact with sea turtles, 16 of which are coastal (Table 1, Figure 1) and 2 are high seas, or pelagic (Table 2, Figure 2). The pelagic longline fishery in Brazil generally targets tuna species (e.g., *Thunnus* sp), swordfish (*Xiphias Gladius*), and sharks. Preliminary data and anecdotal reports from fishermen suggest that the main species interacting with pelagic longline gear are primarily loggerheads (ca. 65%) and leatherbacks (ca. 25%), followed by occasional captures of green and olive ridley turtles, with a reportedly high incidence of turtles captured and released alive. Preliminary analysis from a limited data set obtained from on-board fisheries observers in the longline fleet also suggests a region (ca.30° and 40° S and 30° and 40° W) with exceptionally high rates of loggerhead captures (Figure 2).

Driftnet fisheries, which generally target shark (primarily hammerhead, *Sphirna* spp) for a domestic market (only the meat), and the fins to the international market, have been monitored since 2002 in collaboration with local fishermen. To date, the fleet in Ubatuba, Sao Paulo is the only one monitored. There are approximately 50 vessels that use drift nets on a regular basis. Preliminary data obtained from a few on-board observers and from anecdotal reports from fishermen suggest that most of the sea turtles captured in this fishery are leatherback (ca. 70%), followed by loggerhead turtles (15%), with occasional captures of green and hawksbill turtles. There is a high rate of mortality upon capture.

This is an initial assessment and characterization of the various fisheries in Brazil that interact with sea turtles, a key step in addressing fisheries management priorities in order to minimize turtle bycatch and effectively work towards restoring sea turtle populations. Characterizing and monitoring these fisheries has enabled: (1) the development of a methodology that will enable estimation of turtle capture rates per unit of fishing effort (CPUE); (2) species identification and life history stage of turtles captured per fishery; and (3) participation in fora where stakeholders directly involved in priority fisheries can interact. For each identified fishery the Action Plan developed four objectives: 1) monitoring the fishing operations; 2) developing specific experiments or tests; 3) developing mitigation measures; and 4) supporting actions for sustainable fishing. This preliminary work has allowed for these actions to occur, and furthermore has identified priority areas to maximize conservation efforts.

Of particular note is the identification of a bycatch "hotspot" in the Brazilian longline fishery.

Previous preliminary studies on sea turtle incidental captures in this fishery have been reported elsewhere (Barata *et al*. 1998; Kotas *et al*. 2004; Pinedo & Polacheck 2004). Despite limited data collected in our study we are confident in our ability to identify the area between approximately 30° and 40° South and 30° and 40° West as a bycatch hotspot with an exceptionally high rate of incidental capture of primarily loggerhead and secondarily leatherback turtles (Sales *et al*., unpublished data; Figure 2). This area, known as Rio Grande Rise (Elevação do Rio Grande), is approximately 600 nautical miles off the southern Brazilian coast where depths range between 300 and 4000 m and with a bathymetry characterized by a chain of underwater mountains (Sales *et al*. unpublished data). This area hosts large pelagics (e.g. *Thunnus* sp.) and fishermen report numerous interactions with sea turtles (Sales *et al*., unpublished data). This area is likely to be an important habitat especially for loggerhead sea turtles in the South West Atlantic Ocean and further research on the occurrence of turtles and ways to minimize bycatch in that region is clearly an urgent need.

We are also working towards a better understanding of the genetic stock of sea turtle populations in areas with high rates of incidental capture in fisheries. Preliminary results using mitochondrial DNA analysis indicate that 45% of loggerhead turtles incidentally captured off the coast of south Brazil, especially on Rio Grande Rise, originate from a unique Brazilian loggerhead nesting population from the states of Bahia and Espírito Santo. Juvenile loggerhead turtles with origins suggested for Australia, South Africa, Oman and other unknown locations also contribute to the bycatch hotspot (Soares, unpublished thesis).

In the future, determination of bycatch rates for coastal fisheries will be estimated by linking fisheries information with sea turtle stranding data or direct observations from onboard observers, with an emphasis on the latter method as linking stranding data with fisheries interactions can be a flawed approach (Epperly *et al*. 1996). In addition, conversations with fishermen on the subject of turtle capture rates will allow for a more reliable estimate of turtle bycatch occurring in Brazil's extensive and complex coastal fisheries. In the meantime, more research is needed in order to define fisheries "effort" (e.g. net or trap size and numbers) in coastal fisheries in Brazil (and elsewhere in the world) so that such reporting can be standardized for various purposes regarding factors influencing the marine habitat in this region.

