

Interference with Fish Traps by Dolphins (Delphinidae) in Jamaican Waters

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ABSTRACT

Between November 2003 and June 2006, selected portions of the coastal waters of the island of Jamaica were evaluated for populations of dolphins (Cetacea, Delphinidae). All trips were conducted from small boats (canoes) owned by fishers. A total of 107 interviews by questionnaire were also done to obtain information on the species, distribution, behaviour, and the nature of the interference with fish traps operated by commercial fishers. Dolphin interference with gear was found to be real and not imagined. The most commonly involved species was the Bottlenose Dolphin (*Tursiops truncatus*). At least two other species of dolphins, Atlantic spotted dolphin (*Stenella frontalis*) and Pan-tropical spotted dolphin (*S. attenuata*), may be involved but to unknown degrees. A pattern of distribution emerged where larger dolphin species, probably the offshore morph of Bottlenose dolphin (*T. truncatus*) and other spotted species (probably *Stenella*), were never observed inshore. Highest numbers of dolphins were reported from southwestern oceanic banks. Lower numbers of dolphins appear to be found in eastern coastal waters than in the west. In Kingston Harbour, there is a small resident pod of Bottlenose dolphins and another small dolphin pod in Bowden bay, St. Thomas in the southeast. The nature of the interference essentially is a series of shaking and rolling movements in order for dolphins to obtain fish from the interior of fish traps. Traps were turned upright or completely overturned, as well as moved some distance from the original position set by fishers. The reasons for this interference are presently unclear, but may be related to reduced fish abundance on Jamaican reefs or to the use of dynamite. Dolphins took fish from other types of fishing gear, such as gill nets, and caused damage while doing so.

KEY WORDS: Dolphins, *Tursiops*, fish traps, Jamaica, behaviour

Interference with Fish Traps by Dolphins (Delphinidae) in Jamaican Waters

Entre noviembre, 2003 y junio, 2006 porciones escogidas de las aguas costeras de la isla de Jamaica fueron evaluadas para poblaciones de delfines (Cetacea, los viajes de Delphinidae) All fueron realizados de pequeños barcos (canoas) poseído por pescadores. Un suma de 107 entrevistas por cuestionario fue hecho también obtener información en la especie, la distribución, el comportamiento y la naturaleza de la interferencia con trampas de pez operadas por pescadores comerciales. Interferencia de delfín con engranaje fue encontrada para no ser verdadero e imaginado. El la mayoría de la especie comúnmente implicada fue el Delfín de Bottlenose (*Tursiops truncatus*). Por lo menos 2 otra especie de delfines delfín marcado atlántico (*Stenella frontalis*) y delfín marcado Critica-Tropical (*S. attenuata*) puede ser implicado pero a grados desconocidos. Una pauta de la distribución surgió donde especie más grande de delfín, probablemente el cercano a la costa se transforma de delfín de Bottlenose (*T. truncatus*) y otra especie marcada (probablemente *Stenella*) nunca fueron observados a la orilla. Los números más altos de delfines fueron informados de bancos oceánicos del sudoeste. Los números más bajos de delfines aparecen ser encontrados en aguas costeras orientales que en el oeste. En el Puerto de Kingston hay una pequeña vaina residente de delfines de Bottlenose y otra pequeña vaina de delfín en la bahía de Bowden, S. Thomas en el sudeste. La naturaleza de la interferencia es esencialmente una serie de sacudir y movimientos rodantes en la orden para delfines de obtener pez del interior de trampas de pez. Las trampas fueron giradas vertical o completamente volcados, así como movió alguna distancia del conjunto original de la posición por pescadores. Las razones para esta interferencia son actualmente poco claras, pero pueden ser relacionado a la abundancia reducida del pez en escollos jamaquinos o al uso de dinamita. Los delfines tomaron pez de otros tipos de engranaje pesquero, tal como redes de agalla, y el daño causado al haciendo así.

PALABRAS CLAVES: Los delfines, *Tursiops*, pesca las trampas, Jamaica, el comportamiento

INTRODUCTION

The first reports of interference by dolphins with fish traps originated from Whitehouse fishing beach in Westmoreland parish in about 2000. These reports were recorded by investigators in the course of another UWI Life Sciences Department fisheries project conducted by the first author along with graduate student Anginette Murray. They were considered only as curious anecdotes until similar stories emerged again and again from more fishers. It soon became clear that there could be cause for genuine concern about the level of dolphin interference with fishers' traps and its apparent widespread nature. Reports about dolphins disturbing fish traps were also confirmed at this time by the Fisheries Division of the

Ministry of Agriculture. Considerable interest about this matter by UWI researchers resulted in a proposal being prepared and submitted in early 2003 to the Environmental Foundation of Jamaica and funding was obtained in summer 2003 for the present study.

The objectives of the present study were to determine;

- i) The nature of the interference, and its extent,
- ii) The dolphin species involved, and characterization of their populations,
- iii) The relative abundance (numbers) of the population,
- iv) Patterns of occurrence of disturbance, and
- v) To prepare a plan for the sustainable management of dolphins alongside the reef (trap) fishery in

Jamaica.

Preliminary research into the literature had shown that there was almost no data on dolphins in Jamaican waters but for an early aerial survey (Fairbairn and Haynes 1983) and the much later review of Cushnie (2003). Knowledge of the present population(s) and migratory movements in local waters were, however, largely unknown, and thus would be of considerable value in a) assembling a database and b) planning for their potential management (Chilvers and Corkeron 2003 in Perez –Cao *et al.*, 2005).

