# ROUGH-TOOTHED DOLPHIN, *Steno bredanensis*, FEEDING BEHAVIORS IN ILHA GRANDE BAY, BRAZIL.

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ABSTRACT

Feeding behaviors by rough-toothed dolphins, *Steno bredanensis* (Lesson, 1828), were opportunistically observed on seven occasions, in Ilha Grande Bay, Brazil southeastern coast, from 1990-1998. The preys were mullet (*Mugil* sp. and *Mugil curema*), cultlass fish (*Trichiurus lepturus*) and balao (*Hemirhamphus brasiliensis*). On one occasion, rough-toothed dolphins were feeding in association with bottlenose dolphins (*Tursiops truncatus*). Magnificent frigate birds (*Fregata magnificiens*) and brown boobies (*Sula leucogaster*) were associated with rough-toothed dolphins on three occasions. In all observations, subgroups of dolphins appeared to push fish schools against the shore. We describe a line formation of dolphins trapping a fish school against the coast, and other feeding maneuvers such as circles and aerial behaviors around the schools. On five occasions, rough-toothed dolphins were observed shaking their heads at the water's surface while holding a fish in their mouths. An underwater observation made it possible to witness a dolphin beheading a mullet. We also describe an adult apparently feeding a calf and, in other occasion, a group of approximately 15 adult dolphins assisting a feeding juvenile, as well as dolphins' interactions with human fishing activities (circular gill-nets and mariculture facilities). Despite the small number of observations, this paper ad new prey species for *S. bredanensis,* and present some insights on this poorly known species' feeding behaviors in the wild.

**Key words:** rough-toothed dolphin, *Steno bredanensis*, feeding behavior, Brazil, fishery interactions.

RESUMO

**Comportamentos de pesca do golfinho-de-dentes-rugosos (*Steno bredanensis*) na Baía da Ilha Grande, Brasil.**

Comportamentos de alimentação de golfinhos-de-dentes-rugosos, *Steno bredanensis* (Lesson, 1828), foram oportunisticamente observados em sete ocasiões na Baía da Ilha Grande, costa sudeste do Brasil, entre 1990 e 1998. As presas identificadas foram tainhas (*Mugil* sp. e *Mugil curema*),

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peixe-espada (*Trichiurus lepturus*) e panaguaiú (*Hemirhamphus brasiliensis*). Em uma observação, golfinhos-de-dentes-rugosos estavam se alimentando em associação com toninhas (*Tursiops truncatus*). Fragatas (*Fregata magnificens*) e atobás-marrom (*Sula leucogaster*) encontravam-se associados com *S. bredanensis* em três ocasiões. Em todas as observações, subgrupos de golfinhos pareciam encurralar os cardumes contra a costa. Nós descrevemos uma formação linear de golfinhos encurralando um cardume contra a costa e outras manobras como círculos e comportamentos aéreos ao redor dos cardumes. Em cinco ocasiões, golfinhos-de-dentes-rugosos foram vistos balançando suas cabeças na superfície da água com os peixes seguros pelos seus rostros. Em uma observação submarina foi possível testemunhar um golfinho decaptando uma tainha. Nós também descrevemos um adulto aparentemente auxiliando a alimentação de um filhote e, em outra ocasião, um grupo de aproximadamente 15 golfinhos ajudando um juvenil a se alimentar. Também são reportadas interações com atividades pesqueiras (redes de espera e fazendas marinhas). Apesar do pequeno número de observações, este trabalho acrescenta novas espécies de presas para *S. bredanensis* e apresenta algumas revelações do pobremente conhecido comportamento de pesca dessa espécie na natureza.

**Palavras chave:** golfinho-de-dentes-rugosos, *Steno bredanensis*, alimentação, comportamento, Brasil, interações com pescarias.

## INTRODUCTION

The World Conservation Union (IUCN, 1996) has listed the status of the rough-toothed dolphin, *Steno bredanensis* (Lesson, 1828), word wide as being "Deficient Data". Very little information is available on life history, social organization, or behaviors of this species anywhere in its distribution.

Information on rough-toothed dolphin feeding behavior is specially limited. Almost all of the known data about the diet of the species comes from stomach content analysis. The basic diet consists of fish and mollusks, including squid and octopus, according to LAYNE (1965); PERRIN and WALKER (1975), and MIYASAKI and PERRIN (1994).

