

Impact of Commercial Fishing on Trindade Island and Martin Vaz Archipelago, Brazil: Characteristics, Conservation Status of the Species Involved and Prospects for Preservation

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ABSTRACT

Visual records, radio interviews and onboard observations of the fishing activities during a 58 days scientific expedition to Trindade Island and the Martin Vaz Archipelago were obtained from February to April 2007. The regular activities of four different fisheries were observed: pelagic longline, bottom line, trolling and handline. These fisheries caused mortality of at least seven species with some level threat, according to the International Union for Conservation of Nature list. The establishment of specific restriction norms for hook-and-line activities around the oceanic islands was seen as an alternative for the conservation of the ichthyofauna of the region. Satellite monitoring to track the fishery vessels could be established through the national program as another legal mean to diminish fishing the impact.

Key words: Ocean fishery; Trindade Island; Martin Vaz Archipelago; longline; bottom line; conservation

INTRODUCTION

There has been increasing interest regarding the ichthyofauna of oceanic islands, as geographic isolation leads to unique speciation and community patterns (Gasparini, 2004). In Brazilian waters, the fact that some oceanic islands remain preserved environments due to their distance from the coast and protection from the government agencies (e.g. Atol das Rocas and Fernando de Noronha Archipelago), together with the high proportion of endemism compared to coast (6 to 12% - Gasparini and Floeter, 2000), enhances their peculiarities. Until recently, however, scientific expeditions to investigate the

reef ichthyofauna of Brazilian oceanic islands were scarce, mainly due to the distances involved as well as the lack of infrastructure to support research in these regions (Sampaio et al., 2006). Trindade Island (20°30'30"S, 29°19'30"W), located 1160 km from the central coast of Brazil, and the Martin Vaz Archipelago (20°29'00"S, 28°51'00"W) is the only emerged components of a chain of extinct underwater volcanoes, denominaing the Vitória-Trindade Seamounts and are the easternmost points of the Brazilian territory. With the establishment of the Oceanographic Station in 1957, Trindade Island fell under the protection of the Brazilian Navy. In 1989, Trindade Island and the Martin Vaz

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Archipelago were declared an Ecological Reserve of the city of Vitória (state of Espírito Santo) with the aim of permanent preservation of the islands. Fishing with several gears (pelagic longline, bottom longline, handline, trolling, drift net, surface seine and mid-water seine) occurs in oceanic regions of Brazil. Some of these fisheries may affect the integrity of the fish community structure of the oceanic islands and seamounts. The lack of specific control legislation for most of the different line fishery modalities in Brazil increases this risk. Fishery activities have a direct influence on the composition and abundance of resident sedentary species (Koslow et al., 2000). The decline in the number of large fish at the top of the food chain, which is the first symptom of exploitation, may cause significant pattern changes in the trophic structure (Ferreira et al., 2004), including cascade effects (Friendlander and DeMartini, 2002). There is evidence that over-fishing may have been responsible for local extinctions of reef species on other Brazilian oceanic islands (e.g. reef-sharks of the Saint Peter and Saint Paul Archipelago - Oliveira et al., 1997). The known fishery activities practiced in oceanic regions of Brazil are surface longline, pelagic longline, bottom longline (on banks and around islands), handline, (on banks and around islands), trolling, drift net, surface seine and mid-water seine. This work reports, for the first time, a baseline description of the characteristics of professional fisheries as well as target species and caught species in the Trindade-Martin Vaz insular complex.

MATERIALS AND METHODS

Along a scientific expedition organized by the TAMAR/ICMBio Project and with logistical support from the Brazilian Navy, the fishery activities in the Trindade-Martin Vaz insular complex were observed for 58 days (February 28 to April 26, 2007). Seven beaches located on the eastern and western sides of the island were roved daily and the presence of fishing vessels that approached the island was recorded and radio contact was established from the Brazilian Navy (Trindade Island Oceanographic Station) and the boat captains were interviewed. The interviews included the questions on the characteristics of the vessel (size, origin and destine ports, store capacity), fishing gear, crew and species caught.