METHODOLOGY

Background to Survey Methods

A graduate student was identified for the project and a questionnaire for fishers was designed for administration at fishing beaches around Jamaica. In November 2003, after a period of literature review on the subject, field work began at Whitehouse beach in Westmoreland, at the location that the phenomenon was first reported to researchers. Questionnaires were also administered at all other sites visited after Whitehouse beach, continuing in a clockwise direction around Jamaica (See Table 1).

Data both from boats encountered at sea as well as from fishers just landing catches were gathered. Final field trips were done in June 2006. In the early part of 2003,

also, the government's National Environmental & Planning Agency (NEPA) initiated a brief survey of dolphins in Jamaican waters. This study indicated that the trap interference problem was real and not imagined, and that fishers there were advocating some regulation of the activities of dolphins in order to protect and sustain their livelihood (Cushnie 2003).

Allied to this study was another by NEPA in January and February 2004 to conduct an aerial survey of dolphins around Jamaica. The results of this study are published in a paper by Kenney *et al.* (2004). It showed that dolphins were not abundant in coastal waters at the time and season that the aerial survey was conducted as none were seen (See Discussion). The National Environmental and Planning Agency (NEPA) is the government agency in Jamaica that is responsible for managing populations of marine mammals in Jamaican waters. Although the prime reason for undertaking the present study was the complaints from Whitehouse fishers, it must also be mentioned that in the last few years (2002 to 2004) NEPA had received applications for permits to capture live bottlenose dolphins (*T. truncatus*) from Jamaican waters. As mentioned in Kenney *et al.* (2004), NEPA required information about the abundance of bottlenose dolphins in the areas where the live captures had been proposed.

Table 1. List of locations named as having trap and other fishing gear interference by dolphins (compiled from various sources including fishers' interviews).

Location	Closest Parish	Dolphin interference	Dolphin species	Comments
(1) Whitehouse island Shelf	Westmoreland	Yes	Bottlenose dolphins	Trap interference
(2) Windward bank (New bank)	Westmoreland	Yes	Bottlenose dolphins Spotted dolphins?	Not clear if spotted dolphins also interfere with traps, though seen nearby.
(3) Leeward bank (New or Rose bank)	Westmoreland	Yes	Bottlenose dolphins Spotted dolphins	As above
Walton Bank	Westmoreland	Yes	As above	As above
Pedro Bank	South coast Jamaica	Yes	As above	WH and Rocky Point fishers report trap and net interference
(4) Montego Bay shelf	St. James	Yes	Bottlenose dolphins (BNDs)	Only BND observed
Sandy Bay	Hanover	Yes	BND	BNDs seen with Whale sharks Dec. 2004
(5) Kingston Harbour	Kingston	Yes	BND	Gill nets set in KH
(6) Old Harbour Bay (Portland Bight)	St. Catherine, Clarendon	Yes	BND	Traps and gill nets
(7) Island shelf off Rocky Point	Clarendon	Yes	BND, Spotted dolphins	Traps on shelf and drop nets on Pedro Bank
(8) Gun Cay, Port Royal	Port Royal cays, Kingston	Yes	BND	Took fish from sprat nets
(9) Alligator Pond	Manchester	Yes	BND	Traps moved
(10) Bowden (Port Morant) harbour	St. Thomas	Yes	BND	Took fish from tangle (Chinese) nets

The University of the West Indies with funding from the Environmental Foundation of Jamaica (EFJ) had decided to investigate the interference with fish traps in Whitehouse and other areas by:

- i) Using questionnaires to obtain information from fishers,
- ii) Surveying, in a limited way, nearshore coastal waters from which recent reports of dolphins had been received,
- iii) Using this information to prepare a report on the nature of the phenomenon ,and
- iv) Making relevant recommendations to the NEPA and the Fisheries Division of the Ministry of Agriculture (the two government agencies directly involved in the phenomenon) concerning the management of the dolphin species and stocks involved with a view to facilitating the sustainability of the reef fisheries activities of Jamaica.

So, for a total of six months, the present study executed regular monthly and occasional bi-weekly visits to Whitehouse in Westmoreland, to interview fishers. The intent was to thoroughly monitor dolphin sightings for a short period at this “major” interference location. Six months later, in June 2004, we undertook coastal survey trips in canoes rented for the purposes from fishers. During each of these survey trips in coastal waters, at least two observers watched for any sign of dolphins in the area. Simultaneously, the fishers who accompanied the observers were questioned regarding the nature of the appearance and activities of dolphins and their interference with traps owned by those fishers and others. On most trips, a GPS instrument was used to take position fixes and to log a track of the survey line. Photographs of various activities were taken with a variety of cameras. In a typical surface search trip, the fisher boat captain who was in charge of the

canoe leased by scientists, was asked to run directly south offshore to about 1.6 km and then to parallel the coastline and search east and then west. The runs consisted of transects arranged in a random manner, a method similar to that used in Cuba by Perez Cao *et al.* (2004). The method is said to allow coverage of a larger area in less time than other line transect methods and to have good results with dolphins (Kenney 1990, Gerrodette 1999). A waterproof set of colour drawings of various dolphin and whale species found in Caribbean waters (Wynn and Schwartz 2003) was shown to all fishers to facilitate identification.