A review of literature shows that, preceding this paper, the only two records of observations of feeding behaviors of free-ranging rough-toothed dolphins are those reported by SMEENK et al. (1995) for Mauritania and by STEINER (1995) for the Azores Archipelago.

In this paper, we put together descriptions of feeding events by rough-toothed dolphins in Ilha Grande Bay and discuss some interesting aspects of the feeding behaviors of this poorly known species. We also report dolphins' interactions with human fishing activities and some potential threats, such as accidental capture, decreasing of fish stocks and direct competition with fishermen.

## METHODS

Ilha Grande Bay (23°05'S 44°00'W - 23°16'S 44°30'W), with a total area of 1,124 km², is located in the south of Rio de Janeiro State, Brazilian southeastern coast, in a very large curve of the shore between Ponta Grossa da Marambaia and Ponta da Juatinga. Grande Island, with it's 193 km² replete with broad, flat sand beaches and mountainous cliffs reaching the water, is located in front of the bay, providing a biogeographic barrier that maintains the bay's warm waters calm. In the continent, four small bays can be found along the coast: Mangaratiba Bay, Jacuacanga Bay, Bay of Ribeira and Paraty Bay (Figure 1).

Between December of 1990 and January of 1998, during 55 cruises to observe cetaceans' distribution, movements and behaviors in Ilha Grande Bay, opportunistic direct observations of rough-toothed dolphin's feeding behaviors on fish schools have been made. Observations were made from the 8m to 13m research vessels.

Every time dolphins' groups were first sighted, the research vessels turned off their engines, in order not to interfere or disturb their natural behavior. Only when the distance between the dolphins and the vessels became over 70m for more than 3min, the engines were turned on again to approach the animals one more time.

The determination of age class of the dolphins was made based on the estimated length of the individuals. Adults have lengths equal or greater than 2,10m (MIYASAKI and PERRIN, 1994), juveniles have lengths between approximately 1,60-2,10m, and calves have lengths of less than 1,60m (3/4 of adult's total length).

## RESULTS

In five sightings during austral winter, one during autumn and one during summer, rough-toothed dolphins were observed foraging in seven different locations: Ponta do Drago, Parnaioca Beach, Gipóia Island, Algodão Island, Sítio Forte Bay, Angra dos Reis Harbor and Sabacu Island (Figure 1). The dolphins were observed foraging both outside the bay — in waters of depths of 15-39m and close to steep slopes, and in inner and shallow waters of five-11m, close to gentle slopes.

All the observations were made when the foraging activities had already started.

In all observations, when approached by the research boat, some rough-toothed dolphins would stop feeding for a while and would come to bowride the boat for one-three min before feeding resumed.

The dolphins were always divided into subgroups, pushing the fish schools against the shore (beaches or rocks). The dolphins appeared to feed in a coordinated fashion, concentrating prey.

The rough-toothed dolphins sighted during feeding activities in Ilha Grande Bay were never more than 50m from shore.

Below we present descriptions of seven feeding events by rough-toothed dolphins in Ilha Grande Bay.

**Record One**

On 5 September 1992, at 1345h, a group of at least 20 rough-toothed dolphins was observed for 25min feeding very close (one-eight m) to a rocky coast in a steep slope area, near Ponta do Drago. The water depth was 39m; the Beaufort Sea State was four. Despite the rough seas, as the research vessel approached Ponta do Drago to turn round Grande Island, we noticed the dolphins' presence by their permanently exposed dorsal fins at the water's surface. They were surfacing in tight subgroups of three-five individuals, side by side, with their facing towards the coast. The dolphins were not energetic, and we initially thought they were resting. The group was compromised mostly of adults, with only one juvenile. While observing the behavior more closely, we determined that they were actually pushing by crowding a school of a small fish (that could not be identified to species due to poor sighting conditions) towards the shore and against the water's surface. As approximately 15 dolphins stayed in chorus line formation, at least five m from the coast, the juvenile was observed leaping and tail-slapping directly in front of the rooks, sometimes at distances of almost one m from the coast. At intervals of two-five min, one-two adults would leave the line formation and would surface beside the juvenile, for one-two min, at which time, we would observe much foam on the water and fish at the water's surface. The adults would then return to the line and the juvenile would be seen alone again at the water's surface for another interval of two-five min. This behavior was repeated approximately five times during the period of observation. During the 25min of observation, the juvenile was the only individual that leapt. While in the line formation, the adults would be logging at the water surface.