Five days on board of two fishing boats were made. Photos and filming of the fishery activities and specimens of the species caught were deposited at the Department of Oceanography and Ecology of the Universidade Federal do Espírito Santo.

The habitat and local abundance of the species were grouped according to Gasparini and Floeter (2001). The classification regarding the degree of the conservation status was based on the International Union for the Conservation of Nature (IUCN, 2008) list and that of the Brazilian Environmental Agency IBAMA (Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis, 2003a, 2003b). Species distribution was based on Froese and Pauly (2008).

RESULTS

Pelagic longline

Three pelagic longline vessels, one of which was a wooden-hulled boat from Caravelas (state of Bahia, east coast of Brazil) and two were steel-hulled boats from Itajaí (state of Santa Catarina, southern Brazil) were sighted and interviewed. The vessels ranged in size from 14 to 25 m and operated 1.9 km from the Trindade and Martin Vaz islands, deploying longlines from 15 to 55 km in length (500 to 3 000 hooks), mainly targeting the blue shark (*Prionace glauca*) and swordfish (*Xiphias gladius*) (Fig. 1). The vessels capacity ranged from 15 to 40 tons of catch and could remain from 15 to 25 days at sea. Fishery production recorded on a single night on the smallest of the three boats was eight blue sharks and two swordfish, using 550 hooks. Besides the target species, the interviewed reported catches of sea turtles *Chelonia mydas* and *Dermochelys coriacea* (respectively, one and two individuals), however, with no evidence presented. It should be stressed that longline catches have a considerable impact on species of sea turtles, all of which are highly threatened status. The potential of this negative impact is great in the Trindade-Martin Vaz insular complex, as Trindade is one of the large reproduction grounds for the green turtle *C. mydas* in the Atlantic Ocean (Moreira et al., 1995). All boat captains reported the presence of large Asian vessels operating clandestinely in Brazilian waters.



Figure 1 - Pelagic longline fishery off Trindade Island. a) swordfish (*Xiphias gladius*); b) blue shark (*Prionace glauca*). Photos: HT Pinheiro.

Bottom longline, Trolling and Handline

Around Trindade, the constant presence of fishing boats was observed from Vitória (state of Espírito Santo), operating with three different hooks gears: bottom longline, trolling and handline (Fig. 2). Interviews were made with six fishermen during three days on board. The boats were wooden-hulled, 15 m in long and manual traction longline retrieval, each measuring approximately 2 km in length and holding approximately 200 hooks. The bottom longline fishery targets reef sharks (e.g. *Carcharhinus perezii* and *Ginglymostoma cirratum*) and large serranids. The gear (at least two bottom lonlines) were deployed at the end of the afternoon in the shallow reef habitats of the islands a few meters from the shoreline and retrieved the following morning. During the longlines soaking, both at day and night, handlines were used, targeting large carangids (*Caranx lugubris*, *C. latus*, *Elagatis bipinnulata* and *Seriola*

spp.) and serranids (*Epinephelus mystacinus*, *Mycteroperca venenosa* and *Ephinephelus adscensionis*), but also catching Priacanthidae, Gempylidae and Muraenidae. Small scombrids were used as bait, along with other local reef fish such as *Cephalopholis fulva*, *Holocentrus adscensionis*, *Heteropriacanthus cruentatus* and *Gymnothorax moringa*, caught with trolling or bottom line. According to one of the boat captains who had been fishing at the Trindade-Martin Vaz complex for 12 years, there was a visible process of population decline of the yellowfin grouper (*M. venenosa*). Between four and ten years ago, catches of this fish ranged from 400 to 800 kg per trip, whereas only between one and three specimens were currently caught per trip.

Table 1 displays a summary of the characteristics of the different fishery activities. Table 2 displays information on the species involved with the different fishery activities studied.



Figure 2 - Bottom line and handline fisheries of Trindade Island and the Martin Vaz Archipelago. a) yellowfin grouper (*Mycteroperca venenosa*) caught by bottom line at Martin Vaz; b) misty groupers (*Epinephelus mystacinus*) caught by bottom line at Trindade; c) reef sharks (*Carcharhinus perezii*) caught by bottom longline at Martin Vaz. Photos: HT Pinheiro and D. Krise (D).

