Strategic Plan for Eliminating the Incidental Capture and Mortality of Leatherback Turtles in the Coastal Gillnet Fisheries of Trinidad and Tobago

PROCEEDINGS OF A NATIONAL CONSULTATION

Port of Spain, Trinidad, 16-18 February 2005

Ministry of Agriculture, Land and Marine Resources, Government of the Republic of Trinidad and Tobago, in collaboration with the Wider Caribbean Sea Turtle Conservation Network (WIDECAST)

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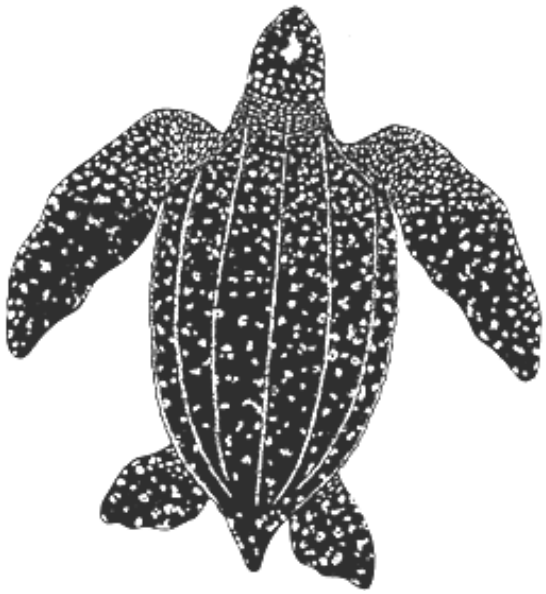

PREFACE AND INTENT

For more than two decades the Wider Caribbean Sea Turtle Conservation Network (WIDECAST), with Country Coordinators in more than 40 Caribbean States and territories, has linked scientists, conservationists, resource managers, resource users, policy-makers, industry groups, educators, and other stakeholders together in a collective effort to develop a unified management framework, and to promote a regional capacity to design and implement scientifically sound sea turtle management programs.

As a Partner Organization of the UNEP Caribbean Environment Programme, WIDECAST is designed to address research and management priorities at national and regional levels, both for sea turtles and for the habitats upon which they depend. We focus on bringing the best available science to bear on contemporary management and conservation issues, empowering stakeholders to make effective use of that science in the policy-making process, and providing an operational mechanism and a framework for cooperation at all levels, both within and among nations. Network participants throughout the region are committed to working collaboratively to develop their collective capacity to manage shared sea turtle resources. By bringing people together, and by encouraging inclusive management planning, WIDECAST is helping to ensure that utilization practices, whether consumptive or non-consumptive, do not undermine sea turtle survival over the long term.

There can be no doubt that one of the most serious and intractable management issues facing the Caribbean region is the wastage associated with sea turtle bycatch. Not only does the capture and mortality of sea turtles incidental to subsistence and commercial fisheries diminish an already depleted sea turtle resource, compromising recovery efforts at national and regional scales and reducing the number of turtles that could otherwise enter the marketplace in more productive ways, but, through gear damage and time spent, it can cripple the ability of fishers, many of whom subsist in marginal economies, to make a living for their families.

Our intention in convening this meeting was to demonstrate that a community can meet this challenge even as it reaches crisis proportions – as it has along the northeast coast of Trinidad – and threatens to overwhelm stakeholder sensibilities. We are particularly awed and inspired by the fishers, who clearly have the most to lose in shifting the delicate dynamics of their economies. They brought their expertise, their humor, their frustration, their creativity and, perhaps most importantly, a willingness to visualize a new path. These proceedings are dedicated to all who gave of their time and talent over those three days, and all who will find these efforts inspiring and seek to duplicate them in other parts of the world.

Karen L. Eckert
Executive Director
WIDECAST

ACKNOWLEDGMENTS

A consultation of this magnitude, bringing together interest groups from every region of the nation, representing a wide range of life and professional experiences, could not have been accomplished without the innovative spirit and broad support of the nation's fisher community, sea turtle scientists, community groups, natural resource managers, and policy-makers, as well as our logistical coordinators, donors, and invited experts. We gratefully acknowledge the more than 50 participants who took time from their busy lives to start the important process of building bridges to span the gap between profitable fisheries and the conservation of endangered leatherback sea turtles. The enthusiasm and generosity of all participants was tremendously inspiring.

Such a meeting would never have proceeded without the proactive initiative of the Ministry of Agriculture, Land and Marine Resources, especially Ms. Anne-Marie Jobity (Director of Fisheries) and Dr. Arthur Potts (Assistant Director of Fisheries). Their realistic appraisals of the practical, and the commitment of their agency to this process has been invaluable. We also gratefully acknowledge the following individuals who worked so hard to organize and manage the myriad of details: Ms. Ruth Davis Ms. Lara Ferreira, Ms. Allys Forte, Ms. Sherma Gomez, Ms. Michelle Picov-Gill, Ms. Nadia Ramphal, Mr. Mervin Sendall, Ms. Wendy Thomas, and, especially, Ms. Nerissa Nagassar.

Finally, no progress would have been made without financial support from the World Wide Fund for Nature (WWF), The CGMK Foundation, and the U.S. National Marine Fisheries Service. Scott and Karen Eckert's time was partially supported by the *Mary Derrickson McCurdy Visiting Scholar* Fellowship at Duke University. These contributions are greatly appreciated by all.

…With a hopeful eye to the future, and confident that the recommendations herein will be implemented and the bycatch challenge, a crisis for fishers and endangered turtles alike, solved, we thank in advance all who will support the work to come.

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EXECUTIVE SUMMARY AND RECOMMENDATIONS

Accidental entanglement of leatherback sea turtles (*Dermochelys coriacea*) in the gillnet fisheries of Trinidad is the most serious conservation problem faced by the species and threatens to undo several years of proactive conservation and innovative management by the government of Trinidad and Tobago and many local non-government organizations (NGOs). The entanglement problem also places a severe strain on the ability of Trinidad fishers to operate economically, and is so severe that many are unable to fish during the sea turtle nesting season.

Undisputed among stakeholders is that incidental capture is the largest single source of mortality to leatherbacks in the country, killing more leatherbacks than all other factors combined. Because it supports the second largest known nesting aggregation in the world, the Republic of Trinidad and Tobago plays a uniquely important role in the survival of this species on a global scale. With this in mind, incidental capture and mortality to reproductively active females in waters under the Republic's jurisdiction constitute a major threat to this Critically Endangered (cf. IUCN) species on both Atlantic basin and global scales.

In an attempt to open a dialogue on these issues, and facilitate a stakeholder driven process of solution-making, a National Consultation was hosted by the Wider Caribbean Sea Turtle Conservation Network (WIDECAST) and the Fisheries Division (Ministry of Agriculture, Land and Marine Resources) in February 2005. Invited participants included fishers drawn from all affected communities, including representatives from Tobago, local and national NGOs, the government's primary natural resource management agencies, the Ministry of Foreign Affairs, and a small number of international fishing and conservation experts.

The goal of the meeting was to review the problem of sea turtle bycatch in coastal gillnet fisheries, in particular along the north and east coasts of Trinidad where most leatherback nesting takes place, and to apply the shared expertise of the forum to devising a series of potential solutions suitable for field-testing and evaluation by fishers and natural resource management professionals. To this end, twin objectives were proposed: fishers must be better off economically as a result of any proposed solution to the bycatch crisis, and the incidental capture and mortality of leatherback sea turtles in coastal fisheries must cease.

The goal of the meeting was met through technical presentations in a conference setting, open-forum question and answer sessions, an all-day field excursion to coastal fishing communities and fishing depots, Working Group discussions, plenary consensus on recommendations, and publication of this Proceedings document.

Participants acknowledged that the problem is a difficult one, and that no single solution would likely suffice for all areas and all fisheries. Thus it was proposed that a series of investigations be designed to evaluate, under realistic field conditions, various bycatch reduction options

including: new bait types (e.g. artificial, dead and non-traditional baits) to enhance hook-and-line fishing as a replacement for gillnets; new technologies, techniques, or gear modifications (e.g. power take-up reels, alternate net materials, FADs; net-fishing at different depths); and creative approaches to net avoidance (e.g. sonic 'pingers', shark silhouettes). It was agreed that each of these options should receive equal weight during the experimental phase, and that the results of each trial should determine subsequent experimental priorities.

New regulatory regimes, and in particular the implementation of time and area closures, were also discussed. The recommendation was made that gillnets be banned from 1 March to 31 May within a region extending from the south end of Fishing Pond Beach to the west end of Paria Beach, and extending 8km offshore. Other types of gear would be allowed. There was concern over the government's capacity to enforce the closure, however, and the need for improved marine resource management capacity was noted. Also noted was the need to harmonize the Fisheries Act (specifically the 1975 Protection of Turtles and Turtle Eggs Regulations) and the Conservation of Wild Life Act, such that protection to the leatherback turtle at all times was unambiguous.

With regard to evaluating fishery alternatives, the meeting uniformly agreed that active fishermen must be involved in the testing and development of each new method, with oversight and assistance by relevant experts. It was proposed that the best mechanism for initiating the field-testing component would be to invite proposals from relevant national and international experts (see "Project Implementation Notes"), and that fund-raising, including the paid participation of fishers, would need to occur on a case-by-case basis.

Furthermore, there was consensus that the following criteria be taken into account when evaluating the various mitigation options:

- What - will the experiment measure (objectives and variables)?
- How - will the experiment be conducted (materials and methods)?
- Where - will the experiment be conducted?
- Who - will conduct and evaluate the results of the experiment?

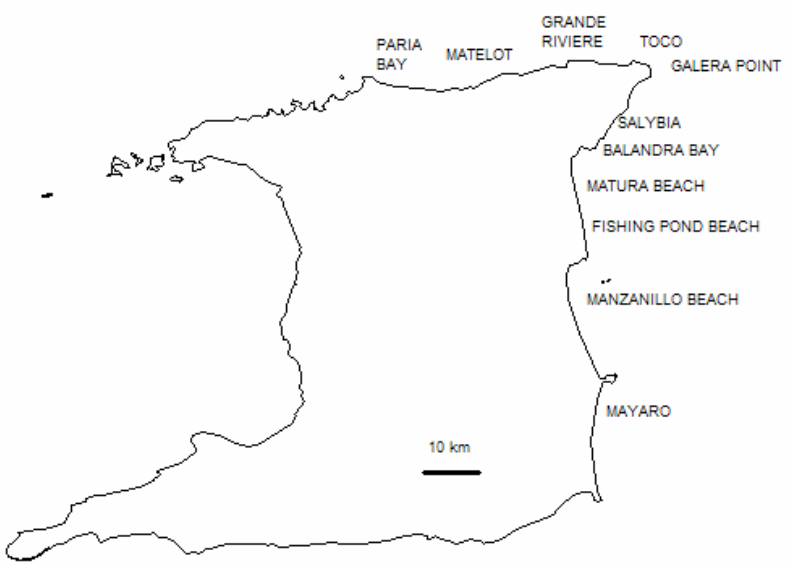
There was also consensus that the following Evaluation Criteria be adopted:

- Can the new technique catch fish?
- Is it economically viable (i.e. producing equivalent or increased revenue)?
- Does it reduce adverse impact to leatherback sea turtles?
- Can it be managed/regulated?
- Is it logistically feasible for local conditions?
- Is it biologically and commercially sustainable?
- Will it be supported/accepted by the stakeholders?

Finally, there was widespread interest among participants that a mechanism be created, perhaps by Government, to facilitate an ongoing dialogue between fishers and natural resource managers, and embracing the expertise of communities and NGOs, on subjects of fisher concern regarding the bycatch issue and the hardships endured during the seasonal struggle to fish in the presence of large numbers of leatherback turtles.