Study Area

The present study, as mentioned previously, examined selected areas of Jamaica’s coastal waters. The approximate areas are shown in Figure 1. The limited area sampled was due the small number of persons involved in the study, the limited funds and the relatively short duration of the project. Whitehouse, Westmoreland was the main focus of the study as this was the area from which the first reports originated. In this area, there is a rapid increase in depth with distance offshore into depths exceeding 500 m. Also, five small oceanic banks exist in the intervening area to the southwest between that site and the northern edge of Pedro Bank (a large bank 160 km south of Jamaica). All of these banks are fished and significantly, have reports of dolphins and interference with fish traps by them. Over these banks, the water is said to be clear and of a lighter blue colour than over the deeper intervening water. Fish trap density there is said to be high. Water depth over these banks averaged approximately 30 m. Current speed in the area of these small offshore banks is slight at approximately 1.0 – 1.5 kts. for most of the year (NOAA charts 2005). These banks are mentioned, as they are sites of dolphin sightings by fishers.



Figure 1. Satellite image (1999) of Jamaica showing some bathymetric features (light blue areas especially to south of island) and some of the small offshore banks (from Wikipedia.com)

Generally, seas around Jamaica are moderate to rough in the windy season between March and August annually with wind (Northeast Trades) velocities ranging from 10 - 20 kts. (Munro 1983). From June to November there may be tropical storms and hurricanes that pass through the region. The fisheries of Jamaica are mainly based on harvesting of coral reef fish resources by means of traps, nets, and lines. The status of the stocks is relatively poor with overfishing being a feature since at least the late 1970s (Munro 1983, Aiken 1993). At least 30 species of reef fishes make up 70% of the landings from traps, but spiny lobsters supplement trap catches. There is small but profitable and relatively well managed queen conch fishery (*Strombus gigas*) industrial fishery on the largest offshore bank, Pedro Bank some 160 km to the south of Kingston. Most of the conch catch is exported under a quota system (Aiken *et al.* 1999). Interference with fish traps has previously not been reported, hence the justification for this study.

RESULTS

The Artisanal Fishery and Dolphins

Antillean fish traps are used by approximately 60% of all fishers in Jamaica. The original design is probably West African and they have been in use in Jamaica since the Spanish occupation (Munro 1983). The average fish trap is of a category called the Antillean or West Indian fish trap. Traditional fish traps or fish pots used in Jamaica are artisanal (made by artisans) and have a characteristic Z-shape. Each consists of a framework made of hardwood sticks or poles, covered with a hexagonal shaped galvanized meshwire body. These sticks are harvested from interior dry limestone forests by other artisans, who specialize in the supply of them. The average trap measures approximately 180 cm long, by 90 cm wide, by 60 cm high and possesses two horse-neck (curving downward) entrance funnels. The wooden framework is covered with mesh wire often with a maximum diameter of 2.24 cm (or 1.25 inches). It is this mesh wire that retains the fish which enter through one of the two funnels. Each trap weighs approximately 15 kg when empty. This weight would be easily "handled" (moved) by adult bottlenose dolphins, which can weight 250 kg at maturity.

Fish traps are often set with bait which can consist of any of a wide variety of items ranging from small dead fish to stale bread, whole oranges, tinned sardines, ackee pods, and even broken crockery. They are often set individually, each with its own surface float connected to the trap by a synthetic rope line. They may be set in groups (though never "ganged" or tied together in series), most often adjacent to but never on, coral head or irregular bottom. Depths fished vary considerably around the island, but it would be unusual to see traps set in less than 20 m or in more than 100 m depth. Water transparency is high in Jamaican waters except after heavy rainfall or near the

outfalls of rivers, such that dolphins, with their keen eyesight, can easily see fish traps and their entrapped fish catches.

Fishers may own and operate substantial numbers of traps. In Whitehouse, Westmoreland, for example, successful fishers may each own as many as 200 traps, though not all are at sea at any one time. On average each fisher regularly operates or fishes at least approximately 10 to 20 traps and will haul all of them an average of once every three to five days soak (time underwater fishing). Traps set longer than this period tend not to have greater catches than those set for 3 - 5 days as there is an increased escapement rate over ingress of new fishes (Munro 1983). Some fishers have resorted to setting their traps without marker floats due to trap theft. In this case, the water must be relatively clear, and trap position is revisited using triangulation with shore landmarks. To retrieve traps a small grappling hook on a line is dragged over the seafloor in the vicinity of where they were set, in order to snag the unmarked pots and the traps hauled manually to the surface, and the contents emptied into the canoe. Dolphins are reported to interfere with both floated and un-floated (un-marked) traps.

Dolphins are of the family Delphinidae are marine mammals that swim alone or more often in groups termed pods. Often these pods are made up of family members including adults as well as young called calves. They are fast swimming, far-ranging animals that feed on fishes, lobsters and other crustaceans. They are reported to consume up to 15 kg of fish per adult dolphin per day. They can dive to considerable depths. These depths encompass those in which fish traps are set in Jamaican waters.

Species Present

A review of the literature on the species of cetaceans (marine mammals of the whale order) occurring in Jamaica waters suggested that no less than 28 species could possibly be found at various times (Ward *et al.* 2001 and Kenney *et al.* 2004) and showed the bottlenose dolphin (*T. truncatus*) is but one of 10 dolphin species that could occur in Jamaican and adjacent waters. Of these 10, three predominate.

Based on fishers' interviews and our observations, 69.15% of the sightings were of bottlenose dolphins only, while they appeared with other species in 27.10% of the other sightings. Other species sighted by themselves without bottlenose dolphins, comprised only 3.74%. Other species sighted included Atlantic spotted dolphins, Striped dolphin, Fraser's dolphin, and Risso's dolphin. Some of these identifications such as for Fraser's dolphin, are rated as dubious. Figure 2 shows the species of dolphins reported as ever having been seen by fishers. Where more than one species is listed together, this indicates that fishers saw these together in the same pod.