TAMAR will continue to improve its data collection, analyses, and assessments by working cooperatively with the coastal fisheries and pelagic commercial fleets. Ideally, this work will lead to management efforts that will effectively minimize both turtle bycatch and the negative economic impacts these mitigation efforts pose to fishing communities. TAMAR will continue to participate in the Western South Atlantic Network that includes Brazil, Argentina, and Uruguay. It is also necessary to continue working on mitigation measures such as awareness campaigns through stakeholder fora and specific educational material, including safe-handling practices to increase turtles' chances of survival after their release from fishing gear. Furthermore, TAMAR will continue efforts at the federal level to reduce the incidental capture of sea turtles and improve international exchange of information on incidental capture of sea turtles in international waters through the

various Regional Fisheries Bodies and International Conventions, such as the International Convention for the Conservation of Atlantic Tunas and Inter-American Convention on Sea Turtles.

Acknowledgements: Projeto TAMAR is affiliated with IBAMA, co-managed by the Fundação Pró-TAMAR, and officially sponsored by PETROBRAS. We thank Yonat Swimmer and Luciano Soares for their kind assistance on this manuscript, the Brazilian longline commercial fleet for their cooperation, Projeto Albatroz, and the following universities: UNIVALI, UFRPE, UEFS, UFES and UFRJ. The work was partially funded by the University of Hawaii, Joint Institute of Marine and Atmospheric Research, Honolulu, Hawaii, USA.