Table 1 – Summary of commercial fishery activities carried out in areas surrounding the Trindade-Martin Vaz insular complex.

Gear	Gear Characteristics	Vessel Characteristics	Port of Origin	Target Species
Surface longline	Longlines from 15 to 55 km in length; 500 to 3000 hooks. Retrieval by motorized traction.	Vessels from 14 to 25 m; 15 to 40 T catch capacity; spend from 15 to 25 days fishing.	Caravelas (east coast) and Itajaí (southern coast)	Blue shark (<i>P. glauca</i>) and swordfish (<i>X. gladius</i>)
Bottom longline	Longlines with a minimum of 2 km in length and minimum of 200 hooks. Retrieval by manual traction.	Vessels of 15 m; 15 T catch capacity; spend up to 20 days fishing.	Vitória (east coast)	Reef sharks <i>C. perezii</i> and <i>G. cirratum</i> and large Serranidae
Trolling	Up to four lines, with artificial bait	Same as bottom longline characteristics	Vitória (east coast)	Scombridae and Carangidae (small specimens used as bait in bottom longline fishing)
Bottom line	To depths of 150 meters	Same as bottom longline characteristics	Vitória (east coast)	Large Carangidae (<i>C. lugubris</i> , <i>C. latus</i> , <i>E. bipinnulata</i> and <i>Seriola</i> spp.) and Serranidae (<i>E. mystacinus</i> , <i>M. venenosa</i> and <i>E. adscensionis</i>)

Table 2 - Species involved with distinct fishery activities studied.

Species involved	Conservation Status		Habitat	Local Abundance	Distribution
	IUCN	IBAMA			
<i>Prionace glauca</i>	Lower risk	Threatened with overexploitation	P-O	Not recorded	WA
<i>Xiphias gladius</i>	Data deficient	-	P-O	Not recorded	WA
<i>Carcharhinus perezii</i>	Lower risk	-	P-C	Uncommon	WA
<i>Ginglymostoma cirratum</i>	Data deficient	Threatened with extinction	D	Common	PA; EP
<i>Caranx lugubris</i>	-	-	P-C	Very Common	WA
<i>Caranx latus</i>	-	-	P-C	Common	PA
<i>Elagatis bipinnulata</i>	-	-	P-O	Uncommon	PA
<i>Seriola spp.</i>	-	-	O-P	Uncommon	PA
<i>Epinephelus mystacinus</i>	-	-	D	Not recorded	WA; EP
<i>Mycteroperca venenosa</i>	Lower risk	-	D	Uncommon	WA
<i>Ephinephelus adscensionis</i>	-	-	D	Common	PA
<i>Cephalopholis fulva</i>	-	-	D	Very Common	WA
<i>Holocentrus adscensionis</i>	-	-	D	Very Common	PA
<i>Heteropriacanthus cruentatus</i>	-	-	D	Common	WA
<i>Gymnothorax moringa</i>	-	-	D	Common	WA; CA
<i>Chelonia mydas</i>	Endangered	Vulnerable	P-O-C	Not recorded	WA
<i>Dermochelys coriacea</i>	Critically endangered	Critically endangered	P-O	Not recorded	WA

Habitat: D=demersal; P=pelagic; O=oceanic; C=coastal. Distribution: AO=all oceans; PA=Pan-Atlantic; WA=Western Atlantic; CA=Central Atlantic; WAEP=Western Atlantic and EP=Eastern Pacific.

DISCUSSION

The difficulty in the establishment and maintenance of reef fish populations in oceanic regions, due few shallow areas, makes these environments sensitive to any type of impact or anomaly, whether of an anthropogenic or natural origin. This characteristic makes the extinction or loss of fish species from the local community more easily than the colonization of species coming from the continental shelf. Due to its reduced reef area available, a large number of factors threaten this fragile ecosystem. One of the major threats to insular reef fish is fishing pressure on top predators, which has a cascade effect on other species, including endemic species (Friendlander and DeMartini, 2002; Sampaio et al., 2006).