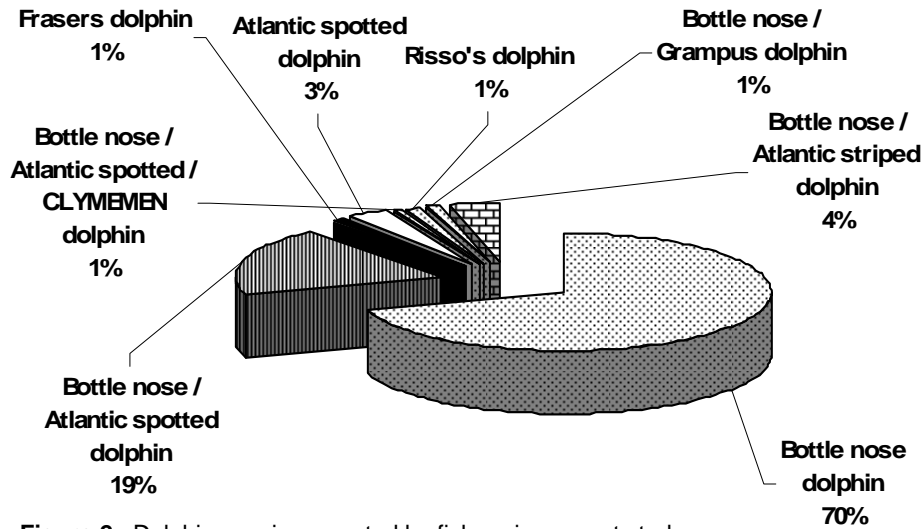


Figure 2. Dolphin species reported by fishers in present study

Locations of Trap Interference

The traps that were interfered with were located in a wide number of areas ranging from the shelf and small oceanic banks near Whitehouse, Westmoreland to the narrow north coastal shelf and the wider southern shelf. Traps are set in all these areas and thus could provide interest to the roving pods of dolphins. Most fishers reported pods were comprised of between 2 to 10 individuals (Figure 3). In the Montego Bay area near Whitehouse, St. James, the fishers seasonally use larger traps called Jack pots between October and November until February and March annually. These are larger by about 20 % over the standard traps used.

As mentioned in the methodology, traps which provide food by means of their entrapped fishes, would be found all over the nearshore coastal waters. Extensive interviews with fishers, boat surveys of coastal waters during field trips, as well as the aerial survey done in early 2004 (Kenney et al., 2004), all indicate widespread trap interference by dolphins. Table 1 shows a listing of the interference locations identified during the present study.

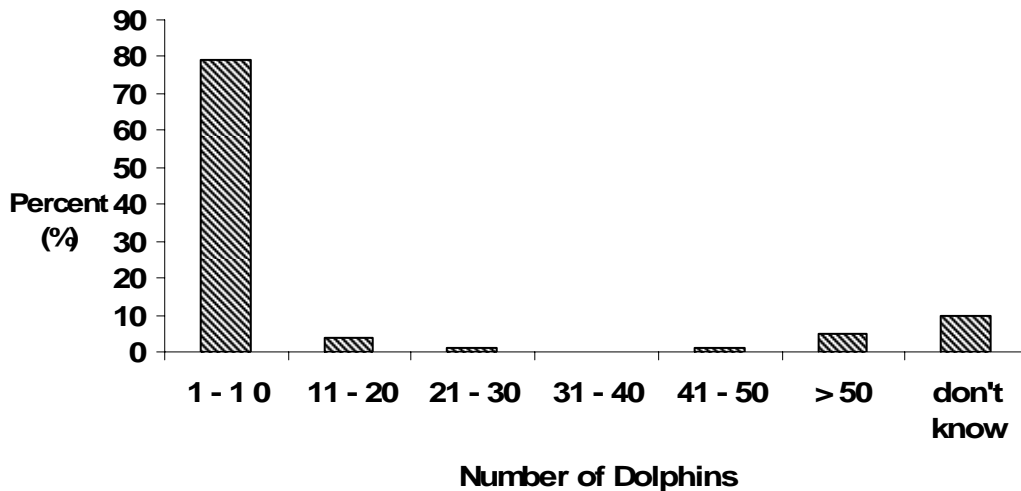


Figure 3. Pod sizes of dolphins observed by fishers.

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Nature of Trap Disturbance by Dolphins

Based on an early survey done by the NEPA in February - March, 2003, and incorporating data gathered by the present study, it appears that the typical manner of interference occurs as follows. One or more dolphins approach a fish trap and use their snouts to lift the trap up and to flip it (turn it over completely until the normal lower surface is uppermost) several times along the seafloor. Significantly, nearly all reports of interference suggest that the traps are always moved towards deeper water. In many cases, the traps are lost as they would fall over the edge into deeper water and the floats marking their location dragged completely underwater, making later recovery by fishers impossible. In many cases, the rope attached to the float marking the trap's location was rolled around the trap several times. This, it was said, resulted in the prevention of fish entering the trap so affected. Some traps were reported to have been stood on their ends with the long axis vertical by the dolphins. In such a posture, fish could not enter the trap. Many traps were said to have been lost to dolphin interference. In one case, fishers observed the dolphins cooperatively feeding. In this action, one dolphin would shake the fish trap and another would grab the fishes as they escaped from the trap. Table 2 lists the types of interference reported by fishers at Whitehouse and other areas in the present study.

Figure 4 shows a summary of the trap fishing gear interference behaviour reported by fishers to be displayed by dolphins.

Other Types of Fishing Gear Interference by Dolphins

Other types of fishing gear, in addition to traps, were also reported as having been interfered with by dolphins. Table 3 is a summary of the information gathered regarding other gears disturbed by dolphins.