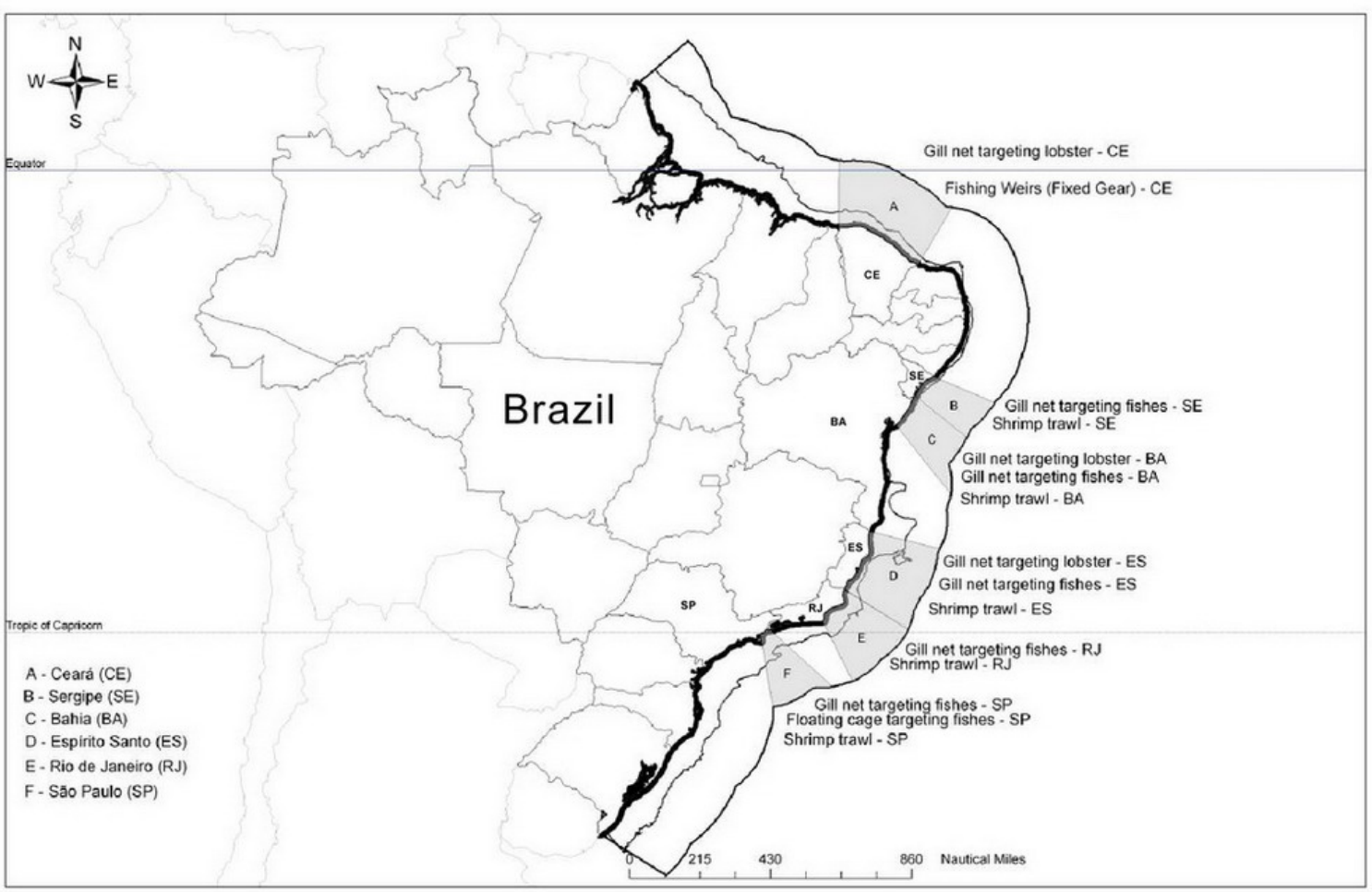
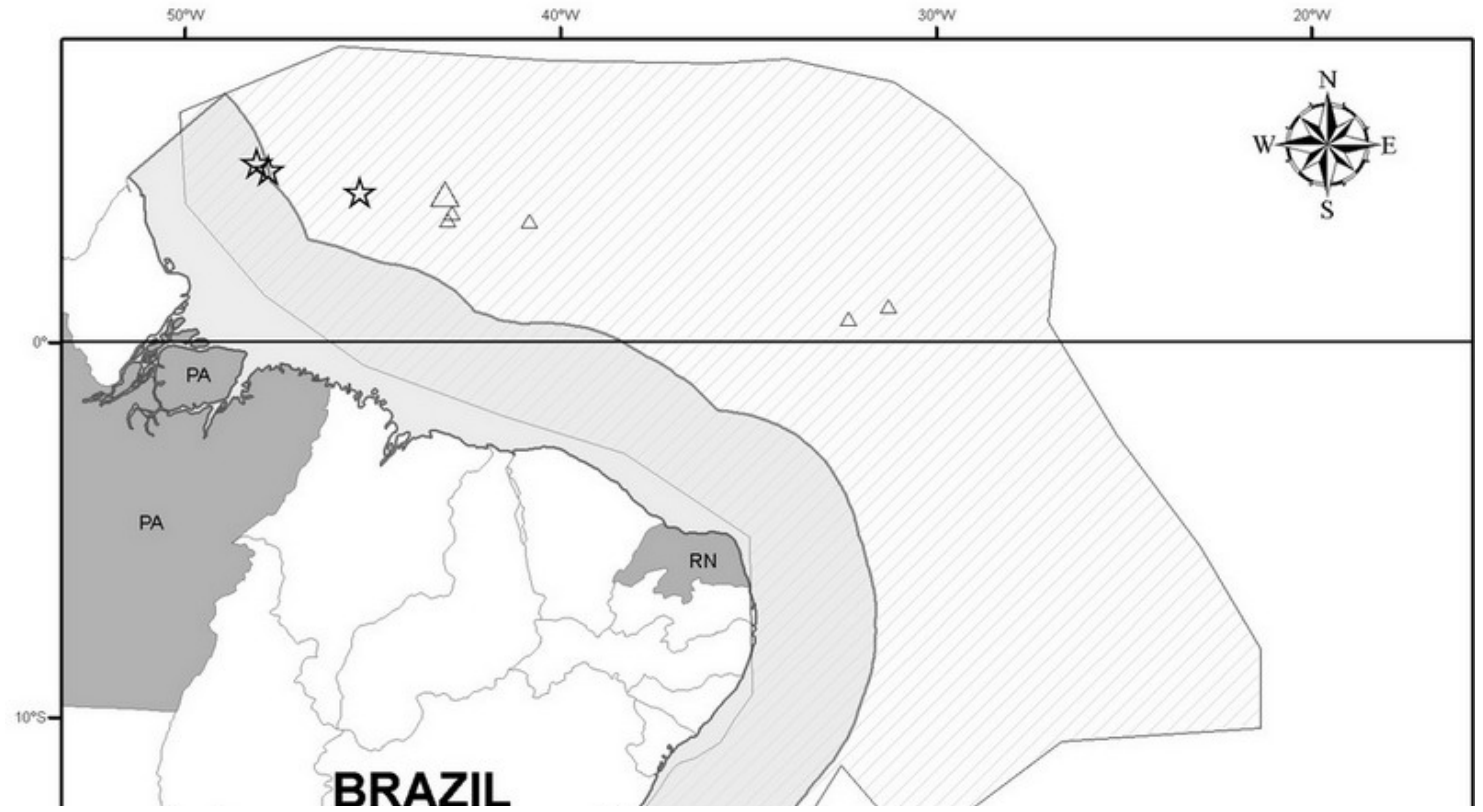


Figure 1. Location of major coastal fisheries, monitored by Tamar, interacting with sea turtles along the Brazilian coast.