A recent list of threatened fish from Brazilian oceanic islands includes five shark species at Trindade and Martin Vaz (Sampaio et al., 2006). Among these species, the blue shark (*P. glauca*) and the nurse shark (*G. cirratum*) have been the target of exploitation in this region by large vessels from the states of Santa Catarina, Bahia and Espírito Santo. Likewise, the reef shark (*C. perezii*) and yellowfin grouper (*M. venenosa*),

which are both listed as threatened species by the IUCN, have been exploited for a number of years by the bottom longline fleet in shallow regions around Trindade and Martin Vaz. In fact, the captains and crew interviewed confirmed that of these boats, the populations of these species exhibited an accentuated decline. Koslow et al. (2000) reported the “boom and bust” cycle that characterized many individual bottom oceanic fisheries, where often within 5-10 years could drive commercial exploitation to extinction.

The frequent catch of juvenile specimens of *C. perezii* by the coastal bottom longline fishery (Fig. 1) could indicate that shallow areas of the Trindade-Martin Vaz insular complex served as nursery for this species, as has been observed at other Brazilian oceanic islands (Garla et al., 2006). This raises the concern for conservation of this species on the island. Species threatened due to their distribution being restricted to around the island (except *P. glauca*) and the unique characteristics of their life history run the risk of disappearing if not managed correctly, as occurred with shark species from around the Saint Peter and Saint Paul Archipelago (Debelius, 1997; Oliveira et al., 1997). These examples stress the vulnerability of isolated populations limited to

oceanic islands to any type of exploitation or alteration in the habitat (Oliveira et al., 1997; Sampaio et al., 2006).

Martins et al. (2005) reported the decline in catch rates of large reef fish by the Espírito Santo fleet in the 1980s, which forced the fishermen to change the focus of fisheries. The authors described the large movements of the fleets in search of the best fishing grounds and eventually coming to the Vitória-Trindade seamounts, but bottom longline was the least employed fishery modality in the state of Espírito Santo. The present study showed that even the low fishery efforts by the small fleet from the city of Vitória threatened the fragile structure of reef fish communities at Trindade and Martin Vaz.

The banning of the hook-and-line activities in the few shallow areas around these oceanic islands could be the only alternative for the conservation of the threatened species. This restriction would not compromise the activity as a whole, as it occurs throughout nearly all the continental shelf and oceanic areas of Brazil. Monitoring could be done by satellite through PREPS, the national program of satellite tracking of fishery vessels. However this program should be extended to the boats smaller than 15 m as boats fishing around Trindade are 10 to 15 meters long. Considering the responsibility of the Navy for guarding these islands – including their natural heritage – and the surrounding waters, joint efforts between the Navy, IBAMA and the Secretary of the Environment of Vitória City Hall would be the best form of in situ management of these insular environments, with the establishment of regulatory measures regarding activities of considerable impact and thereby avoiding the capture of threatened species and those sensitive to overfishing.

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RESUMO

Reportamos atividades de pesca comerciais no complexo insular mais afastado da costa brasileira: Ilha da Trindade e Arquipélago Martin Vaz. As atividades foram estudadas através de embarques e entrevistas com os mestres e pescadores das embarcações durante uma expedição científica realizada entre fevereiro e abril de 2007. Quatro modalidades de atividades de pesca são realizadas na região, capturando ao menos sete espécies que possuem algum risco de extinção. O estabelecimento de normas específicas de restrição para atividades que pescam sobre os recifes das ilhas é uma alternativa para a conservação das espécies ameaçadas. O monitoramento das embarcações pode ocorrer via satélite através do programa nacional de rastreamento de embarcações pesqueiras (PREPS).