**Record Two**

On 26 August 1994, at 1328h, a group of 12 rough-toothed dolphins was observed for 70min capturing cutlass fish (*Trichiurus lepturus*) near Parnaioca Beach. The group consisted of all age classes, including only one calf. The water surface temperature was 22°C. A Beaufort Sea State of one facilitated observations. The water depth was 15-26m. When first sighted, the dolphins were foraging very close (three-five m) to a circular gill-net "cerco" more than 30m long, located ten m from shore. Dolphins were observed leaping out of the water and tail slapping. On eight occasions, an adult would be seen holding a fish out of the water in its mouth, shaking its head several times until the fish ceased movement, and them, the dolphin would quickly dive holding its prey in the mouth (Figure 2). An adult followed by the calf held the fish in its mouth at the water's surface and after one-two min released the fish. The calf took the still alive fish and held it in its mouth for less than 30sec. The calf than set the fish free and the same adult took it again to repeat the procedure. The fish was captured still alive by the research team. It was 1,2m in length and had several parallel scratches made by the dolphins teeth on both sides of the body (Figure 3).

**Record Three**

On 27 August 1994, at 0935h, a group of approximately 15 rough-toothed dolphins, associated with at least two bottlenose dolphins (*Tursiops truncatus),* was observed foraging near Gipóia Island. The water surface temperature was 22°C, the depth was ten m. A Beaufort Sea State of one aided in the 90min observation period. The group consisted of all age classes. When first sighted, the dolphins were foraging close to a mullet mariculture facility, approximately ten m from coast. Complete leaps out of the water and tail slaps were observed near the fish school. The group was divided into subgroups of three-four dolphins, with fluidity in group membership. The dolphins were feeding on a school of mullet (*Mugil* sp.), in association with magnificent frigate birds (*Fregata magnificiens*) and brown boobies (*Sula leucogaster*). On several occasions, it was possible to observe the dolphins holding the fish in their mouths. One adult bottlenose dolphin bowrode the slow moving research vessel for almost one min holding a mullet in its mouth. The subgroups swam in circles around the fish school diving in a synchronized manner. Fish were seen to jump in the middle of the fish ball. Several headless mullet were observed floating at the water surface.

**Record Four**

On 14 May 1996, at 1530h, near Algodão Island, approximately 15m from the shore, a group of nine adult rough-toothed dolphins was observed feeding on cutlass fish for 40min. The dolphins were observed shaking their heads several times out of the water while holding a fish in their mouth. Some individuals tail slapped on several occasions. The water depth was about 11m; the Beaufort Sea State was two.

**Record Five**

On 8 August 1996, at 1020h, in Sítio Forte Bay, a group of six adult rough-toothed dolphins was observed feeding on mullet in association with magnificent frigate birds, approximately eight m from shore. The Beaufort Sea State was one, the water depth was approximately ten m and the water surface temperature was 23°C. The observation lasted 55min. The dolphins were surface active and leapt several times out of the water near the fish school. An underwater observation made it possible to witness a rough-toothed dolphin beheading a mullet.

**Record Six**

On 2 September 1996, at 0905h, a group of six adult rough-toothed dolphins was observed for ten min feeding near Angra dos Reis Harbor, 50m from coast. The Beaufort Sea State was one, the water temperature was 24°C. The dolphins were chasing mullets. Magnificent frigate birds and brown boobies were associated with the activity in water depths of five-ten m. A female magnificent frigate bird was seen kleptoparasitizing a mullet from a dolphin, who was forced to leave the fish that was in its mouth at the water surface by several attacks of the bird to its head. The dolphins were very surface active and, from time to time, one of the individuals would leap out of the water. The dolphins were observed on several occasions shaking their heads out of the water holding mullets in their mouths.

**Record Seven**

On 17 January 1998, at 1143h, a group of 12 rough-toothed dolphins was observed for 1h50min capturing mullet (*Mugil curema*) and balao (*Hemirhamphus brasiliensis*) near Sabacu Island, approximately 50m from shore. The group was divided into two subgroups: the first consisted of eight individuals of all age classes, including one calf and two juveniles, and the

second of four adults. The water surface temperature was 22°C; the depth was 15m. A Beaufort Sea State was one facilitated observations.