Various types of dolphins showed a number of different behaviour which were regularly observed in proximity to fishers' boats in Jamaican. These data are summarized in Table 4.

Figure 5 shows a summary of the various types of behaviour observed by fishers in the present study.

Other Marine Species Observed

In the course of the present study, several other species of mammals and non-mammals have been observed by fishers and the present researchers which may be of interest to other marine biologists. These are listed below in Table 6.

Table 2. Summary of types of trap interference behaviour by Dolphins noted by fishers in Jamaican waters.

Date	Location & source	Depth m	Observed dolphin behaviour	Number of dolphins	Result
22 Nov 2003	Whitehouse fisher, Westmoreland	30m	Rolling trap Several times	One or two	Lost traps, fish released
17 Jan 2004	Whitehouse, Westmoreland	30 m	Pots pushed into opening of caves near WH. Pots moved some distance to deep water. Swimming around pots. One seen with numbers branded on side!	Unknown	Traps damaged and lost, fish released. At least one non-Jamaican dolphin
14 Jan 2005	Whitehouse, St. James fishers	20 m	Standing traps on end (i.e. vertically) and rolling traps	Several	More fish cannot enter, fish inside leave
14 Jan 2005	Great River, Hanover	20-30m	Rolling of traps	Several	Fish lost, and traps lost
July & Aug. 2005	Old Harbour Bay (Portland Bight), St. Catherine	10 m - 30 m	Standing traps upright, rolling of traps, damage to mesh, fish escape		Damage to traps, loss of traps, fish lost
Dec. 2005	Pedro Bank (as noted by Rocky Point, Clarendon fishers)	30 – 40 m	Trap turned upright, (Upending) interference with funnel to get fish	Several	Damage to traps, loss of traps, fish lost.
Feb. 2006	Alligator Pond, St. Elizabeth	30-40 m	Traps damaged and moved to other locations	Several	Gear damage and fish loss
April, 2006	Black River, St. Elizabeth	20 – 30 m	Traps rarely interfered with by dolphins	All	Rare gear damage or fish loss
June, 2006	Bowden (Port Morant) Harbour, St. Thomas	10 – 30 m	Tangle (Chinese) nets had fish removed and holes torn in nets	All	All reported gear damage and catch loss

Table 3. Non-trap types of fishing gear interfered with by dolphins in Jamaican waters based on fishers' interviews.

Fishing gear type	Location	Month/Period	Gear Interference behaviour
Gill nets	Kingston Harbour, Kingston	Summer	Removal for herrings from nets as clearing took place by fishers at surface
Drop nets	Portland Rock, East Pedro Bank	All year	Removal of fishes from net, tearing holes in net, swimming through nets, damage to net.
Tangle (Chinese) nets	Bowden harbour (Port Morant), St. Thomas	All year (but at intervals)	Removal of fishes, especially mullets, repeatedly tearing holes in nets

Table 4. Summary of various Dolphin behaviour types observed in proximity to fishers boats in Jamaican waters (compiled from various sources in present study).

Observed behaviour	Depth	Individual or group	Duration of behaviour	Time of day observed	Proportion of All observations
Wave riding	Surface	Group	Several minutes on average	Various	High
"Spyhopping" (approaching to observe)	Surface	Individual	Brief	Various	Small
Playing	Surface	Groups	Brief	Various	Small
Mating	Just below surface	Groups	Brief	Various	Small

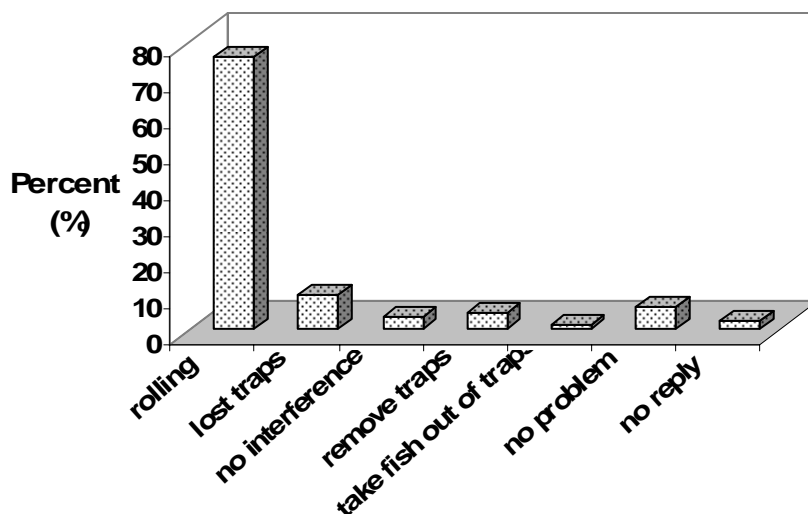


Figure 4. Types of trap interference behaviour in dolphins reported as observed by fishers

Table 5. Bottlenose Dolphin behaviour observed by authors in Jamaican waters during the present project.

Observed behaviour	Location	Depth	Indiv. or group	Duration of behaviour	Time of day	Proportion of all observations
Spyhopping	Black River, St. Elizabeth	Surface	Group	Brief	0922 – 1200 hrs.	High
Protective ("blocking" to come between calf and observer) "Lobtailing"	Black River (BR)	Surface	Indiv. (mother)	Brief	At intervals during above period	Small
	BR	Surface	Individual	Brief	Once in above period	Very small (rare)
Remaining just below surface	Bowden Harbour, St. Thomas	Near surface	Individual	Brief?	0930 -1000 hrs.	Small

Table 6 List of other species mentioned as seen in areas where dolphins reported in Jamaican waters.