INTRODUCTION

That leatherback sea turtles (*Dermochelys coriacea*) are accidentally entangled in coastal fishing gear in Trinidadian waters has been known for many years. In interviews with Matelot fishermen (April-May 1992), Fournillier and Eckert (1998) reported a capture rate of 10 leatherbacks per 61m of net per season. Between March and August 1995, seven Matelot fishermen documented the capture of 139 leatherbacks in their nets. In 1997, an estimated 200-450 leatherbacks were captured in gillnets between Balandra Bay and Salybia on the east coast of Trinidad (Map 1), and it was suggested that leatherback death rates off Toco Point were so high that mortality in the northeast region of the country probably exceeded 1,000 egg-bearing female turtles every year (Fournillier and Eckert, 1998), although the authors could not speculate on the extent to which the data reflected multiple captures of the same individuals.



Map 1: The major fishing ports on the north and east coasts of Trinidad, West Indies.

Eckert and Lien (1999) published the results of interviews they conducted with fishers on the east and north coasts of Trinidad, during which fishers were queried about the accidental capture of leatherbacks in their fishing gear. The following findings are noteworthy: one Matelot fisherman reported that each of the 25 boats (operating out of Matelot) averaged 1-2 turtles captured per fishing trip (i.e. per day); fishermen from Manzanilla (3 boats) reported catching one leatherback per day (five days per week) from January to April, with a 50% mortality; off the coast of Mayaro, where 50 boats operate (25 from Mayaro, 25 are from other ports), each boat reportedly caught five leatherbacks between January and April; mortality was estimated to exceed 95% due to an illegal black market in leatherback meat in coastal

communities. Eckert and Lien (1999) offered management recommendations based on these interviews, as well as summarizing current literature and additional information provided to them by local biologists, resource managers, and community-based conservation organizations. A follow-up study conducted by the Institute for Marine Affairs (IMA) confirmed the general conclusions of Eckert and Lien (1999), but estimated that more than 3,000 leatherbacks had been captured incidental to gillnet fishing in the coastal waters of Trinidad in 2000 and that more than half likely died as a result of such an encounter (Lee Lum, 2003).

According to Eckert and Lien (1999), two primary factors influence the probability that the turtle will die. The first variable is gear type. Fishermen report that monofilament nets result in higher incidental mortality than woven nylon "green-web" netting. Eckert and Lien (1999) described the entanglement of a leatherback in green-web off Madamas Beach. The turtle was alive and able to drag the net to the surface to breathe. It exhibited a distinctive net imprint/ scarring that is often seen on nesting females. The authors noted that the 4.25 inch [10.8 cm] mesh net did not entangle the turtle sufficiently to cause drowning (though escape was clearly impossible), and that the relatively coarse line appeared not to foul the turtle as seriously as did the monofilament, possibly leading to lower acute mortality rates. Another possibility may be that monofilament nets are used primarily as set nets, in which the net is set deeply and anchored to the bottom, perhaps preventing an entangled turtle from surfacing to breathe. The second variable is how the turtle is treated after capture. At the time of Eckert and Lien's writing, leatherbacks were regularly killed either to simplify their release from the net or, as in the case at Mayaro, to support an illegal market in sea turtle meat. Nesting beach patrols sometimes encounter turtles severely cut, apparently by fishermen, which successfully escaped the net. Fishermen report that killing the turtle quickly prevents further damage to the net, and that dismembering the turtle simplifies its removal.

Figure 1. Multifilament "green-web" netting used by coastal fishers in northeastern Trinidad. © Carlos Drews/ WWF

Further evidence of unsustainable rates of capture resulted from studies in which leatherback turtles carrying radio transmitters were reported captured or disappeared offshore for inexplicable reasons. In 1995, three leatherbacks were equipped with satellite transmitters at Matura Beach, on the east coast of Trinidad. One of the three (30%) was captured and released by a gillnet fisherman from Toco. In a follow-up telemetry study in 1996, six leatherbacks were equipped with VHF radios for tracking purposes, and all (100%) disappeared abruptly. Wholesale equipment failure is unlikely, and radio range and coverage were extensive enough to dismiss the idea that the turtles simply left the area. The most likely explanation is that these turtles were killed in fishing operations south of Fishing Pond Beach. In 2003, four satellite transmitters were deployed on nesting leatherbacks (two at Grande Riviere, two at Matura Beach); both Grande Riviere turtles (50% of the total) are known to have been caught and killed in coastal gillnets (Eckert, 2006).

To encourage fishers to untangle the turtles rather than to dismember them, and to compensate fishers for damage caused by the incidental capture of leatherbacks, the United Nations Develop-ment Program (UNDP)/GEF Small Grants Programme provided a grant in the late 1990s to the Grande Riviere Environmental Action Trust (GREAT) to refund fishers the cost of net repair when damage was caused by a turtle that was released alive. The program was to be a pilot project, with intentions of replication if it was successful. It is acknowledged that the pilot project represented at best a "stop-gap" measure and not a final solution to the problem of incidental fishing mortality, since there was no attempt to prevent capture in the first place. The program is currently being evaluated, pending potential renewal.

Figure 2. Adult leatherback entangled in a gillnet off the northeast coast of Trinidad. © Scott A. Eckert/ WIDECAST

Together, the available data strongly corroborate what fishermen have described for several years, and that is that many and perhaps most egg-bearing leatherbacks arriving to nest on the shores of Trinidad, one of the largest and most important rookery areas in the world for this species, are entangled at least once by coastal gillnets during their seasonal residence in national waters – and many of them die.

The most important conclusion, and one that is undisputed among stakeholders, is that incidental capture is the largest single source of mortality to leatherbacks in Trinidad and Tobago, killing more leatherbacks than all other factors combined. The Republic of Trinidad and Tobago plays a uniquely important role in the survival of this species on a global scale, in that the islands support the second largest nesting aggregation in the world (after French Guiana/Suriname). With this in mind, incidental capture and mortality to reproductively active leatherbacks in waters under the Republic's jurisdiction constitute a major threat to this Critically Endangered (cf. IUCN) species on both Atlantic basin and global scales.

Figure 3. Leatherbacks stranded on Matura Beach, Trinidad, after having been drowned in fishing nets offshore. © Dennis Sammy/ Nature Seekers

Less well-studied, but equally important to understand, is that the impact such accidental entanglements have on the sustainability of coastal fisheries. Trinidad fishers have long complained that leatherbacks are increasingly entangling their gear, and that such entanglement is causing economic hardship and mortal risk to the fishers. Between the net repair costs

and loss of fishing time while nets are repaired, it is increasingly clear that coastal gillnet fishing is virtually impossible during leatherback nesting season. For example, according to Saheed Mohammed (Toco fisher) and Nigel Gabriel (Balandra Bay fisher), in June 2005 one full night of fishing with a fillette net (surface-drift gillnet) off the east coast of Trinidad yielded 100lb of kingfish, 105lb of carite, and 66lb of cravalle, with a gross estimated value of $2,600 TT; that same night, a single entangled leatherback caused ca. $3,000 TT in damage to the net, damage that would require two weeks to repair. In many areas the problem has reached a crisis level, so much so that fishermen are unable to fish during much of the time when leatherbacks are most abundant, accounting for a substantial part of the year (i.e. February-August).

Continued mortality in coastal fisheries would be expected to cause a ripple effect, both within the local nesting population and throughout the greater Atlantic basin where the species is known to forage in north-temperate and West African waters (e.g. Eckert, 2006). There can be no doubt that such mortality could eclipse national, regional and possibly even global conservation efforts in the same way that the commercial gillnet fisheries of Chile and Peru have been implicated in the near extinction of some 50% of all reproductively active adults on Earth, which until recently nested on the Pacific coast of Mexico (Sarti et al., 1996; Eckert and Sarti, 1997).

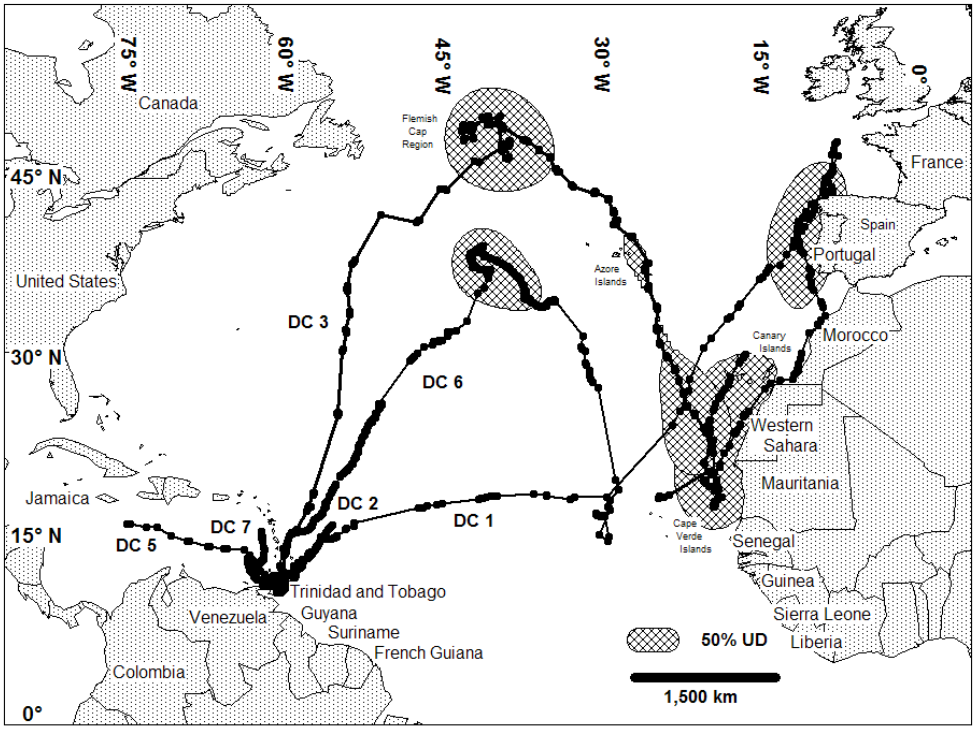


Figure 4. Post-nesting movements of six leatherback turtles monitored using satellite telemetry, showing high-use areas in the Atlantic Ocean (source: Eckert, 2006).

Leatherback nesting populations in Trinidad (the same cannot be said for Tobago) appear to be stable or rising at the present time, further exacerbating interactions between turtles and fishing

gear. From the standpoint of both turtles and fishers, a solution must be found to the incidental capture crisis. To this end, the objective of the national meeting was to develop a strategic plan for eliminating the incidental capture and mortality of leatherback turtles in Trinidad and Tobago by reviewing all available data, convening an inclusive national stakeholders' meeting, soliciting input from local and international experts, and achieving a national consensus on a series of experiments designed to test alternatives to coastal gillnetting in its present form.

BACKGROUND

Fishing in Trinidad and Tobago

The north and east coast fisheries on Trinidad are made up primarily of small-scale artisanal fleets based at fishing ports distributed along the coastline. Vessels are generally constructed of fiberglass or polyester-resin covered wood, 5-7m in length and powered by a single outboard engine. Gear used in the fleet varies by season, location and target species but most use gillnets for at least part of the year. The most recent survey conducted by the Fisheries Division tallied 41 vessels fishing with gillnets on the east coast and 61 vessels fishing with gillnets on the north coast in 1998; of 273 gillnet fishermen interviewed in Trinidad, 73% described themselves as full-time fishermen (Nagassar, 2000).