When first sighted, the dolphins were chasing mullet. There were already a launch (eight m) and a trawler (seven m) escorting the animals when the research vessel approached them. After 15min of observation, a sailboat (11m) also began to follow the dolphins. The dolphins didn't seem to be bothered by the boats' presence. Just the opposite was observed: the animals seemed to take advantage of the boats, used by them as floating barriers to trap fish against. This behavior was also observed involving the research vessel: a mullet, chased by an adult dolphin, approached the vessel swimming rapidly close to the water surface and disappeared diving under it, followed by the dolphin at distances of less than one m.

During the mullet chasing, the dolphins were seen diving under the boats and trapping prey against them several times. It was also noticed that individuals would disperse from the subgroups for two-three min in order to pursue fish, often in direction of collision with one another. Leaps and tail slapping were frequently observed during the feeding behavior. On several occasions, the dolphins would be seen shaking its head out of the water holding a mullet in its mouth.

After 15min of observation, a diver who was in the research vessel went into the water to try to make an underwater observation of the feeding behavior. The water visibility was poor (less than two m), but the diver could listen several clics and whistles while an adult dolphin that immediately disappeared approached him. In a depth of four m the diver found a mullet head recently perforated by dolphin's teeth and, some meters away, at the same depth, he found a mullet's gut (Figure 4).

The dolphins continued to chase mullets for 30min more, and, suddenly, began to apparently rest. During the probable resting, after regular intervals of 1'30"min submerged, the two subgroups would surface in a synchronized way, with a maximum distance of approximately 500m and a minimum distance of five m between them. The two subgroups would stay probably resting at water surface, in chorus line formation, swimming very calmly, for three min, than would dive again for another 1'30"min.

At 1230hr balaos were seen swimming out of the water in strait lines, moving their tails very fast inside the water. Immediately after the fish were noticed by the researchers, all the dolphins dove, reappearing in pairs or individually at the surface in front of the fish, swimming in high speed

describing curves. When feeding restarted, the dolphins were very active again at the water surface, tailslaping frequently. This frenzy lasted for more than 20min of observation. When the research vessel left, the dolphins were still foraging.

During the whole period of observation, no fluidity in group membership could be detected. Several photographs show that the subgroup compromised of four adults presented the same position among individuals in relation to the vessel: the dolphin that would swim closest to the vessel was always the same one (a very scared and marked adult).

## DISCUSSION

### Fish shattering and beheading

As mentioned in Records five and seven, this species may behead and/or shatter mullets, feeding only on parts of the body of the fish. Reinforcing the direct observations reported in this paper, after interviews with local fishermen, we discovered that this behavior is well known from different locations inside the bay. Fishermen also complained about the dolphins' habit of fish beheading and shattering, discarding the fish after eating only some parts of its body.

Fishermen also described the rough-toothed dolphins' behavior of head shaking holding the fish in the mouth, observed in Records two, three, four, six and seven, which may be related to prey shattering.

DEFRAN and PRYOR (1980), report that captive rough-toothed dolphins might behead and extirpate fish, a fact also noticed by R. Lenzi in French Polynesia (personal communication).

As indicated by its common name, rough-toothed dolphins have fine ridges running down the enamel cap of each tooth, as opposed to other odontocetes that have uniform and smooth teeth, the only other exception being the Amazon river dolphin (*Inia geoffrensis*). A similar behavior was described for Amazon river dolphin, which captures the prey with the front teeth and transfer it to the stronger back teeth, where it is broken and swallowed. Big fish are thus broken into pieces and their heads discarded (SILVA, 1983).

The evidences mentioned above indicate that the rough-toothed dolphin may feed only in parts of fish, and that the behavior of head shaking at water surface holding the prey in the mouth, consequently shattering and extirpating it, may be one of the feeding techniques of this species.

### Adult's assistance towards feeding juvenile and calf

In Record one, when first observed the dolphins were very calm at the water surface. The same behavior of close knit surfacing, with low activity at the water surface, was observed in the group of rough-toothed dolphins that was presumed to be feeding in the Azores Archipelago (STEINER, 1995), when the feeding behavior was also initially confused with resting. In the observation of Azores it was also observed that calves and juveniles, occasionally together with a few adults, displayed aerial behaviors while the other adults were seen with none energetic behavior at the water surface. Steiner interpreted this as the calves and juveniles being feeding segregated from the adult groups. In our observation reported in Record one, we believe that the adults observed relaxed at the water surface were actually assisting the feeding juvenile, making a barrier to prevent fish escaping.