Species/family	Common name	Size (approx.)	Number	Location	Date	Behaviour observed
<i>Grampus griseus</i>	Risso's dolphin	unknown	One?	Whitehouse, St. James	Jan. 2005	Playing, leaping
<i>Rhynchodon typus</i>	Whale shark	20 m	One	Sandy Bay, Hanover	Jan. 2005	Swimming with mouth open (feeding), trailed by small (1.0kg) tunas
<i>Physeter macrocephalus</i>	Sperm Whale	20 m	Several	In deep water south of Rocky Point, Clarendon between shelf & Pedro Bank	Dec. 2005	Seen near canoes in transit to and from Pedro Bank
<i>Orcinus orca</i>	Killer Whale	"Adults"	Several	Near Montego Bay, St. James	Summer 2005	Threatened boats at one stage
Chelonidae	Marine turtles	Mixed adults (possibly hawksbills?)	Few	Whitehouse & Montego Bay, St. James	2005	Used to be more frequently seen

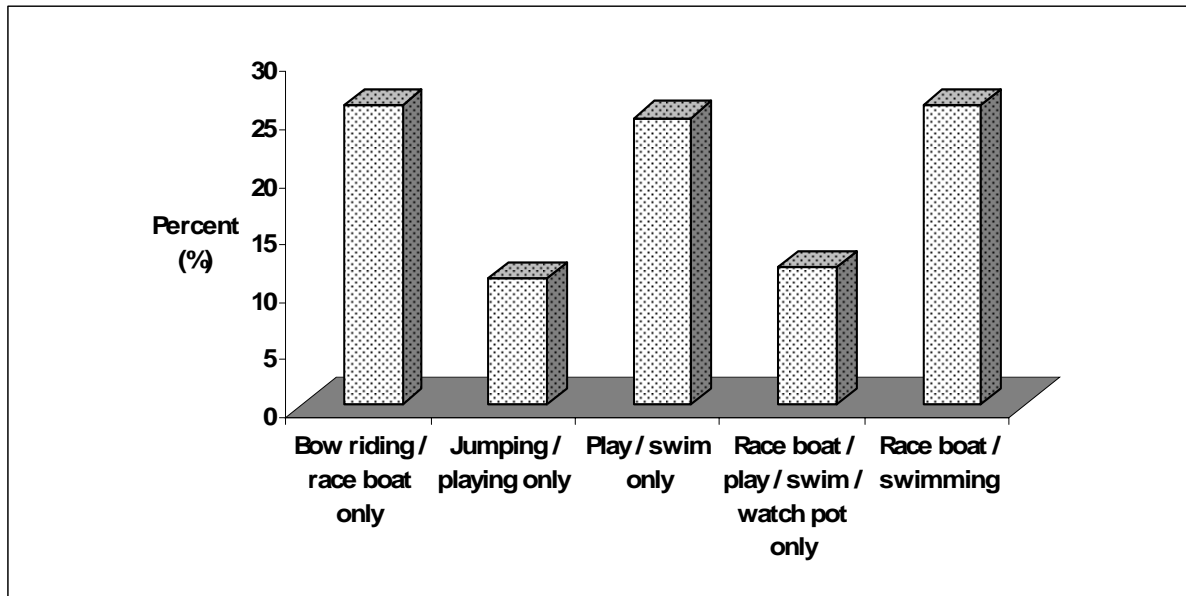


Figure 5. Dolphin behaviour types away from fishing gear seen by fishers

Suggestions by Fishers for Management of Dolphins

All fishers interviewed were asked for their suggestions for potential action to be taken regarding dolphin interference with traps. The answers provided by fishers form the basis of the following table (Table 7) which summarizes these suggestions. Some of the suggested management measures are direct quotes from fishers themselves.

Figure 6 shows the various types of management suggestions made by fishers for the management of dolphins so as to reduce interference with fishing gear.

Attitudes of Fishers to Dolphin Presence

The perceived attitudes of fishers interviewed in the study regarding the presence of dolphins on their fishing grounds are shown in Table 8.

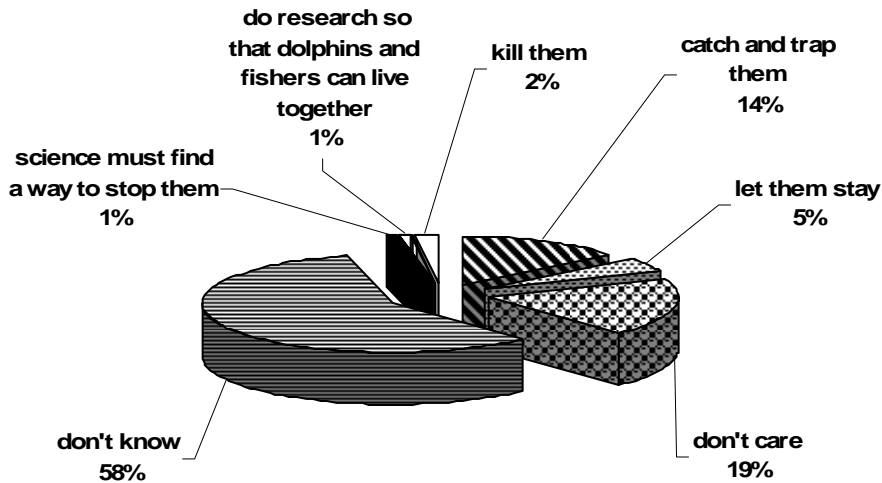


Figure 6. Various management suggestions for dolphin management made by fishers in the present study.