Figure 5. Typical fishing depot on the north coast of Trinidad. © Jordan Gass/ Duke University

According to Nagassar (2000), "Approximately 1,404 fishermen [are] directly involved in the Gillnet Fishery of Trinidad and Tobago. These include boat owners, captains and crew on board vessels operating both monofilament and multifilament gillnets. There are approximately 1,368 fishermen operating in the gillnet fishery of Trinidad and approximately 36 operating in Tobago." A variety of mid-water and bottom species are targeted by gillnet fisheries in Trinidad and Tobago, including shark, grouper, snapper and various mackerel species (Henry, 1992; Hodgkinson-Clarke, 1994; Nagassar, 2000). Nagassar (2000) lists the following:

Anchovy (*Cetengraulis edentulus*)
Atlantic Bumper *(Chloroscombrus rysurus)*
Beechine (*Sphyraena guachancho*)
Blacktip Shark (*Carcharhinus limbatus)*
Blinch *(Diapterus rhombeus)*
Blue bone (*Strongylura marine*)
Blue marlin *(Makaira nigricans)*
Bonito *(Euthynnus alletteratus)*
Crevalle Jack *(Caranx hippos)*
Cutlassfish *(Trichiurus lepturus)*
Dolphin *(Coryphaena hippurus)*
Flying fish (*Hirundichthys affinis)*
Grand ecaille *(Egalops atlanticus)*
Grunt *(Haemulon spp.)*
Herring
Jack
Kingfish *(Scomberomorus cavalla)*
Macrio Tuna *(Katsuwonus pelamis)*
Mullet *(Mugil curema)*
Ocean gar
Pampano *(Trachinotus carolinus)*
Redfish *(Lutjanus spp.)*
Sailfish *(Istiophorus albicans)*
Sea Catfish *(Bagre spp.)*
Shark *(Carcharhinus spp.)*
Sierra Mackerel *(Scomberomorus brasiliensis)*
Snook *(Centropomus ensiferus)*
Tuna *(Thunnus spp.)*
Weakfish *(Cynoscion spp.)*
Whitefish
Whitemouth Croaker *(Micropogonias furnieri)*
Zapate

Fishing techniques can be divided into (i) hook and line, including trolling and (ii) net fishing.

Hook and Line

Banking - This type of fishing relies on a weighted vertical line and one or more horizontal perpendicular lines with 10-20 hooks, each baited with live or dead bait. The horizontal lines are extended parallel to the bottom by the current and the boat can be anchored or drifting. In some cases the fisher can actively work the line by retracting and extending the vertical line so that the weight bounces along the bottom, or by tying off the line to the boat and letting the rise and fall of the boat work the line.

A-la-vive - This type of fishing primarily uses live bait hooked on a weighted line with multiple hooks. The bait line is trailed from a boat that drifts with the current. Bait movement results from the fact that the bait is hooked in such a manner as to keep it alive. Depth of fishing is predominately mid-water: the target species are kingfish and carite. Of all hook and line styles of fishing, most fishermen prefer a-la-vive as they believe it has the highest rate of catch of the most valuable commercial species.

Switchering – Switchering uses essentially the same gear as a-la-vive, but relies on dead bait.

Trolling - Trolling is used frequently in Tobago and to a lesser extent in Trinidad. As practiced in Trinidad, 1 - 4 lines may be used directly from the boat with no outriggers. Bait is usually dead, artificial baits are used only rarely.

Net Fishing

Filette – Filette netting, or green-web as it is sometimes called, is made of twisted nylon multifilament line, usually dark green or black in color. National fisheries regulations limit all nets to a minimum 4.25 inch [10.8 cm] mesh size (measured on the diagonal) to preclude capturing under-sized fish. Filette nets are most commonly set in the late afternoon for fishing at night; fishers report that this reduces its visibility to the target species. Filette nets are usually fished as a surface drift net, extending from the surface to between 3-6m in depth and extending for up to 2km in length. Typical soak time: 2-4 hours.

Bottom-set – Bottom-set nets are constructed of monofilament and usually anchored to the bottom for fishing during the day. Like filette nets, these nets are limited to 4.25 inch [10.8 cm] mesh size and can be as long as 2 km.

Leatherback Turtles in Trinidad and Tobago

Leatherback sea turtles are the oldest and largest of the seven species of living marine turtles. Evolved during the Cretaceous Era, the genus *Dermochelys* is believed to be more than 90 million years old; its precise evolutionary history is poorly understood due to the paucity of fossil material (Wood et al., 1996). Mature females typically range from 250-500 or more kg in the Caribbean Region (Boulon et al., 1996; Eckert et al., 1989), but the largest male on record weighed more than 900 kg (Morgan, 1989). Arguably the most pelagic of the sea turtles, leatherbacks are well-adapted for life in the open ocean. Their hydrodynamic shape features broad shoulders and a posteriorly tapered carapace, long front flippers for propulsion, and dorsal longitudinal ridges that improve laminar flow and increase swimming efficiency. As a result of these adaptations, leatherbacks expend three times less energy during swimming than any other turtle species (Wyneken and Salmon, 1992).

Geographic distribution of the species is the broadest of any reptile, ranging from 47°N to 71°S (Pritchard and Trebbau, 1984). For populations inhabiting the North Atlantic basin, satellite telemetry data indicate that adults make annual north-south migrations, presumably to optimize foraging and reproduction (Eckert and Eckert, 1988; James et al., 2005; Eckert, 2006). Analyses of stomach samples have shown that adults feed primarily on cnidarians (jellyfish, siphonophores) and tunicates (salps, pyrosomas) (Brongersma 1969; Hartog and van Nierop 1984; Davenport and Balazs 1991), some (e.g. *Physalia*: 'Man-O-War') highly noxious.

Figure 6. Leatherback hatchlings crawling to the sea. © J. Freestone

Mating has been observed between February and May each year in the nearshore waters of Trinidad, and Galera Point is one location where regular reports by fishermen and satellite

telemetry data suggest that mating may occur (James et al., 2005; Eckert, 2006). Gravid females remain at Caribbean nesting grounds for 1-4 months, depositing as many as 11 clutches of eggs (Eckert, 1987). During the 10-day interval between nestings (referred to as the "inter-nesting interval"), there are indications that females feed on jellyfish and related animals, and perhaps primarily at night (Eckert et al., 1986, 1989). Such behavior is intriguing, as sea turtles are, in general, believed not to feed substantially during an active nesting season.

Results from satellite telemetry studies indicate that Atlantic leatherbacks leave North Atlantic waters (Canada and northern Europe) and arrive in the early spring at their primary nesting beaches in French Guiana and Trinidad, the largest and second-largest nesting colonies, respectively, for this species in the Western Hemisphere (James et al., 2005). The nesting season for Trinidad and Tobago begins in early March, although isolated nesting events are documented throughout the year (D. Sammy, Nature Seekers, pers. observ). Nathai-Gyan et al. (1987) estimated that 500-900 leatherbacks nested each year in Trinidad. More recent estimates, based on more thorough data collection, suggest that at least 2,000 females nest at Matura and Grande Riviere beaches every year (Wildlife Section-Forestry Division, unpubl. data).

Figure 7. Popular tour guiding programs provide seasonal income to communities living near the nation's largest nesting beaches. © Scott A. Eckert. WIDECAST

Matura Beach and Grande Riviere sustain the highest density nesting in Trinidad, but lower density nesting occurs along the north and east coasts, primarily at Fishing Pond, Paria Bay, Murphy Bay, Petite and Gran Tacarib, Madamas, Cochipa, Manzanilla, and Mayaro (Map 1), with lower density nesting on the south coast at Guayaguayare and Moruga, as well as on the Caribbean coast of Tobago.

Leatherback population status became a topic of great concern a decade ago as surveys of the largest nesting colony of leatherbacks in the world indicated that the population had been reduced more than 90% in less than 10 years (Sarti et al., 1996). The decline was attributed mainly to mortality incidental to gillnet and longline swordfish fisheries thousands of kilometers distant to the nesting beaches (Eckert and Sarti, 1997). It is mainly due to these swift and catastrophic declines in the Pacific Ocean (see Spotila et al., 2000) that the species was recently re-classified by the World Conservation Union as Critically Endangered (IUCN, 2004).

In the Atlantic basin, the status of this ancient species is less clear. While the scientific community is guardedly optimistic that the largest populations are not declining at the present time, data are available only for reproductively active females, ignoring the possibility that serious threats, such as pollution events, changing patterns of prey distribution and/or incidental capture in commercial fishing gear, may be affecting juvenile recruitment and survival rates. It is also quite clear that nesting has "dramatically declined throughout the Eastern Caribbean" in recent decades (Eckert, 2001). The nation of Trinidad and Tobago, therefore, has a unique responsibility to the survival of this species on a hemispheric and even global level.

National Legal Status: The laws of the Republic of Trinidad and Tobago conferred complete protection to all sea turtle species under the Conservation of Wild Life Act (Act 16 of 1958, amended by Act 14 of 1963, Chapter 67:01). But more recently, the 1975 Protection of Turtles and Turtle Eggs Regulations (promulgated under Section 4 of the Fisheries Act of 1916, Chapter 67:51), created a five-month open season for the harvesting of sea turtles. The Fisheries Act Regulations state that:

- No person shall – (a) kill, harpoon, catch or otherwise take possession of any female turtle which is in the sea within any reef or within one thousand yards from the high water mark of the foreshore where there is no reef; (b) take or remove or cause to be removed any turtle eggs after they have been laid and buried by a female turtle or after they have been buried by any person; (c) purchase, sell, offer or expose for sale or case to be sold or offered or exposed for sale or be in possession of any turtle eggs.

- No person shall, between 1 March and 30 September, kill, harpoon catch or otherwise take possession of or purchase, sell, offer or expose for sale or cause to be sold or offered or exposed for sale any turtle or turtle meat.

  Offenders of these provisions are liable on summary conviction to a fine of $2,000 TT and imprisonment for six months.

Conflicts and deficiencies in the legislation, coupled with inadequate law enforcement, have had the result that a largely uncontrolled take of marine turtles continues in and out of season, especially for hawksbill and green turtles, and this provides meat and eggs (as well as turtle shell) that are consumed locally and marketed formally and informally throughout the country. In addition, illegal hunting of nesting leatherback turtles has been considered an acute management challenge since the 1970s. Although this pressure has eased considerably in Trinidad with the advent of nesting beach protection and community-based conservation

efforts in the early 1990s, in Tobago the presence of carcasses on the nesting beaches has been identified as "an immediate management crisis" (Eckert and Herron, 1998) and sparked protests amongst the tourists on which the island has come to depend so heavily (SOS Tobago, 2003).

Since as early as May 1987, government officials in various Ministries have been urging regulatory reform on behalf of marine turtles in Trinidad and Tobago. Despite agreement between the lead agencies more than a decade ago on a legislative proposal to amend the Fisheries Act to give complete protection to marine turtles (Fournillier and Eckert, 1998), Parliament has yet to adopt this legislation (Bräutigam and Eckert, 2006).

Figure 8. With a long history of involving communities in the conservation of Critically Endangered (cf. IUCN) leatherback turtles, Trinidad and Tobago is a global leader in innovative co-management approaches. © Scott A. Eckert/ WIDECAST

International Conservation Status: The leatherback sea turtle, *Dermochelys coriacea*, is classified as Critically Endangered by the World Conservation Union (IUCN, 2004), a reflection of the species' global status as defined by quantitative criteria pertaining to past or projected future population declines, population size and trend (probability of extinction in the wild), and geographic range. Species qualify for Critically Endangered status when, among other things, the global population can be shown to have suffered "an observed, estimated, inferred or

suspected reduction of at least 80% over the last 10 years or three generations, whichever is the longer" (see http://www.redlist.org).

International Legal Status: The leatherback is listed on Annex II (full protection) of the Protocol concerning Specially Protected Areas and Wildlife (SPAW) to the UNEP Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (Cartagena Convention); Appendix I (full protection) of the Convention for Migratory Species; Appendix I (full protection) of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES); and is included in the annexes to the Convention on Nature Protection and Wild Life Preservation in the Western Hemisphere, a designation intended to convey that their protection is of "special urgency and importance".

The Republic is Party to the SPAW Protocol which, *inter alia*, prohibits taking, possession, killing (including incidentally), and commercial trade in Annex II-listed species. Significantly, the Protocol also prohibits the "disturbance" of listed species during periods of breeding, incubation, aestivation or migration and other periods of biological stress. The Republic is also Party to the Western Hemisphere Convention (1969) and CITES (1984), demonstrating a strong commitment to its neighbors and to the international community with regard to the protection of sea turtles and other species of endangered fauna and flora.

The Republic is not yet Party to the Interamerican Convention on the Protection and Conservation of Sea Turtles, but noteworthy is the fact that several participants suggested, during the meeting's final plenary discussion, that accession to the IAC would be a positive step for Trinidad and Tobago.