State	Fisheries	Target species	Turtle spp interaction	Fishing Effort	Degree of Turtle Interaction	Mitigation Measures
CE	Gill net	lobster	Cc; Cm; Dc; Ei; Lo	ca 2000 vessels (9-15m length)	Unknown. Observers now on board to collect data	Forced replacement of gear to traps. #Gill nets forbidden by federal law since December 2004
	Fix cage	fishes	Cc; Cm; Dc; Ei; Lo	48 Fix cage	299* turtles caught in 2003. High capture rate, nearly 100% turtles released alive	Awareness campaign for fishermen.
SE	Gill net	fishes	Cc; Cm; **Ei; Lo**	Not estimated	Unknown	Area closures in some regions and awareness programs oriented to fishermen
	Shrimp trawl	shrimp	Cc; Cm; **Ei; Lo**	ca 500 vessels	Direct estimates unknown. Stranding data used to infer estimates	Time-area closures (during nesting season or in important feeding areas), TEDs required but not enforced. **Awareness campaigns for fishermen.**
BA	Gill net	lobster	Cc; Cm; **Ei; Lo**	ca 50 vessels	Unknown. Observers now on board to collect data	Forced replacement of gear to traps. #Gill nets forbidden by federal law since December 2004
	Gill net	fishes	Cc; Cm; **Ei; Lo**	ca 350 vessels	Unknown	Area closures in some regions and awareness programs oriented to fishermen
	Shrimp trawl	shrimp	Cc; Cm; Ei; Lo	ca 250 vessels	Direct estimates unknown. Stranding data used to infer estimates	Time-area closures (during nesting season or in important feeding areas), TEDs required but not enforced. **Awareness campaigns for fishermen.**
ES	Gill net	lobster	Cc; Cm; **Dc; Ei**	ca 186 vessels	Unknown	Forced replacement of gear to traps. #Gill nets forbidden by federal law since December 2004
	Gill net	fishes	Cc; Cm; **Dc; Ei**	ca 698 vessels	Unknown	Area closures in some regions and awareness programs oriented to fishermen
	Shrimp trawl	shrimp	Cc; Cm; **Dc; Ei**	ca 186 vessels	Direct estimates unknown. Stranding data used to infer estimates	Time-area closures (during nesting season or in important feeding areas), TEDs required but not enforced. **Awareness campaigns for fishermen.**
RJ	Gill net	fishes	Cc; Cm; **Ei**	ca 150 vessels	Unknown	Area closures in some regions and awareness programs oriented to fishermen
	Shrimp trawl	shrimp	Cc; Cm; **Ei**	ca 125 vessels	Direct estimates unknown. Stranding data used to infer estimates.	Time-area closures (during nesting season or in important feeding areas), TEDs required but not enforced. **Awareness campaigns for fishermen.**
SP	Gill net	fishes	Cc; Cm; **Ei**	Not estimated	Unknown	Area closures in some regions and awareness programs oriented to fishermen
	Shrimp trawl	shrimp	Cc; Cm; **Ei**	ca 150 vessels	Direct estimates unknown. Use stranding data to infer estimates.	Time-area closures (during nesting season or in important feeding areas), TEDs required but not enforced. **Awareness campaigns for fishermen.**
	Floating cage	fishes	Cc; Cm; **Ei**	10 Floating cages in Ubatuba-SP	Unknown. Nearly 100% turtles released alive.	Monitoring of cages, awareness campaigns for fishermen.

Despite the 2004 regulations forbidding gill nets for lobsters, this law has still not being enforced.

Table 1. Coastal fisheries and sea turtle interactions in Brazil. Codes for turtle species: Dc=leatherback (*Dermochelys coriacea*), Cc=loggerhead (*Caretta caretta*), Lo= olive ridley (*Lepidochelys olivacea*), Cm= green (*Chelonia mydas*), Ei= hawksbill (*Eretmochelys imbricata*).