SMEENK et al. (1995) also observed adult's assistance towards two juveniles that were feeding in Mauritania waters. They also report that those juveniles displayed "very rigorous play behavior".

In Record two we describe an interaction between a calf and an adult of rough-toothed dolphin that can be interpreted as a clear teaching and learning process. Observational learning has been noted for various feeding delphinid behaviors (**e.g.**, SHANE et al., 1986).

### Association with birds

In Records three, five and six the rough-toothed dolphins were feeding in association with birds. Magnificent frigate birds were present in all three events, while brown boobies were seen in only two of them. In Ilha Grande Bay, these two species of birds are frequently associated with dolphins, especially when they are feeding (personal observation). While the boobies seem to take advantage together with the dolphins of the fish schools, feeding in a associative manner, the dolphins sometimes are disturbed by the magnificent frigate bird habit of steeling the fish from other hunters, as mentioned in Record six. A similar attack of a female frigate bird was also seen involving marine tucuxi (*Sotalia fluviatilis*) that was feeding in Ilha Grande Bay (unpublished data).

### Association with human fishing activities and potential threats

In Ilha Grande Bay, fishing activities are concentrated in nine main "blocks" (Figure 1). Some of those blocks are located exactly in the same

places as the rough-toothed dolphins were observed feeding. The blocks called Ponta do Drago (Records one and two) and Abraão (Record five) are considered to be two of the three main fishing areas of Ilha Grande Bay.

Mullets, included in the diet of rough-toothed dolphins, are commercially valuable in the region, while the cutlass fish and balao has very small value and is not often sold but more commonly used for the fishermen's own consumption.

Rough-toothed dolphins of Ilha Grande Bay might be impacted by the apparent decreases in fish stocks and direct competition with fisheries, since their main use of the region is probably as a feeding ground.

Like happens in Hawaii, were rough-toothed dolphins exploit fisheries for food stealing hooked fish, which harass the longline fishermen (IVERSEN, 1975), rough-toothed dolphins of Ilha Grande Bay appear to capitalize on human fishing activities. In this region, though, the dolphins may feed on disabled fish that escape or are discarded from nets. Such interactions may occasionally result in incidental capture. On 24 April 1997 and 23 September 1997, two dead rough-toothed dolphins were found floating in moderate state of decomposition near Ponta Negra and Meros Island, respectively. The first one presented a piece or rope around the beak, and the second animal had the beak broken, evidencing their possible interaction with fisheries.

On the other hand, a different kind of interaction between rough-toothed dolphins and fisheries might also be happening in Ilha Grande Bay. As mentioned in Records two and three, the dolphins might take advantage of the increase of marine life generated around fish farms and other fixed nets. Besides those records, on 12 August 1997, close to Jipóia Island, an underwater observation indicated that the dolphins might be feeding on the octopuses (*Octopus* sp.) that commonly predate on coquile Saint Jacques (*Nodipecten nodosus)* and mussel (*Perna perna*) cultivated in mariculture facilities.

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LITERATURE CITED

1. DEFRAN, R.H., PRYOR, K. The behaviour and training of cetaceans in captivity. In: HERMAN, L.M.. (Ed.). **Cetacean Behaviour: mechanisms and functions.** New York: John Wiley, 1980. 463p. p. 319-62.

2. **IUCN Red List of Threatened Animals**. Gland: The IUCN Species Survival Commission, 1996. 368 p.

3. IVERSEN, R.T.B. **Bottlenose dolphins stealing fish from Hawaiian fishermen's lines.** Report. Southwest Fisheries Center, Honolulu Laboratory. National Marine Fisheries Service, NOAA, 1975. [Manuscript, 12 p].

4. LAYNE, J.N. Observations on marine mammals in Florida waters. **Bulletin of the Florida State Museum**, Gainesville, Florida, v. 9, n. 4, p. 131-181, May 1965.

5. MIYASAKI, N., PERRIN, W.F. Rough-toothed dolphin *Steno bredanensis* (Lesson, 1828). In: RIDGWAY, S.H., HARRISON, R. (Eds.). **Handbook of Marine Mammals**. London: Academic Press, 1994. v. 5. 416 p. p. 1-21.