THE 2005 NATIONAL CONSULTATION

To develop a solution to the problem of leatherback capture and mortality in the coastal gillnets of Trinidad and Tobago, with a focus on the north and east coasts of Trinidad, a National Stakeholders' Consultation was held in Port-of-Spain from 15-18 February 2005 (Appendix I). The interactive meeting was jointly hosted by the Trinidad Ministry of Agriculture, Land and Marine Resources (Fisheries Division), with authority for managing fishery resources, and the Wider Caribbean Sea Turtle Conservation Network (WIDECAST), with more than a decade of service in the role of scientific advisor to the sea turtle conservation and management programs of Trinidad and Tobago.

The forum was designed to promote the full and transparent exchange of ideas and develop consensus concerning future directions and options in mitigating the bycatch crisis, fishermen, research biologists, natural resource managers, policy-makers, and relevant NGOs from

throughout the Republic were invited to work together to design as many potential solutions as possible.

The Forum Moderator, Dr. Karen Eckert of WIDECAST, tasked the participants with meeting twin objectives:

- fishers must be better off economically as a result of any proposed solution to the bycatch crisis, and
- the incidental capture and mortality of leatherback sea turtles in coastal fisheries must cease.

Participants were drawn from stakeholder and resource management groups involved either in fisheries or in sea turtle management, as well as national and international experts in gear technology and bycatch reduction (Appendix II). These Proceedings summarize the results of the meeting, and provide recommendations for reducing the incidental capture and mortality of leatherback sea turtles in waters under the Republic's jurisdiction, with particular reference to the coastal gillnet fisheries of the north and east coasts of Trinidad.

Following a formal Opening Ceremony, the meeting featured technical presentations on leatherback turtles and local fisheries, followed by local perspectives on the entanglement issue and the conservation status of leatherbacks, international perspectives on how related fishery challenges are being met elsewhere (Appendix III), a full-day field trip to several of the most affected fishing ports, and a full day of moderated deliberation in the context of self-selected Working Groups (Appendix IV).

Figure 9. Participants in the National Consultation. © Carlos Drews/ WWF

To facilitate discussion and the formulation of mitigation strategies, participants were asked to join one of four Working Groups. Each Group was assigned one of three subject areas to consider: Regulatory Options (Working Group 1), Fishing Gear Options (Working Groups 2 and 4), Fishing Methods and Techniques Options (Working Group 3). Each Group selected a Chairman and a Rapporteur responsible for reporting the Group's major findings and recommendations to the meeting, and responding to questions and peer discussion concerning those findings.

Recommendations for Priority Action

Given that a significant number of egg-bearing adult leatherbacks is subject to entanglement in coastal gillnet fisheries, and that this entanglement threatens both the stability of the turtle population as well as the livelihood of coastal fisheries off the north and east coasts, there was consensus that management intervention with an aim to reduce or eliminate this mortality – while protecting the livelihoods of fishers – should be a priority.

There was agreement that no one mitigation option would be adequate, given the level of variation in fishing techniques used among fishing areas and villages. Ideally, each village or fishing co-operative should be offered a choice of mitigation methods. Further, to increase the chance that fishermen will adopt these methods, all viable techniques should be evaluated in field trials that have direct participation of fishermen with strong oversight and involvement of all stakeholders. Finally, training and other support (financial or otherwise) should be provided to fishermen to enhance their willingness to try out and apply new methods.

The meeting culminated in the convening of four Working Groups tasked with comprehensively evaluating possible mitigation options focusing on the regulatory framework (e.g. time and area closures), gear modification (e.g. how to adapt the gillnet fishery to reduce incidental capture), and alternative fishing methods (e.g. replacing gillnetting with a-la-vive fishing). The main conclusions of each Working Group are presented below, with important background information presented in Appendix III.

Regulatory Options: Working Group 1 focused on the concept of time and area closures as a mitigation tool. The Group recommended that all gillnet fishing be prohibited from 1 March to 31 May within a region extending from the southern end of Fishing Pond Beach to the western end of Paria Beach, and extending 8 km offshore. Other types of gear would be allowed in this region at this time of the year. They noted that lack of marine resource management was of concern, and that the need for improved marine resource management must be addressed. The Group also noted the need for harmonizing the Fisheries Act's sea turtle regulations with the Conservation of Wild Life Act, such that protection to the leatherback at all times was unambiguous, and urged that increased education and training programs be made available to stakeholders. Finally, the Group noted that commercialization of recreational fishing should be encouraged as an alternative to gillnet fishing during sea turtle nesting season.

Fishing Gear Options: Working Group 2 focused primarily on modifying gillnets to reduce sea turtle bycatch. Specific methods considered were repulsion devices, such as sonic 'pingers' that have proven successful in reducing small cetacean (e.g. dolphins, small whales) bycatch, or

repulsion lighting or chemicals that may cause turtles to avoid nets. In all cases a lack of scientific information on turtle responses to sensory stimulation was noted as a drawback to the successful development of such methods, and the Group placed high priority on the pursuit of studies on how sea turtles would respond to potentially repulsive stimuli. It was noted that studies on these aspects of sea turtle biology would be best if leatherbacks could be kept in captivity, and further noted that, given the difficulty of keeping leatherbacks in captivity, such experiments were unlikely to be possible, but that the husbandry of keeping leatherback turtles in human care should be studied. The Group recommended that field trials of a few promising gear-modifying techniques be undertaken simply to explore the potential of any proposed methods.

Working Group 2 also considered whether nets could be constructed and/or deployed in such a manner as to reduce sea turtle bycatch. In particular, it was suggested that lighter strength twine might allow turtles to break free more easily (but still retain target fish species), and that research into this aspect of net construction would be useful. It was suggested that breakaway head-ropes might also reduce sea turtle mortality, or that daytime net fishing might reduce entanglement since biotelemetry data indicate that nesting females are less likely to be near shore during daylight hours (S. Eckert, WIDECAST, unpubl. data).

Working Group 2 also considered net fishing techniques that may reduce sea turtle capture. For example, surface driftnets that drop the float line 1 - 2m below the surface to allow turtles to swim over the net (a method that has been successful in reducing the number of porpoises captured in other areas of the world). They also proposed that tests be conducted to determine if setting nets perpendicular to the shore could reduce entanglement, and they reinforced the need to involve fishermen in all aspects of the testing, including supporting them financially to participate. Finally, they stressed the need for improved public education and awareness.

Working Group 4 also reviewed fishing technology as a means to reduce sea turtle bycatch. Most of the discussion focused on replacing gillnets with alternate fishing gear. In particular, this Group promoted the idea that live bait hook-and-line fishing ("a-la-vive") could replace net fishing if baits were available, which, according to fishermen, are less available during leatherback nesting season along the northeast coast of the island. With this in mind, Working Group 4 recommended that artificial baits be tested for effectiveness and that new sources of bait be developed. Since it was reported that one limitation to bait availability was the reduced coastal salinity during the rainy season, it was suggested that finding bait sources (e.g. Tilapia) that could be aquacultured and that were salinity tolerant would be very useful.

Working Group 4 suggested that more work be undertaken to evaluate whether there were unexploited fish stocks (such as tile fish) that could be caught with bottom lines. It was also proposed that improved troll fishing could replace net fishing. For example, invited experts reported that new power gear, called "Bandit Reels", are being used in troll fisheries in Florida and have replaced gillnet fishing entirely. It was strongly urged that directed trolling methods using power take up reels such as the Bandit Reel be tested in local waters.

Finally, Working Group 4 proposed that FADs (Fish Aggregating Devices) be tested. Each fishery co-op could maintain their own FADs and use trolling or various hook-and-line gear in the vicinity of these FADs. This latter idea received great emphasis by the group for a number

of reasons: the method could allow an almost complete elimination of gillnets; be inexpensive to implement; and enhance community control and management of marine resources occurring in local waters. As an alternate to fishing during the leatherback nesting season, there was also discussion in this Group surrounding the option that sea turtle ecotourism-related livelihoods be considered for fishers in some locations and that the necessary training be made available. [*Note*: Marine turtles have recently become popular subjects for dive and nature tourism and, in this context, are increasingly becoming a source of revenue for coastal communities throughout the Wider Caribbean Region, such as in Costa Rica, Grenada, Saint Lucia, and Trinidad and Tobago; see Troëng and Drews, 2004, for useful background].

Fishing Method and Technique Options: Working Group 3 was assigned the task of evaluating fishing methods and techniques. This group felt strongly that replacement of gillnets by alternate fishing techniques should be the highest priority. Target species include kingfish, carite, and various shark species. The Group proposed a-la-vive fishing replace gillnet fishing throughout the leatherback turtle season (February to August); however, they felt that improvements needed to be made in a-la-vive fishing methods to make it a viable alternative. Those improvements included: testing light attractors as a means to improve catch rates; addition of bait wells and bait nets to the boats; implementing regulations limiting the sale of baitfish (Joshua) for fishing only (i.e. not for human consumption); and improved training programs in the use of a-la-vive. The Group also recommended that other fishing methods be developed: use of switchering as a dead-bait fishing method; testing of trolling with outriggers (as is commonly used in Tobago); use of "Bandit Reels" to improve trolling catch rates; and further improvements to banking as a fishing method.

Finally, Group 3 suggested that alternative livelihoods be established for fishermen during the leatherback nesting season. These might include developing aquaculture projects in the region, such as shrimp or freshwater lobster (crayfish), Tilapia farming, or further development of seamoss mariculture.

Common Themes of the Working Groups

The four Working Groups featured a number of common themes. For example, all Groups agreed that there is a significant problem both for leatherback sea turtles and for fishers. Most Groups suggested that gillnet fishing be replaced with alternate methods, although there was widespread concern that the marine resource regulatory structure and enforcement framework were inadequate to ensure compliance. Most participants agreed that it was unlikely that a single solution would emerge, and that fishers would need to be given choices. All agreed that it was vital for fishers to be directly involved during testing and implementation of new methods, and that there be fair financial compensation for their involvement.

There was consensus that gillnet fishing should be phased out for at least part of the year, in favor of hook-and-line or trolling, but that experimentation to develop less destructive gillnet methods should also receive focused attention. The primary hook-and-line style fishing methods proposed for use are the following: banking, a-la-vive, switchering, and trolling. All of these techniques are currently in use in north and east coast fisheries; however, each method will need improvement to be practical as a replacement for gillnet fishing.

Decision and Evaluation Criteria

There was consensus that the following Decision Criteria be taken into account when evaluating the various mitigation options:

- What - will the experiment measure (objectives and variables)?
- How - will the experiment be conducted (materials and methods)?
- Where - will the experiment be conducted?
- Who - will conduct and evaluate the results of the experiment?

There was also consensus that the following Evaluation Criteria be adopted:

- Can the new technique catch fish?
- Is it economically viable (i.e. producing equivalent or increased revenue)?
- Does it reduce adverse impact to leatherback sea turtles?
- Can it be managed/regulated?
- Is it logistically feasible for local conditions?
- Is it biologically and commercially sustainable?
- Will it be supported/accepted by the stakeholders?

PROPOSED EXPERIMENTS

Based on recommendations developed by the Working Groups and during Plenary discussions, the following list of experiments should be conducted as a priority during the 2006-2008 nesting seasons (February to August). Ideally, funds should be raised to completely support each experiment, including all equipment, fuel and supply costs, as well as stipends to support those involved in data collection and/or analysis. Particularly important is that participating fishers be salaried to conduct the tests, so that they their complete effort and attention can be applied to each experiment, irrespective of whether fish are being caught. Moreover, the experiments will proceed best if fishers try to achieve maximal catch rates and use their own substantial expertise to modify or develop each experimental method to its fullest. To this end, participating fishers should be entitled to their catch as a bonus for maximizing that particular method's efficiency.

For all experiments, data sheets will need to be designed and prepared. Variables to be gathered will include a careful description of the gear; e.g. hook-and-line type, distances between hooks, number of hooks and lines, and fishing depth. Fishing duration (e.g. soak time, set time, retrieval time) and location (GPS coordinates) should be noted. Species caught, number of fish of each species, weight, and size of each species must be carefully accounted for, irrespective of commercial value. Standard size and weighing methods must be utilized, necessitating that the total catch be brought to a port for documentation. Other factors to be

documented include boat type and size, engine type and size, and fuel consumption. At pre-determined intervals, such as monthly, a balanced experimental design will designate how many days each gear type or bait type will be used.