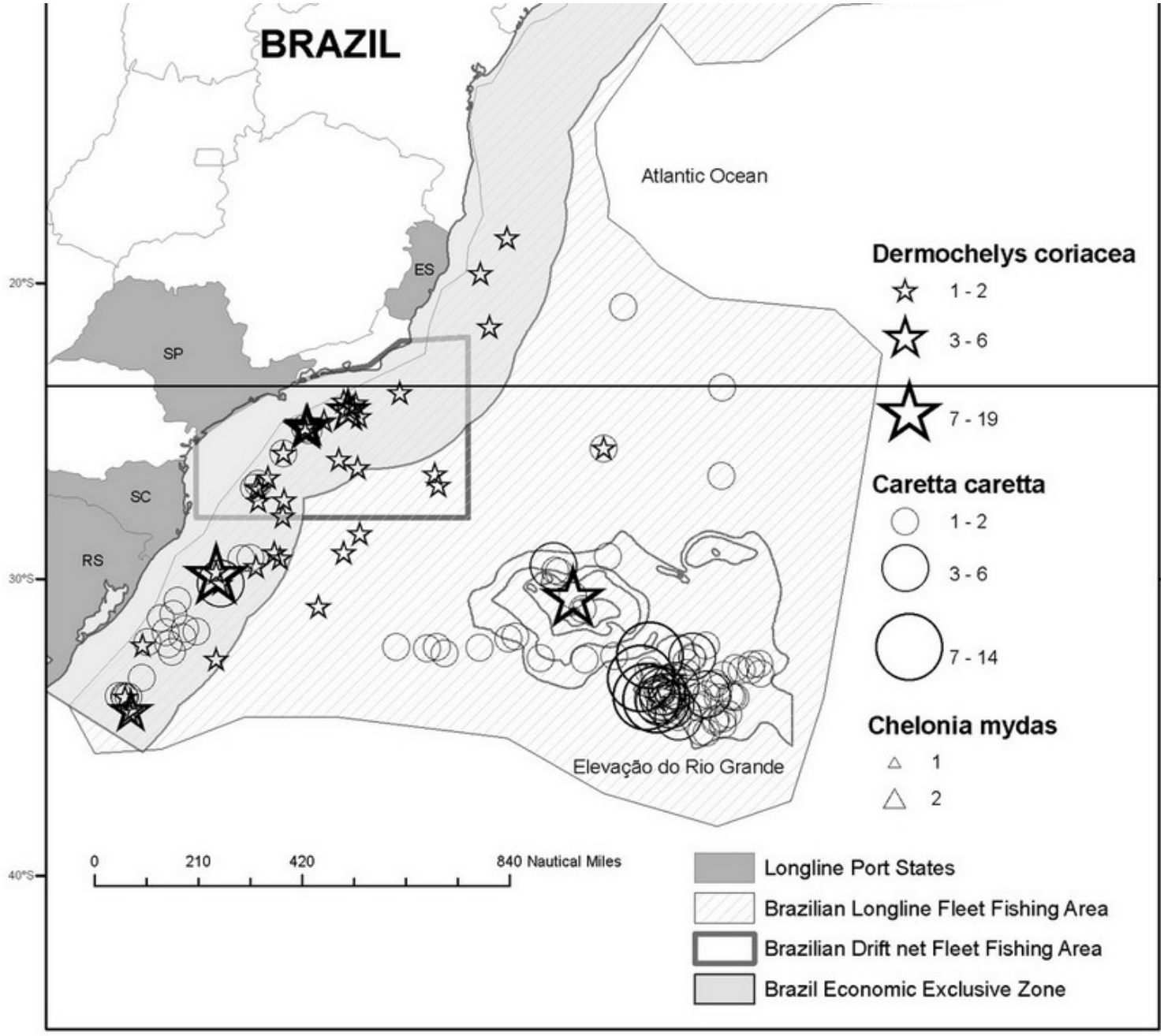


Figure 2. Pelagic longline and drift net interactions with sea turtles off Brazil.

Fisheries	*Target species*	*Turtle spp interaction*	*Mitigation Measures*	*Experiments conducted to minimize bycatch*
Pelagic longline	Swordfish, tuna, sharks	Cc; Cm; Dc; Lo;	Federal Act SEAP (February/2003) requiring use of approved mitigation measures, training courses for fishermen and on-board fisheries observers regarding data collection and safe-handling practices, cooperative agreement with the fisheries industries to develop conservation plan for sea turtles and sea birds, federal act requiring onboard observers in the Brazilian rented commercial fleet (Act SEAP n°. 4810, August 2003).	Field trials on federal research vessels with modified baits and hooks. Experiments with captive turtles with modified baits to identify potential chemical repellent.
Driftnet	sharks	Cc; Cm; Dc; Ei	Time and area closures, creation of a discussion forum with stakeholders to find solutions to minimize the capture of sea turtles such as the replacement for another gear.	n/a

Table 2. Pelagic fisheries that interact with sea turtles in Brazil. Codes for turtle species: Dc=leatherback (*Dermochelys coriacea*), Cc=loggerhead (*Caretta caretta*), Lo= olive ridley (*Lepidochelys olivacea*), Cm= green (*Chelonia mydas*), Ei= hawksbill (*Eretmochelys imbricata*).

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