REFERENCES

- Debelius, H. (1997), *Mediterranean and Atlantic fish guide*. Frankfurt: IKAN – Unterwasserarchiv
- Ferreira, C.E.L., Floeter S.R., Gasparini J.L., Ferreira B.P., Joyeux J.C. (2004), Trophic structure patterns of Brazilian reef fishes: a latitudinal comparison. *J Biogeogr*, **31**, 1093–1106.
- Ferreira, C.E.L., Gasparini, J.L., Carvalho-Filho, A., Floeter, S.R. (2005), A recently extinct parrotfish species from Brazil. *Coral Reefs*, **24**, 128.
- Friedlander, A.M., DeMartini, E.E. (2002), Contrast in density, size and biomass of reef fishes between the northwestern and the main Hawaiian islands: the effects of fishing down apex predators. *Mar Ecol- Prog Ser*, **230**, 253–264.
- Froese, R., Pauly, D., editors. (2008), *Fishbase*. Available from <http://www.fishbase.org> (accessed May 2008).

- Garla, R.C., Chapman, D.D., Shivji, M.S., Wetherbee, B.M., Amorim, A.F. (2006), Habitat of juvenile Caribbean reef sharks, *Carcharhinus perezii*, on two oceanic insular marine protected areas in the southwestern Atlantic Ocean: Fernando de Noronha Archipelago and Atol das Rocas, Brazil. *Fish Res*, **81**, 236–241.
- Gasparini, J.L. (2004), *Ilha da Trindade e Arquipélago Martin Vaz: pedaços de Vitória no azul atlântico*. Vitória, GSA, 100p.
- Gasparini, J.L., Floeter S.R. (2001), The shore fishes of Trindade Island, western South Atlantic. *J Nat Hist*, **35**, 1639–1656.
- IBAMA – Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis, (2003^a), *Lista Nacional das Espécies da Fauna Brasileira Ameaçadas de Extinção*. Anexo à Instrução Normativa nº 3 do Ministério do Meio Ambiente, de 27/05/2003, publicada no D.O.U. nº 101, Seção I, de 28/05/2003.
- IBAMA – Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis, (2003b), *Lista Nacional das Espécies de Invertebrados Aquáticos e Peixes Ameaçadas de Extinção e Lista Nacional das Espécies de Invertebrados Aquáticos e Peixes Sobreexploradas ou Ameaçadas de Sobreexploração*. Anexos à Instrução Normativa nº 5 do Ministério do Meio Ambiente, de 21/05/2004, publicada no D.O.U. nº 102, Seção I, de 28/05/2004.
- IUCN, (2008), *IUCN Red List of Threatened Species*. Available from <http://www.iucnredlist.org> (accessed May 2008).
- Koslow, J.A., Boehlert, G.W., Gordon, J.D.M., Haedrich, R.L., Lorange, P., Parin, N. (2000), Continental slope and deep-sea fisheries: implications for a fragile ecosystem. *Ices J Mar Sci*, **57**, 548–557.
- Martins, A.S., Olavo, G., Costa, P.A.S. (2005), A pesca de linha de alto mar realizada por frotas sediadas no Espírito Santo, Brasil. In-*Pesca e potenciais de exploração de recursos vivos na região central da Zona Econômica Exclusiva brasileira*, ed. Costa P.A.S., Martins A.S., Olavo G. Rio de Janeiro, Museu Nacional do Rio de Janeiro, pp 35–55.
- Moreira, L., Baptistotti, C., Scalfoni, J., Thomé J.C., Almeida, A.P.L.S. (1995), Occurrence of *Chelonia mydas* on the island of Trindade, Brazil. *Marine Turtle Newsletter*, **70**, 2.
- Oliveira, G.M., Evangelista, J.E.V., Ferreira, B.P. (1997), Considerações sobre a biologia e pesca no arquipélago dos penedos de São Pedro e São Paulo. *Bol. Téc. Cient. CEPENE*, **5**, 1–16.
- Sampaio, C.L.S., Carvalho-Filho, A., Feitoza, B.M., Ferreira, C.E.L., Floeter, S.R., Gasparini, J.L., Rocha, L.A., Sazima, I. (2006), Peixes recifais endêmicos e ameaçados das ilhas oceânicas brasileiras e do complexo recifal dos Abrolhos. In-*Ilhas oceânicas brasileiras: da pesquisa ao manejo*, ed. Alves R.J.V., Castro J.W.A. Brasília, MMA, pp 215–234.

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