Table 7. Measures suggested by Jamaican fishers for dolphin management

Location of fishers	Measures suggested	Purpose	Action to be done by whom	Comments
Whitehouse, Westmoreland	a) Remove them (dolphins) from area	Less trap loss	"Government"	Not possible
	b) Leave them alone	"Allow nature to take its course"		
Whitehouse, St. James	Find way to reduce interference	Reduce losses	Government?	Co-management
Rocky Point, Clarendon	Do research to study daily activity patterns of dolphins	So that fishers and dolphins can "live together"	Researchers (UWI, Fisheries Division?)	
Black River, St. Elizabeth	Study them so we can understand them better	So fishers can get along with them	UWI researchers	

Table 8. Summary of perceived attitudes of interviewed fishers to dolphins in Jamaican waters by area

Location	Fishing gear used	Zone	Attitude	Reasons
Whitehouse, Westmoreland	Traps	South shelf & Windward, Leeward banks	Strongly dislike dolphins	Trap damage, trap loss, fish loss, reduced earnings
Whitehouse, St. James	Traps	Northern shelf near Montego Bay	Dislike dolphins	As above
Gun Cay, Port Royal Cays, Kingston	Handlines (hook and line)	Port Royal Cays, and southern edge		
California Bank	Handlines	Small oceanic bank south of Kingston	Like dolphin presence	Means no sharks around to damage their lines
Rocky Point, Clarendon	Traps	Pedro Bank	Dislike dolphins	Damage traps, cause trap loss, reduced incomes
Rocky Point, Clarendon	Drop nets (Tangle nets)	Portland Rock, E. Pedro Bank	Mixed: a) dislike interference with drop nets, b) when dolphins present, there is no shark around	a) gear damage, loss b) safety
Alligator Pond, St. Elizabeth	Traps	Southwest coastal shelf	Generally dislike dolphin interference	Trap damage and fish loss
Black River, St. Elizabeth	Traps	Southwestern coastal shelf	Few fishers disliked dolphins, most like them.	Few reports of gear damage.
Bowden Harbour, (Port Morant) St. Thomas	Tangle (Chinese) nets	Eastern shelf	All net fishers disliked dolphins	Repeated fish removal and tearing of holes in nets

DISCUSSION

Species

Bottlenose dolphins (*Tursiops truncatus*) are but one of perhaps seven species of odontocoete cetaceans (smaller toothed whales) that are found in the western Central Atlantic. *Tursiops* species are found throughout tropical and temperate waters of the world (Leatherwood and Reeves 1982). Bottlenose dolphins are known from Jamaican waters (Pers.observ., & Fisheries Division) as well as other species. Perez Cao *et al.* (2003) noted that the genus *Tursiops* has two main species (*T. truncatus* and *T. aduncus*) which occupy different geographical ranges and that sympatric populations have been identified (Rice 1998). Great whales are also seen in Jamaican waters, thought relatively infrequently (Aiken Pers. observ.).

The results of the study appear to show repetitive reports of a least three species in ranked abundance, the bottlenose dolphin, pantropical spotted dolphin, and common dolphin as being most often associated with the disturbance of fishing gear in Jamaican waters. The various tables show a surprising number of small whales such as Dolphins and occasional great whales. Some unusual species such as *Orca orcinus* (Killer whales) are of considerable interest.

Distribution

Several species, as mentioned in Kenney *et al.* (2004) would be expected to occur only offshore in the winter months. Others are comparatively rare in their distribution. Based on fishers reports, personal observations before and

during the present study, as well as existing reviews in the literature such as Ward *et al.* (2001) and Cushnie (2003), only the Bottlenose Dolphin (*Tursiops truncatus*), the Pan-tropical Spotted Dolphin (*Stenella attenuata*), and/or the Atlantic Spotted Dolphin (*Stenella frontalis*) were reported with any regularity by fishers. One additional point is that there appears to be two varieties or morphs of the Bottlenose Dolphin in Jamaican waters and elsewhere in the Caribbean, such as Cuba (Perez Cao *et al.* (2004) and Puerto Rico (Lopez Pers. comm.).

There appears to be not a lot of information known about the movement and migration patterns of bottlenose dolphins in Jamaican waters or in the Caribbean (Ward *et al.* 2001). As mentioned by Kenny *et al.* (2003) coastal bottlenose dolphins along the Atlantic coast of the United States are migratory in at least part of their range with the animals disappearing from nearshore waters north of North Carolina in the winter.

Dolphins in Jamaican waters are very rare and/or sparsely distributed as indicated by the Kenney *et al.* 2003 aerial survey and the present study over two years. From an aerial survey of coastal waters conducted in 1981 and 1982, Fairbairne and Haynes (1983) reported the highest number of dolphin sightings was in waters off St. Elizabeth parish. For many parishes for examples all along the north coast, no dolphin sighting was made. In the present study we observed bottlenose dolphins in nearshore coastal waters only off St. Elizabeth, Kingston and in St. Thomas parishes. Of considerable consequence, is an early report (2004) by a few fishers at Whitehouse, Westmoreland, that one dolphin was seen on more than one occasion “with numbers stenciled on the side”! There is no such dolphin labeling activity presently or in the past known in Jamaica. Therefore, this Bottlenose dolphin would have to have come from some location outside of Jamaica. This incident demonstrates quite clearly, that at least a few of the dolphins seen in local waters may not be from Jamaica or spend some length of time elsewhere and thus migrate between more than one area. The identity of that area is largely speculative. Could it be our closest neighbor, Cuba? Or could it be Hispaniola, or perhaps Grand Cayman? This is one area greatly in need of additional research.