New Bait Types

Purpose: To determine whether artificial baits, live *Tilapia sp.*, and/or frozen Jashua (*Sardinella aurita*) can be used effectively in hook-and-line fisheries.

Methods and Materials:

Artificial baits – Recommendations for artificial bait types should be sought from other fisheries (in other areas) catching kingfish and/or carite on artificial bait. Initially, this project should conduct a review of all artificial baits, including where they are used, how they are used, and the species targeted. The evaluation can either be contracted to experts in the field or undertaken within the Fisheries Division. For artificial baits that can be used with existing technology, field trials should be initiated with one or two boats in each port of Matelot, Toco and Balandra Bay. Trials should be evenly structured for banking, switchering, and trolling, and should be conducted between February and May.

Tilapia and frozen Jashua Baits – Because some styles of fishing rely on the action of live bait to attract target species, the bait must remain alive to be effective. Seasonal lack of live bait along the northeast coast during times of the year when sea turtles are present is a serious limitation. Fishers operating from northwest ports do not appear to face the same constraint and regularly fish along the north coast with bait brought from Los Cuevas and other northwest fishing ports. Solutions to limitations in bait supply should be investigated. The catch efficiency of easily maricultured fish – such as *Tilapia.* – should be investigated with an eye to replacing traditional bait species. An efficient means to transport and hold bait from northwest to northeast Trinidad should also be explored.

Note: Fishers generally catch their own bait, but it may be useful to consider the establishment of a commercial bait supply program. Some fishers voiced concern over the increasing use of Jashua (the primary fish used as bait) for human consumption, limiting its availability as an inexpensive bait fish.

Local aquaculture facilities should be contracted to provide live *Tilapia* for bait trials. Similarly, fishers should be contracted to capture and freeze Jashua bait for use in the experiments. As with artificial baits, one or two boats from Matelot, Toco and Balandra Bay should be contracted to run these trials. All line gear types should be tested. Finally, research into the availability and effectiveness of various artificial baits and dead baits is needed.

Alternative Gear

"Bandit reels" and outriggers

Purpose: To determine whether, based on data presented by Don Nolls (Lindgren-Pitman, Inc.) showing that the use of outriggers and rapid take-up reels significantly improved catch rates of kingfish in Florida, this style of fishing could be effective in Trinidad.

Materials and methods: Troll fishing is generally considered to be operationally expensive in Trinidad, due to fuel and motor costs; most fishers are not enthusiastic about its use. Lindgren-Pitman, Inc. should be contracted to outfit and train one troll boat from each of three coastal communities (Matelot, Toco, Balandra Bay) to use "Bandit reels" (rapid power take-up reels, using deep-cycle marine batteries) and outriggers in the context of an experimental design. Testing should involve a balanced design using artificial baits as well as dead (frozen) bait.

Net Modifications

Deep Sets

Purpose: To determine whether setting nets at various depths below the surface will reduce sea turtle entanglement.

Materials and methods: Using standard 6cm mesh monofilament or nylon (green-web) nets, cooperating fishers will set the corkline at a series of experimental depths below the surface.

Experimental depths will be determined based on information gleaned from an analysis of high resolution dive depth data available, from WIDECAST, for leatherbacks in Trinidadian waters (S. Eckert, unpubl. data). The means to maintain the depth of the net will need to be determined, but is it likely that the best approach will be to use a standard bottom set net with large surface buoys on tethers, clipped to the net at regular intervals. The surface buoy tether lines will need to be at least 3m apart and made of stiff plastic, to preclude turtle entanglement in the vertical tether. As with other tests, fishers will carefully document all aspects of the gear used, as well as sea state, weather, time set, time retrieved, and location. Total catch quantities, size, and species will also be recorded for each set.

Net Avoidance

Shark silhouette

Purpose: To determine whether a simple shark silhouette can reduce sea turtle entanglement.

Net Avoidance *(cont'd)*

Materials and Methods: Shark silhouettes will be manufactured out of easily obtained items, such as fine nylon mesh or flexible plastic. These will be placed in nets at regular intervals. For nets set at night, illuminated shark outlines may be useful and should form part of the experiment. For each set, the type, location, and number of silhouettes will be documented, as well as water clarity, location, time of set and retrieval, and species (number, size, weight) caught. Several shark silhouettes (different sizes and shapes) should be tested.

Sonic repulsion

Purpose: To determine (i) the maximally sensitive frequency for leatherback hearing; (ii) how leatherbacks respond to sounds generated in those frequencies; and (iii) whether leatherbacks will avoid nets equipped with sonic 'pingers'. While hearing in sea turtles is poorly understood, a few studies have suggested that most sea turtles (leatherbacks have not been successfully studied) hear well in lower frequencies from 100-1000Hz, with peak sensitivity between 350 and 500Hz. Behavioral responses to loud noises (e.g. air cannons used in seismic surveys) are also poorly investigated, but range from increased surfacing periods to avoidance. One successful method for reducing the entanglement of small whales and dolphins in gillnets is to place inexpensive sonic 'pingers' in the gillnet; such an approach has never been tested in sea turtles.

Material and Methods: The first part of this study will be to use Auditory Brainstem Response (ABR) methods to test hearing sensitivity in leatherbacks. Preliminary studies using these methods were initiated in Trinidad by a team led by Dr. Scott Eckert in the 1990s but, due to lack of proper instrumentation and some technique problems, they were largely unsuccessful. Improvements have since been realized in both instrumentation and technique. Once hearing frequencies are understood, development of prototype 'pingers' that work in the range optimal for leatherback hearing should be developed and appropriately field-tested.

Fish Attracting Devices (FADs)

Purpose: To determine whether FADs could be effective at increasing catch rates.

Materials and methods: Optimal FAD construction and design will need to be determined based on a review of current designs in use elsewhere. Once the optimal design for Trinidad conditions (e.g. high current flow, low visibility) is determined, two experimental FADs should be deployed and managed. One off the North coast should be jointly managed by the Toco and Matelot fishing ports; one off the east coast should be jointly managed by the Balandra Bay and Salybea fishing ports. Fishers wishing to fish on the FADs will need to be certified by each port, be willing to record gear and bait types used, and be required to report the details of their catch.

Cautionary Statement: Fishing around FADs is not currently practiced in Trinidadian waters; however, a large variety of methods from hook-and-line fisheries to purse-seines can be used around FADs. FADs concentrate fishery resources and can significantly reduce operational

Fish Attracting Devices (FADs) *(cont'd)*

expenses so that the feasibility of FADs should definitely be evaluated. However, it should also be recognized that FAD fishing can lead to over-fishing. Therefore, the use of FADs must be carefully matched with improved fishery management capacity and regulatory enforcement.

PROJECT IMPLEMENTATION NOTES

Ideally, each budget would be established through formal RFP (Request for Proposals) procedures whereby a project is described briefly and then published or sent to organizations, scientists or experts best able to bid on the project. In each case, the experimental design and proposed budget would then be used to set fundraising targets. Such a process can require extensive periods of time, however, so that in the interest of expediency it is recommended that the Division of Fisheries take the lead, in consultation with workshop participants, in inviting the participation of organizations and experts known to have the capacity to undertake priority experiments.

Lindgren-Pitman, Inc. (USA) has unique expertise in the manufacture and use of rapid take-up reels (e.g. "Bandit Reels"), suggesting that they might be invited to oversee that aspect of the experimental work plan. Similarly, SEAMARCO (The Netherlands) is a global expert in 'pinger' technology and WIDECAST has expertise in sensory biology (e.g. sea turtle hearing studies), such that these organizations could, in partnership, oversee experiments on hearing and sonic repulsion. NOAA/ National Marine Fisheries Service (USA) and Memorial University (Canada) have expertise in experimental design, gear development, and other bycatch mitigation methods (e.g. shark silhouette experiments) and could be invited to oversee studies and evaluations of gear modification(s). A number of these groups, particularly Lindgren-Pitman, Inc., could provide expertise on artificial baits and the Fisheries Division (MALMR) has the capability to design experiments to test alternate live and frozen baits.

As a priority, funding should be sought to support a full-time Bycatch Mitigation Program Coordinator to coordinate the activities of the various projects and to communicate results, on a regular basis, to workshop participants and other stakeholders.

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Appendix I
Agenda for the National Consultation

National Consultation:
"Reducing the Incidental Capture and Mortality of Leatherback Sea Turtles in Gillnets in Trinidad and Tobago"

A Stakeholders Meeting and Strategic Planning Session

16 – 18 February 2005
Ambassador Hotel, Port of Spain

Hosted by the Fisheries Division, Ministry of Agriculture, Land and Marine Resources (Government of the Republic of Trinidad and Tobago) and the Wider Caribbean Sea Turtle Conservation Network (WIDECAST)

Programme

Day 1 – Wednesday, 16 February 2005

Session I: Opening Ceremony

0900 – 0905 National Anthem

0905 – 0910 Chairperson's Opening Remarks – *Ms. Ann Marie Jobity, Director of Fisheries*

0910 – 0920 Welcome Remarks – *Mr. Trevor Murray, Permanent Secretary, Ministry of Agriculture, Land and Marine Resources*

0920 – 0935 Remarks – *Dr. Scott Eckert, Director of Science, WIDECAST*

0935 – 0955 Feature Address & Opening of National Consultation – *The Honourable Jarrette Narine, Minister of Agriculture, Land and Marine Resources*

0955 – 1000 Chairperson's Closing Remarks – *Ms. Ann Marie Jobity, Director of Fisheries*

Session II: Technical Presentations

1000 – 1015 Objectives and Intended Results – *Ms. Ann Marie Jobity, Fisheries Division*
1015 – 1030 Habitat Use by Leatherback Sea Turtles – *Dr. Scott Eckert, Director of Science, WIDECAST*
1030 – 1045 Description of Gillnet Fisheries in Trinidad & Tobago – *Ms. Louanna Martin, Fisheries Division*
1045 – 1100 Entanglement of Leatherbacks by Local Gillnet Fisheries – *Dr. Lori Lee Lum, Institute of Marine Affairs*
1100 – 1130 Conservation of Nesting Leatherbacks in Trinidad & Tobago – *Ms. Nadra Nathai-Gyan, Head, Wildlife Section, Forestry Division*

1130 – 1200 LUNCH

Session III: Local Perspectives

1330 – 1345 Entangling Leatherbacks: A Fisher's Perspective – *Mr. Stephen McClatchie, Toco Fisherman*
1345 – 1400 Economic Importance of Sea Turtles in Trinidad: The Importance of Reducing Mortality – *Mr. Dennis Sammy, Manager, Nature Seekers*

Session IV: Global Perspectives – How is the Challenge met Elsewhere?