6. PERRIN, W.F., WALKER, W.A. The rough-toothed porpoise, *Steno bredanensis*, in the eastern tropical Pacific. **Journal of Mammalogy**, Provo, Utah, v. 56, n. 4, p. 905-7, Nov. 1975.

7. SHANE, S., WELLS, R.S., WÜRSIG, B. Ecology, behavior and social organization of the bottlenose dolphin: a review. **Marine Mammal Science**, Lawrence, Kansas, v. 2, n. 1, p. 34-63, Jan. 1986.

8. SILVA, V.M.F. da. **Ecologia alimentar dos golfinhos da Amazônia.** Dissertação (Mestrado em Ecologia) – Universidade Federal do Amazonas, Manaus, Amazonas, 1983. 118 p.

9. SMEENK, C., ADDINK, C.M., RICHARDS, H. Some observations of the behaviour of wild rough-toothed dolphins *Steno bredanensis*. In: BIENNIAL CONFERENCE ON THE BIOLOGY OF MARINE MAMALS, 11, 14-18.12.95, Orlando. **Proocedings ...**, Orlando, 1995. 147 p. p. 107.

10. STEINER, L. Rough-toothed dolphin, *Steno bredanensis* : a new species record for the Azores, with some notes on behaviour. **Arquipélago. Ciências Biológicas e Marinhas**, Açores, Portugal, v. 13 A, p. 125-7, Aug. 1995.

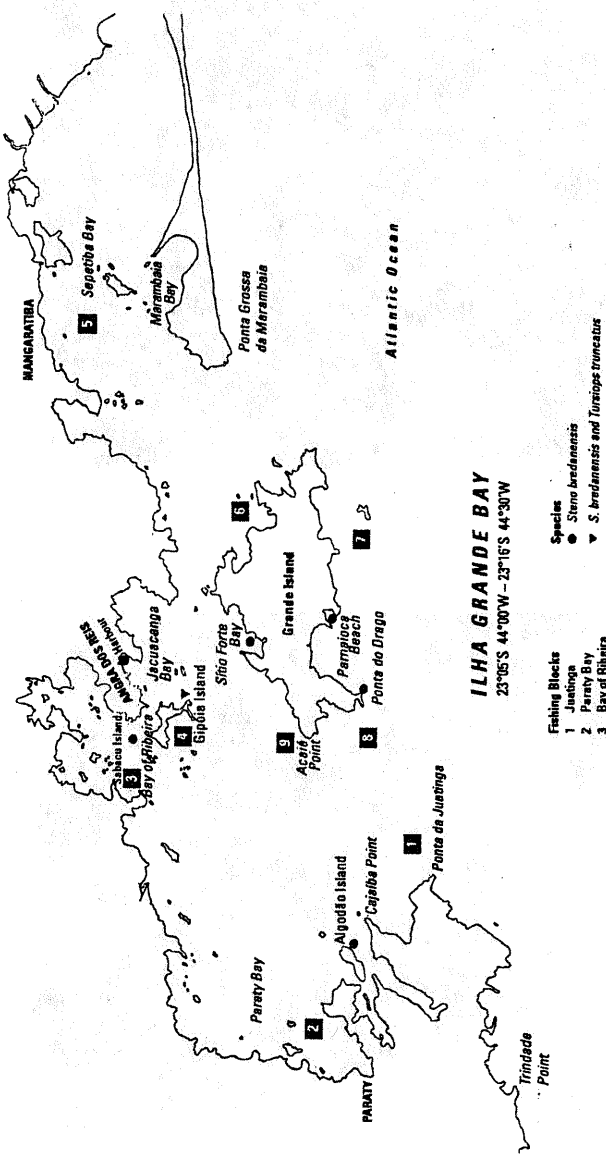


**Fig. 1.** Ilha Grande Bay, indicating the places were the rough-toothed dolphins were observed feeding and the nine main blocks where fishing activities are concentrated.