Numbers and Abundance

Allied to the present study was another by NEPA done in January and February, 2004 to conduct an aerial survey of dolphins around Jamaica. The results of this study are published in a paper by Kenney *et al.* (2004). It showed that dolphins were not abundant in coastal waters at the time and season that the aerial survey was conducted as none were seen (see discussion).

With bottlenose dolphins the numbers were relatively low (two to 10). With the offshore variety, somewhat more (6 to 24). For the spotted dolphins (probably pan-tropical spotted dolphins) the numbers were more substantial in the order of several dozen (> 24) to hundreds (>200). We

actually observed six in Black River bay and one in Port Morant (Bowden) bay, St. Thomas. When compared with the higher number of dolphins observed by Fairbairn & Haynes (1983) during their aerial survey from May 1981 to April, 1982, it may be seen that there is a broadly similar pattern in distribution, but not in number. There may have been a significant reduction in numbers of coastal dolphins over the 1982 aerial survey. The reason(s) for this reduction are unknown at this time.

Highest numbers of dolphins were reported by fishers in western Jamaican waters on the southern shelf in the present study (see also Figure 2). One group of fishers near Montego Bay, St. James (northwest coast) reported pods of up to 24 individuals not far from shore. Fairbairn & Haynes (1983) reported a monthly mean sighting of 12 dolphins in their year-long aerial survey. Our seaborne survey did not sight any dolphins in Old Harbour, St. Catherine, although it is reported that at least two to four are regularly observed around the small cays in the centre of the bay (B. Haye Pers. comm. 2006) by scuba divers. Additionally, our observation of one dolphin at the mouth of Kingston harbor (on a non-survey day), is a new record for Kingston & St. Andrew in this study.

Interference Behaviour

In summary, this consists of two types a) trap and b) gill and seine net interference. In the first type of gear interaction behaviour, there appeared to be i) rolling, ii) head butting of the gear, and iii) mesh tearing. With nets, the dominant behaviour was essentially i) catch (fish) removal and ii) mesh tearing to enter the mesh covering to get at the trapped fishes. Experience gathered over several years by the author researching the artisanal fishery, suggests strongly, that there is a high possibility that those fishers reporting that “dolphins move their traps into deeper water” could be seeing the effects, not of dolphin interference, but of piracy by other fishers. In other words, trap movement is due to removal of fishes by other fishers, who then drop the pillaged, empty trap some distance away from where it was lifted from the seafloor.

Other Dolphin Behavior

Table 5 listed the non-interference behavior that was seen by fishers and the author. What is shown suggested that Jamaican Bottlenose dolphins displayed no behavior that was notable different from coastal specimens seen elsewhere in the region. The major type was bow “wave riding” whereby they were able to come alongside fishers’ vessels for even a short time.

Reasons for Trap Interference Behavior

The most common dolphin species is the bottlenose dolphin and if this species takes up to 15 kg. (33 lbs) of various fishes daily. Therefore, the presently held theory is that a gradual reduction in levels of wild fish due to general overfishing and other marine coastal ecological reasons

have perhaps led to gear disturbance by Jamaican dolphins. Most times the dolphins appeared to be trying to get to the fish contained in the traps they were disturbing. The overfished status of Jamaican fisheries is well documented and though other reasons may be found in the future, presently it is theorized that shortage of normal daily fish prey species in our coastal waters is the primary cause of interference with fishing gear in local waters.

Another theory put forward by one experienced fisher, was that the trap disturbance by dolphins began around 1996 or 1997 when fishers began using dynamite on some of the small southwestern oceanic offshore Banks such as Blossom Bank (SW of Whitehouse). Dolphins came to the area to consume remnant fishes that sank to the seafloor after the use of explosives (on average only 40% of fishes killed by dynamite float to the surface). Whether this dynamiting triggered trap disturbance, is unclear at the time of writing.

Management plan for Dolphins

There is no comprehensive plan that can effectively prevent or eliminate dolphins from interfering with fishers gears. This is mainly because they are intelligent, highly mobile, social, highly adaptive mammals. The present study determined that the incidence of fish trap interference is high, but also patchy. Areas of high interference appear to be positively correlated to high dolphin distribution. If the dolphins are disturbing fish traps and nets in order to obtain fishes that they can no longer get from wild fish, then the only way that they would cease this interference is if the former large numbers of wild fishes are restored. This will most likely not happen, even in the long run, due mainly to continued high levels of overfishing, combined with deterioration of the reef environment due to anthropogenic, as well as natural factors. Fortunately, nearly all fishers interviewed had no ill will against the dolphins and nearly all were aware that they are protected by Jamaican and international laws. In Jamaica, the international trade of dolphins is regulated under the Endangered Species (Protection, Conservation and Regulation of Trade) Act 2000, which mandates that trade in dolphin species listed in Schedule II (Appendix II of CITES) will require a CITES export permit from the Management Authority of the exporting country and an import permit from the Natural Resources Conservation Authority (NRCA), the Management Authority.

A National Policy document on Dolphins is in preparation at the time of writing which addresses the conservation and protection of dolphins under international and Jamaican legislation, licenses to collect dolphins and their use in eco-tourism and other captive environments. The tone of part of the document as it presently is written suggests, in the author's opinion, that capture of local dolphins for use in *dolphinaria* may be part of the planned policy. The present authors do not support such action and more support an alternate view whereby dolphin-(and

whale) watching, an ecologically non-consumptive, highly sustainable, and also increasingly popular activity, fully capable of earning sustainable sums from locals and visitors alike far into the future, is promoted. Once this happens, then dolphins (and whales) would truly be protected in local waters.

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