1400 – 1415 Lessons from the Sea of Cortez (Pacific Mexico) – *Dr. Paul Winger and Phil Walsh, Memorial University (Canada)*
1415 – 1500 Research to Reduce Harbour Porpoise Bycatch in Gillnet Fisheries – *Dr. Ron Kastelein, Sea Mammal Research Company (SEAMARCO) (The Netherlands)*
1500 – 1515 Review of Sea Turtle Bycatch Research in the Western Atlantic – *Mr. John Mitchell, NOAA (USA)*
1515 – 1530 Latest Developments in Artisanal Longlining Equipment – *Mr. Don Nells, Lindgren-Pitman, Inc. (USA)*

1530 – 1600 Coffee Break

Session V: Clarifying the Issues

1600 – 1700 Panel: Session IV Speakers (with audience Questions and Answers)
Panel Moderator – *Dr. Karen Eckert, Executive Director, WIDECAST*
1700 – 1730 Closing Remarks and Adjourn

Day 2 (Field Trip) - Thursday, 17 February 2005

0700 – 1200 Field Trip to East Coast Fishing Ports
Balandra / Salybea / Toco

1200 – 1330 LUNCH at Toco, catered by Nature Seekers

1330 – 1730 Field Trip to North Coast Fishing Ports
Grande Rivere / Matelot

Day 3 – Friday, 18 February 2005

0900 – 0915 Introductions, Announcements
0915 – 0930 Working Group Descriptions, Objectives, and the Designation of Chairs

Session VI: Seeking Solutions

0930 – 0945 Procedural Notes and Expectations – *Dr. Karen Eckert, Executive Director, WIDECAST*

0945 – 1100 Working Groups: Discussion

Working Group I: Regulatory Options (e.g. time and area closures)
Working Group II: Gear Options (e.g. alternative baits, trolling)
Working Group III: Method Options (e.g. a-la-vive, longlines)
Working Group IV: Gear Options (e.g. repulsion devices, net type/mesh/material)

1100 – 1130 Coffee Break

1130 – 1230 Working Groups: Wrap-up and Recommendations

1230 – 1400 LUNCH

Session VII: Working Group Presentations

1400 – 1415 Working Group I
1415 – 1430 Working Group II
1430 – 1445 Working Group III
1445 – 1500 Working Group IV

1500 – 1530 Coffee Break

Session VIII: Future Directions, Priorities and Recommendations

1530 – 1700 Panel: Working Group Chairs (with audience Questions and Answers)
Panel Moderator – *Dr. Karen Eckert, Executive Director, WIDECAST*
1700 – 1715 Drafting Committee assigned to Final Report

1715 – 1800 Closing Remarks and Adjourn

Appendix II
List of Participants [1]

Gervais Alkins	Member	SOS, Tobago
Risha Alleyne	Officer	Environmental Management Agency
Egbert Awai	Member	Caribbean Forest Conserv. Assoc.
Carl Baptiste	Fisheries Biologist	Fisheries Division, Trinidad
Terrence Beddoe	Fisherman	Friends of the Sea (Secretary)
Hope Brock	Graduate Student	Memorial University, Canada
Erol Ceasar	Director, Fisheries	Tobago House of Assembly
Tanya Clovis	Director	SOS, Tobago
Ruth Davis	Fisheries Biologist	Fisheries Division, Trinidad.
Carlos Drews, Ph.D.	Regional Coordinator	WWF-Caribbean, Costa Rica
Karen Eckert, Ph.D.	Executive Director	WIDECAST at Duke University
Scott Eckert, Ph.D.	Director of Science	WIDECAST at Duke University
Lara Ferreira	Fisheries Biologist	Fisheries Division, Trinidad
Allys Forte	Fisheries Biologist	Fisheries Division, Trinidad
Sarsha Franklin	Officer	Ministry of Foreign Affairs
Sherma Gomez	Fisheries Biologist	Fisheries Division, Trinidad
Salim Gool	Fisherman	San Fernando Fishing Cooperative
Nicholas Hopkins	Fisheries Gear Technologist	Nat'l Marine Fisheries Service, USA
Anderson Inniss	Member	Nature Seekers
Ann-Marie Jobity	Director	Fisheries Division
Ron Kastelein, Ph.D.	Director	SEAMARCO, The Netherlands
Gian Carlo Lalsingh	Member	Environment Tobago
Jon Lien, Ph.D.	Professor	Memorial University, Canada
Emile Louis	Fisherman	All Tobago Fisherfolk Association
Lori Lee Lum, Ph.D.	Research Officer	Institute of Marine Affairs
Neela Maharaj	Senior Planning Officer	Min. Agricul., Land & Marine Res.
Louanna Martin	Fisheries Biologist	Fisheries Division
Stephen McClatchee	Fisherman	Toco Fisherman's Association
Cecil McLean	Fisherman	Las Cuevas
Nemme McSweeny	Teacher	Toco Composite School
Danny Melville	Fisherman	Southwest Tobago
John Mitchell	Fishing Gear Technologist	Natl Marine Fisheries Service, US
Saheed Mohammed	Fisherman	Toco
Nadra Nathai-Gyan	Head	Wildlife Section, Forestry Division
Don Nells	Fishing Gear Technologist	Lindgren-Pitman, Inc.
Michelle Picov-Gill	Fisheries Biologist	Fisheries Division-Trinidad
Len Peters	Officer	Grande Riviere T.D.O.
Stephen Poon	Forester	Wildlife Section, Forestry Division
Arthur Potts, Ph.D.	Deputy Director	Fisheries Division, Trinidad
Indar Ramnarine, Ph.D.	Fisheries Biologist	Department of Life Sciences, UWI
Nadia Ramphal	Fisheries Biologist	Fisheries Division, Trinidad
Angela Ramsey	Wildlife Biologist	Dept. Natural Resources, Tobago

Franklyn Roberts	Fisherman	Toco
Renwick Roberts	Member	PAWI Sports, Culture and Eco Club
Sherwin Ruiz	President	GREAT, Grande Riviere
Dennis Sammy	Manager	Nature Seekers
Earl Samuel	Fisherman	Tobago
Reginold Samuel	Fisherman	Tobago
Mervin Sendall	Fisheries Biologist	Fisheries Division, Trinidad
Jacqueline A. Telfer	Member	Caribbean Forestry Conserv. Assoc.
Wendy Thomas	Fisheries Biologist	Fisheries Division, Trinidad
William Trim	Officer	Dept. Natural Resources, Tobago
Richard Wallace	Member	Caribbean Forest Conserv. Assoc.
Philip Walsh	Fishing Gear Technologist	Memorial University, Canada
Paul Winger, Ph.D.	Fish Behaviouralist	Memorial University, Canada

[1] Participation was not as accurately documented as it could have been. We apologize to those who participated fully in the Meeting and in the Working Group discussions, but, for whatever reason, did not have their name recorded. Based on per diem records, at least five (5) additional fishermen participated in the meeting and in the various Working Groups, but did not record their names or affiliations.

Appendix III
Selected Technical Presentations

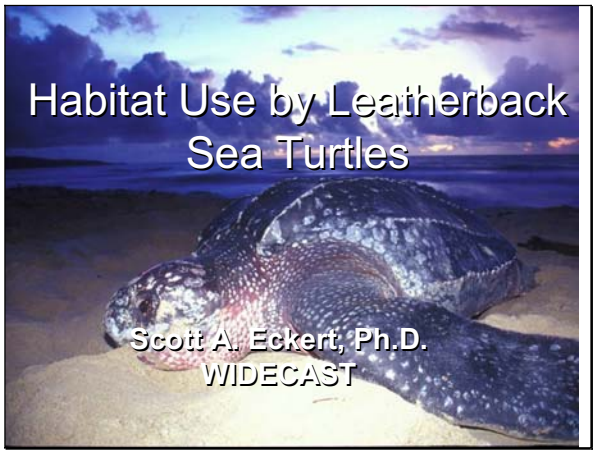
Habitat Use by Leatherback Sea Turtles
Scott A. Eckert, Ph.D. (WIDECAST)

Lessons from the Sea of Cortez (Pacific Mexico)
Paul Winger, Ph.D. and Phil Walsh (Memorial University)

Research to Reduce Harbour Porpoise Bycatch in Gillnet Fisheries
Ron Kastelein, Ph.D. (SEAMARCO)

Review of Sea Turtle Bycatch Research in the Western Atlantic
John Mitchell (NOAA)

Latest Developments in Artisanal Longlining Equipment
Don Nells (Lindgren-Pitman, Inc.)



I'd like to begin with my sincere thanks to all of you for attending this national consultation. We are very grateful that you are generously sharing your time, expertise and enthusiasm to resolving this difficult challenge.

Today, you will hear from a number of experts on fishing technology, marine resource management, sea turtle conservation and from those closely involved in fishing.

My presentation today is on what they do and where they go during the brief time they are in Trinidad and Tobago's waters.

Trinidad Leatherback Tracking

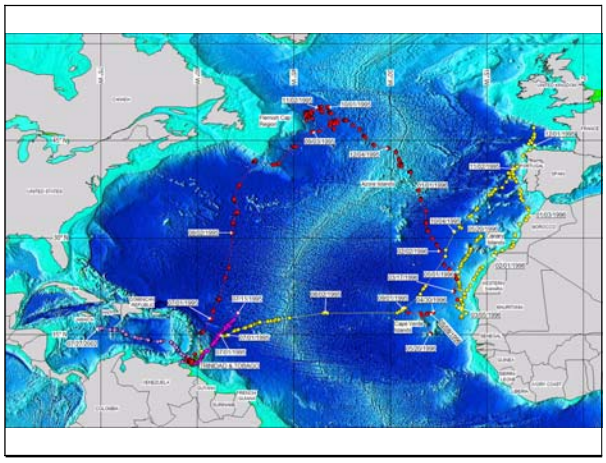
Turtle ID	Tag Type	Length (cm CCL)	Nesting beach	Date deployed	Date of last location	Days tracked	Minimum distance traveled (km)	Date of last trans.	Num of tra
DC1	SSC3	155.0	Matura	05/17/95	05/20/96	369	13,909	05/22/96	44,0
DC2	SSC3	140.0	Matura	05/17/95	07/11/95	55	1,303	07/11/95	8,6
DC3	SSC3	166.0	Matura	05/26/95	03/25/96	304	11,285	05/24/96	29,6
DC4	SSC3	162.0	Matura	03/26/99	04/29/99	34	1,065	04/29/99	21,1
DC5	Kiwisat	154.0	Grand Riviere	06/24/02	07/27/02	33	2,118	07/27/02	—
DC6	SPOT3	155.0	Matura	04/18/03	04/22/04	370	8,734	04/27/04	125,
DC7	SPOT3	140.0	Matura	04/18/03	06/15/03	58	1,604	06/15/03	22,2
DC8	SPOT3	166.0	Grand Riviere	04/20/03	05/14/03	24	1,034	05/14/03	11,2
DC9	SPOT3	154.0	Grand Riviere	04/20/03	05/13/03	23	561	05/13/03	12,0

Trinidad and Tobago support one of the world's largest nesting colonies of the leatherback sea turtle. Current estimates are that more than 6,000 leatherback females nest here annually.

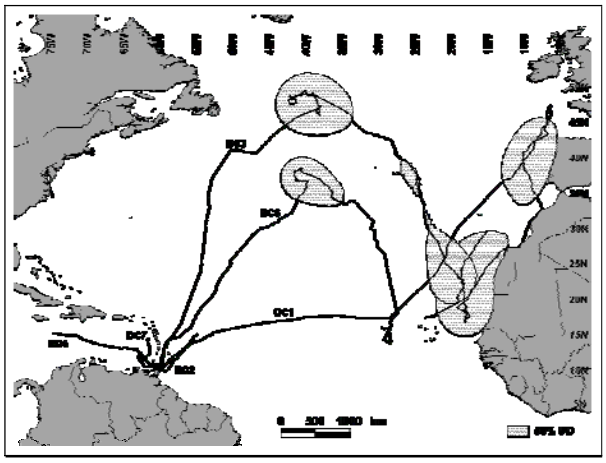
While the conservation of nesting turtles and their eggs is ongoing in a number of well developed projects, less understood are the offshore habitats of the species.

It must first be understood that leatherbacks are not permanent residents of Trinidad and Tobago. Females and males arrive in late January – March each year to initiate mating and nesting. Males remain until May, while females remain through July. While males may come to Trinidad annually, females only return every 2 or 3 years.

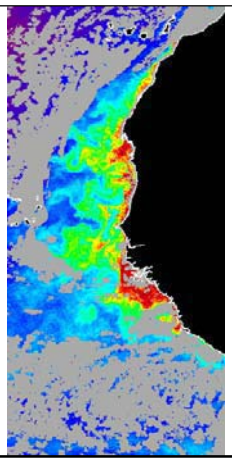
As scientists we have two methods that have led to our understanding of the presence and activities of this species while in our waters. One method uses the attachment of satellite transmitters, or other electronic data reporting devices to the turtles. The other is through the use of identity tags on each nesting turtle.