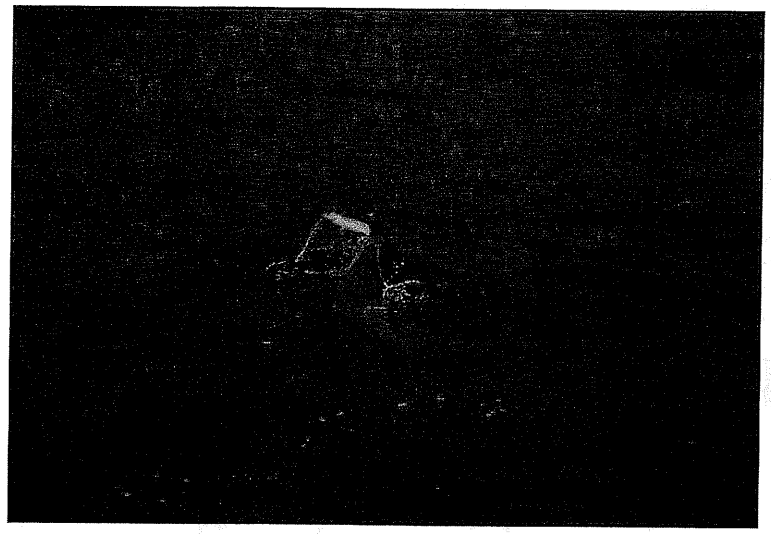

**Fig. 2.** *Steno bredanensis* holding a cutlass fish (*Trichiurus lepturus*) in the beak on 26 August 1994, near Parnaioca Beach.

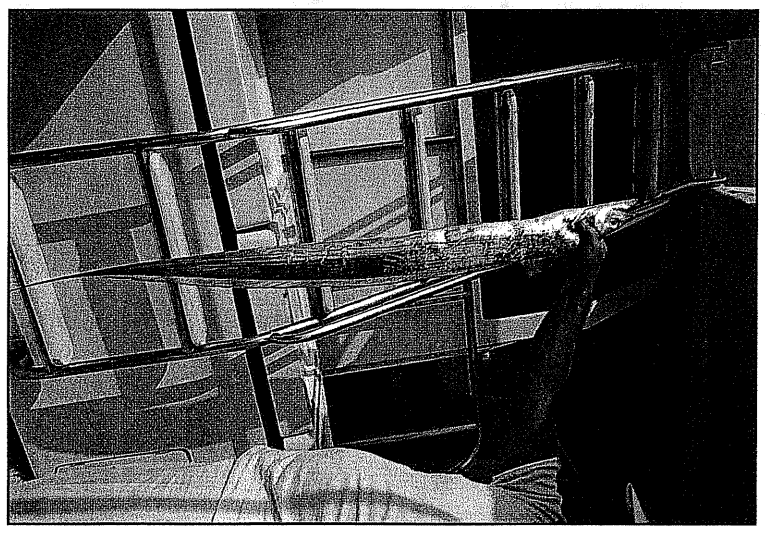

**Fig. 3.** Cutlass fish (*Trichiurus lepturus*) showing scars of the teeth of *Steno bredanensis*. The fish was captured still alive near Parnaioca Beach by the research team. It was 1,2m in length and had several parallel scratches made by the dolphins teeth on both sides of the body.

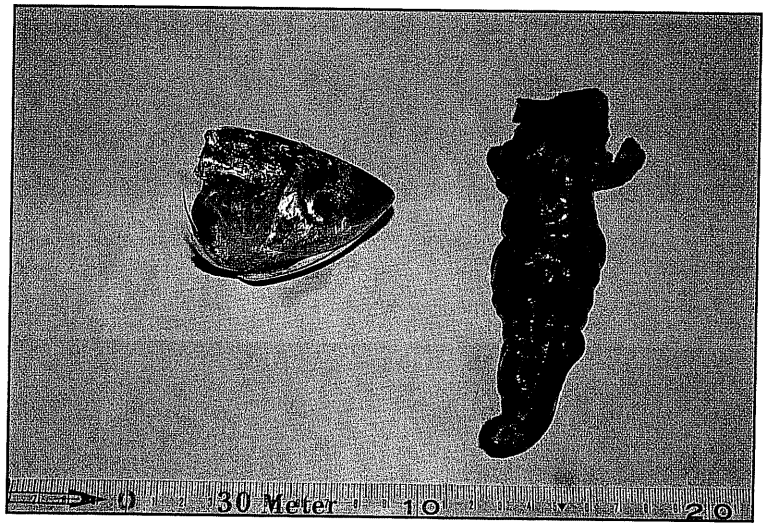


**Fig. 4.** Mullet's (*Mugil curema*) head and gut discarded by the rough-toothed dolphins near Sabacu Island, on 17 January 1998. In a depth of four m the diver found a mullet head recently perforated by dolphin's teeth and, some meters away, at the same depth, he found a mullet's gut.