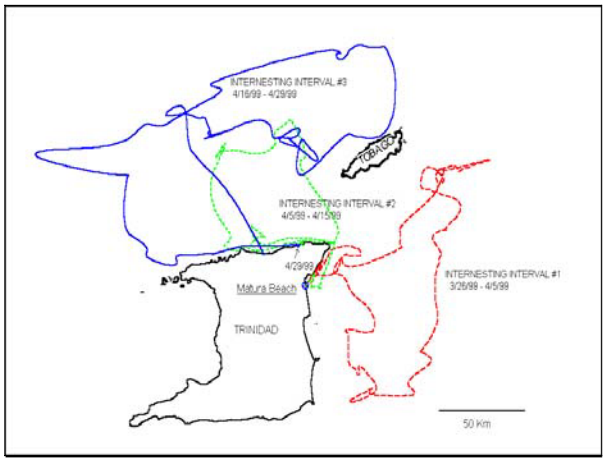
Using those methods we have learned that upon the completion of nesting and average of 6 times and as many as 12 clutches of eggs on Trinidad's beaches these turtles move throughout the Atlantic Ocean, passing through numerous other country's water as well as through the high seas. Trinidad's leatherbacks are actually residents of the entire world!



Each of these lines are individual turtle tracks for up to one year after leaving Trinidad. We have learned that leatherbacks travel throughout the Atlantic Ocean and may swim more than 10,000 km in a single year. The cross-hatched areas are where the turtles stopped to feed on this journey. What is particularly amazing is that the turtles seem to know when and where the food will be and schedule their journey to be in the area when food is most available.

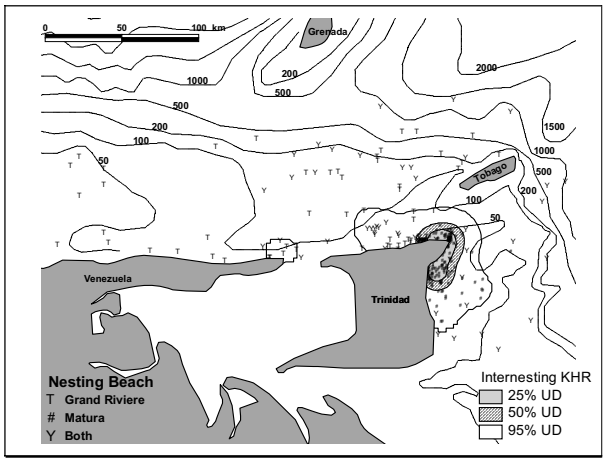


For example this is a satellite image off the west coast of Africa illustrating where the most biologically productive waters are located from March - July. Notice that based on the previous map I showed you, our turtles move directly to this area a year after nesting and arrive in March. It appears that these turtles can anticipate good feeding areas well in advance of the time that food will be available!

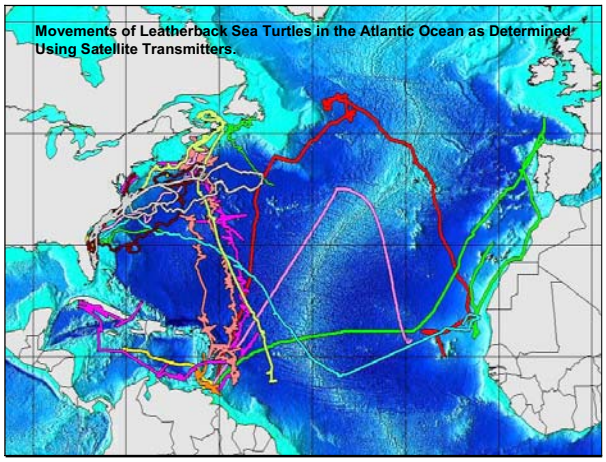


Around Trinidad, leatherbacks can also be highly mobile. Each of the colored lines illustrate where a single female traveled during the ten days between each nesting event. It also shows that they may travel to different beaches to nest.

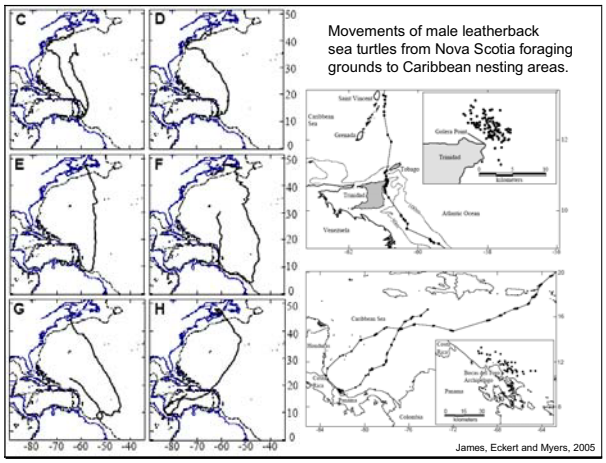
We know that from our other studies we have conducted that leatherbacks rarely stop swimming. Between nestings she will make regular and constant dives to 20 – 150 m, rarely stopping to rest and probably never sleeping.



This figure shows the locations of turtles tracked between nesting events for 10 turtles. Some were originally instrumented on Grande Riviere Beach, while others were instrumented at Matura. The important aspect of this figure is that it shows were most of the turtles spent the majority of their time, in the areas labeled Utilization Distribution or UD. A UD area indicates that this region is of exceptional importance to the turtles – and in this case those areas are off the nesting beach and off Galera Point.



One of the answers to why Galera Point is so important can be found in studies that we are conducting elsewhere. One of those studies is capturing male leatherbacks in Nova Scotia, Canada and tracking them to the Caribbean.



In this study we found that each year, male leatherbacks travel to the Caribbean presumably to mate. Those that come to large nesting colonies like Trinidad, or Panama will reside in a very small area near the island, probably in areas where they have the highest probability of encountering females. For Trinidad this is Galera Point! Each male remains until the peak of the nesting season, by which time all females are probably mated, so they leave.

One of my reasons for presenting this information to you today is so that you have an understanding of where leatherbacks reside in our waters during the nesting season. These areas hold critical importance to our efforts to serve as stewards to this visitor to Trinidad. They are also the same areas that fisherman work, and therein lies our challenge. How can we maintain the fishing livelihoods of Trinidad's fishers….and still preserve the leatherback?

Thank you.

Scott A. Eckert, Ph.D.
Director of Science, WIDECAST

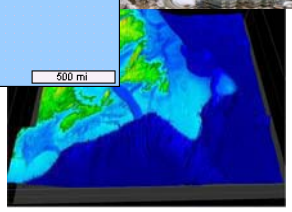
Memorial
University of Newfoundland

Sustainable Harvesting Techniques
Lessons Learned: Canadian Perspective

Paul Winger and Philip Walsh
of
Centre for Sustainable Aquatic Resources
Marine Institute of Memorial University

www.mi.mun.ca/csar

Memorial
University of Newfoundland



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CSAR provides industrial research and development, technology transfer, and education/training services to the fishing industry.

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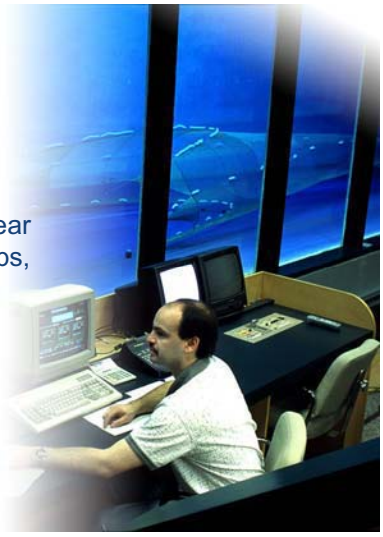

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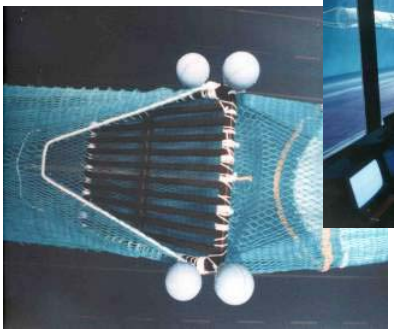
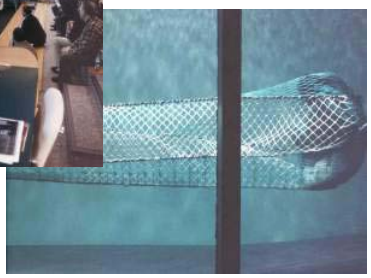
Major Research Areas

Applied Industrial Research





Fishing gear design and testing

Major Research Areas

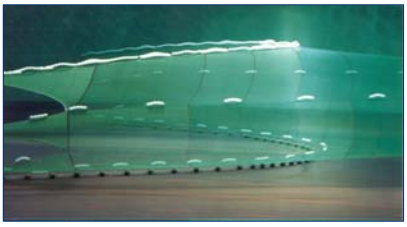
Applied Industrial Research

Fish Behaviour

Fisheries Development

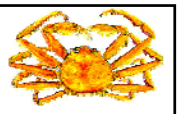
Survivability of Released Fish

Reducing Seabed Impact of Bottom Trawls

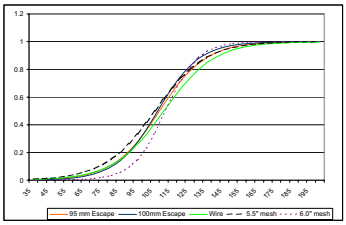


Reduction from
31 to 9 contact points.

Improving Trap Selectivity for Snow Crab



(Chionoecetes opilio)



Design & Evaluation of Baited Cod Traps

Atlantic Cod
Gadus morhua

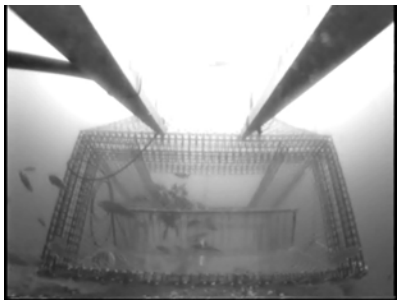
Alternative to gillnets

Environmentally friendliness
High discard survivability
Good species and size selectivity
Source of live fish
Collapsible

The main focus was to see if we could develop a baited cod trap that could catch commercial amounts of cod

Halibut Potting Preliminary Assessment

Atlantic Halibut,
(*Hippoglossus hippoglossus*)



Underwater Observation

Perch entering Trap

Halibut not entering

Lobster by-catch

Reducing Bycatch of Vaquita Porpoise (*Phocoena sinus*) in the Sea of Cortez

(Walsh 2004)

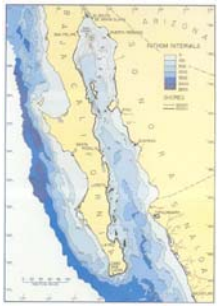
Upper Gulf of California Biosphere Reserve

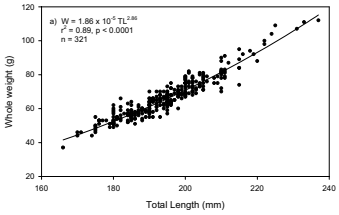
National Institute of Fisheries
Government of Mexico

The National Institute of Ecology
University of Baja California

Reducing Bycatch of Vaquita Porpoise (*Phocoena sinus*) in the Sea of Cortez

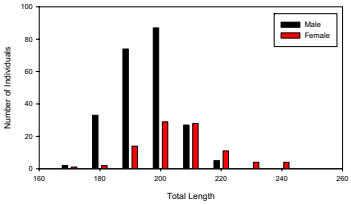
(Walsh 2004)





Penaeus californiensis

Penaeus stylirostris



Reducing Bycatch of Vaquita Porpoise (*Phocoena sinus)* in the Sea of Cortez

(Walsh 2004)

Lessons Learned:

1) **Multi-group approach is necessary.**
2) **Reproductive behaviour vs. feeding motivation.**
3) **Pots will be most effective during slack tides.**
4) **Water turbidity.**
5) **Continued field tests necessary.**

Research to reduce bycatch of harbor porpoises in gillnet fisheries

Prepared for workshop on reduction
of bycatch of Leatherback turtles
in gillnet fisheries
Port-of-Spain, Trinidad, February 16-18, 2005

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3843 CC Harderwijk
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E-mail: researchteam@zonnet.nl

Background Information
In The Netherlands, research to reduce harbor porpoise bycatch by gillnets started in 1993 and followed 3 parallel tracks (a stepwise approach):
1. Behavioral studies in captivity around nets
2. Increase gillnet detection by echolocation
3. Deter porpoises from nets with aversive sound

Track 1: Behavioral studies in captivity around nets
Important parameters affecting the chances of being caught up in the nets were:
1) Age, 2) Context, and 3) Experience of the animals.

The results of these behavioral studies with porpoises around nets have been published in a book (Harbour porpoises, laboratory studies to reduce bycatch (Eds Nachtigall, P.E., Lien, J., Au, W.W.L. and Read, A.J.). De Spil Publishers, Woerden, The Netherlands).

Track 2: Increase net detection by echolocation
Question: Can porpoises detect gillnets by echolocation, and if so at what distance ?
Goal of the study: Determine the distance at which presently used gillnets can be detected by porpoises.

To reach the goal, studies were conducted in the following order :

1) Echolocation signals of the harbor porpoise
2) Echolocation detection ability of the harbor porpoise
3) Target (echo) strength of gillnets

1) *Echolocation signals of harbor porpoises*
Porpoise echolocation clicks have:
1. A high frequency (120-130 kHz)
2. A narrow bandwidth (20 kHz)
3. A low Source Level (165 dB re 1 μPa)
4. A long duration.

2) *Echolocation detection ability of harbor porpoise*
Two studies were conducted:
1) Detection of stainless steel spheres in quiet conditions.
2) Detection of stainless steel spheres in noisy conditions.
Result: detection distances of stainless steel spheres with known target strengths.

3) Target (echo) strength of gillnets
Definition of target (echo) strength: SPL of reflected signal - SPL of the incident signal
Study conducted: Measurements of target (echo) strength of gillnets.
Gillnets were collected from areas around the world where porpoise bycatch occurred. Bottlenose dolphin and Harbor porpoise clicks were projected towards net panels strung across pontoons. The returning echoes were recorded and analyzed.

Results: knowledge on the range of target strengths of the various gillnets.

Calculating detection distances
With the knowledge of the target detection ability study and gillnet target strength measurements, detection distances of gillnets by echolocating bottlenose dolphins and harbor porpoises could be calculated.

Results of the calculations are:
At best (perpendicular approach) Bottlenose dolphins can detect gillnets at a range of 25-55 m. At best (perpendicular approach) Harbor porpoises can detect gillnets at a range of 3-6 m. Echo strength depends on angle of incidence, so in most cases gillnet detection by porpoises occurs at less than 2 m.

Conclusion: Harbor porpoises often cannot detect gillnets in time to evade them.

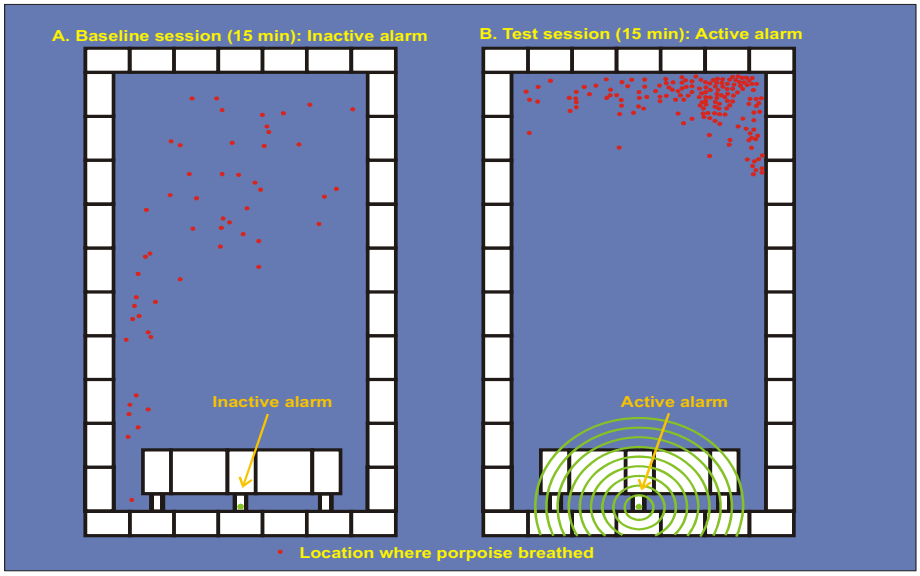
Nets with higher target strength are presently tested in field experiments in North America with the aim to increase the distance at which porpoises can detect gillnets in time to evade them.

Perception of echolocation information

If the perceived image by a porpoise (based on the total ensonification of the net by echolocation) consist of the entire net, this will probably result in no entanglement. However, if the perceived image by a porpoise (based on only the webbing of the net) consists of "glimpses", this will probably lead to entanglement, as the glimpses may resemble the echoes of shrimp or aquatic vegetation. If the perceived image by a porpoise (based on the ensonification of the float on lateral lines and some webbing consists of clear images caused by the strong echoes of the float and lateral lines, the animal may not notice the weak echoes of the webbing and try to swim under the float which results in entanglement.

Track 3: Deter porpoises from nets with aversive sound

When using sound to deter porpoises information is needed on their hearing, behavioral reactions to sounds, and the effects of the sounds on other marine fauna.
.
Hearing features of porpoises that were studies are hearing sensitivity, directionality of hearing, and sound source localization ability.

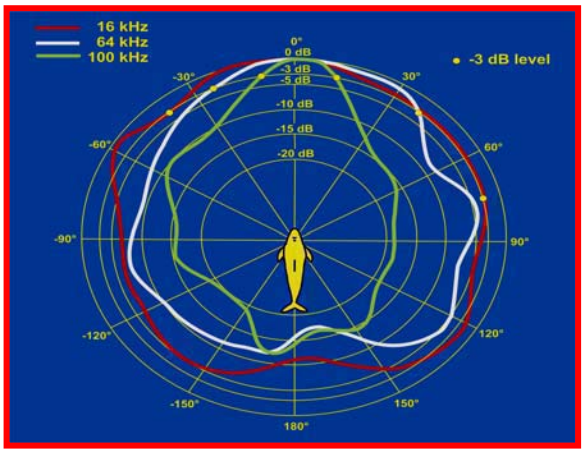


A) *Hearing sensitivity of porpoises*

Conclusion: Best hearing of harbor porpoise is at the frequency of its echolocation signals (around 120 kHz)

B) *Directional hearing of porpoises*

Hearing of dolphins and porpoises is not equally sensitive in all directions.
Conclusion: sounds are best heard when coming from in front of the porpoise



C) Sound source localization ability of porpoises

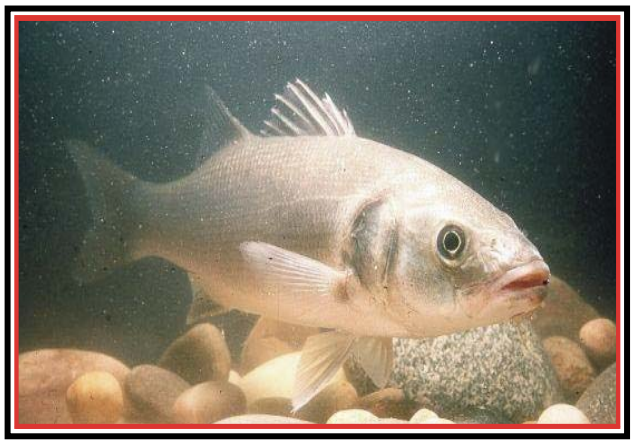
Non-localized sound may scare porpoises into the nets.
Signal parameters that were tested were pulse duration, sound level, and frequency.
Conclusion: Signal duration & level need to be sufficient to localize a sound source

Reactions of porpoises to sounds:
Goal: Determine optimal signal parameters of acoustic alarms for porpoises.

Conclusions of pinger experiments:
1) 1994: Small differences in sound signals can elicit large behavioral differences.
2) 1995: Sweep signals have a much stronger effect on the behavior of porpoises than clicks or tones.
3) 1996: Dukane Netmark 1000 had the strongest effect. A time bracket of 2-30 s for random pulse interval is too long.
4) 1998: Dukane Netmark XP-10 experimental alarm (producing 16 different signals) had strongest effect. Individual variation in reaction to alarms was observed .
5) 2002: Ultrasonic pingers (70 kHz) deter porpoises well, but cause no dinner bell effect for pinnipeds, as pinniped hearing goes up to around 60 kHz.

Effects of selected alarm sounds on other fauna:

Goal: Determine the effect of pingers designed for porpoises on other odontocetes and marine fish.



Determine the effect of pingers, designed to deter porpoises, on other odontocetes
Results: Signals that deterred a harbor porpoise to the other side of floating pen, had no effect on the behavior of a striped dolphin.

Conclusion: Pingers are, or need to be, species specific

Determine the effect of pingers, designed to deter porpoises, on marine fish
All 7 commercially available pingers in 2004 were collected and tested on 5 marine fish species.

Results: Behavioral responses (changes in speed and swimming depth) were seen in Herring to one pinger, Mullet to three pingers, and Sea bass to two pingers. Pout and cod (close relatives) showed no response to any pinger.

Conclusion: in regard to fish, the signal parameters of pingers need to be specified.

Take home message: A step-wise approach is needed to solve a bycatch problem

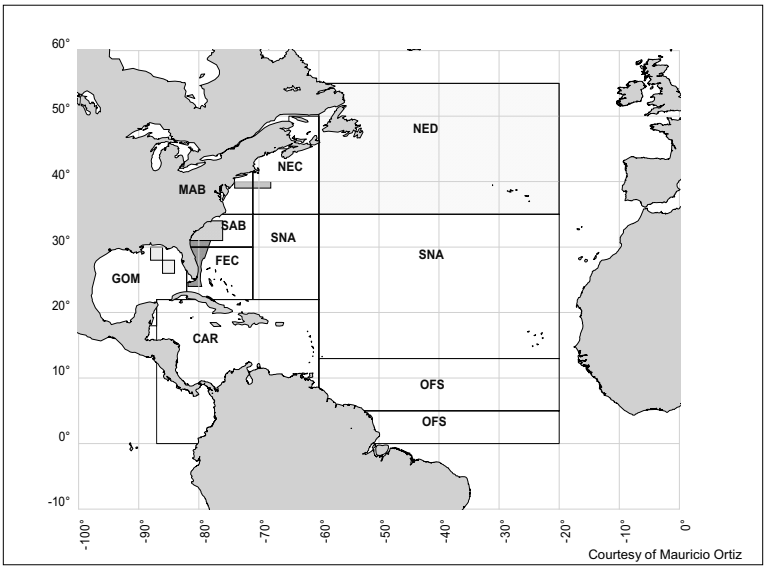
PDF files of publications of the studies can be obtained by sending an e-mail to Ron Kastelein, Seamarco, E-mail address: researchteam@zonnet.nl

Review of Sea turtle Bycatch Research in the Atlantic

- Experiments in Western Atlantic Northeast Distant Waters (NOAA Fisheries & BWFA)
- Reports from Observer Data (NOAA Fisheries and Canadian observer programs)
- Feeding Studies (NOAA Fisheries)

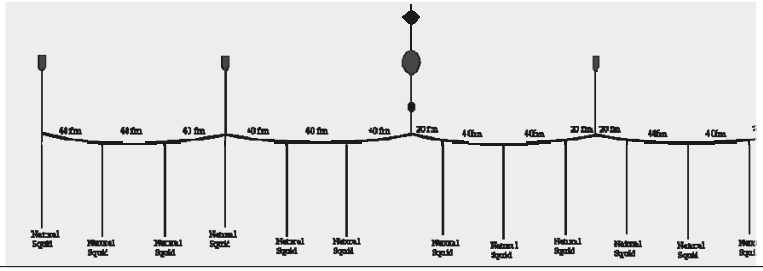
NOAA Fisheries

The US Atlantic Pelagic Longline Fishery

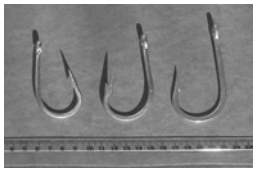


Courtesy of Mauricio Ortiz

2001 Experimental Design



Natural Squid



8/0, 9/0, and 10/0 J hooks

Natural Squid

Blue-Dyed Squid

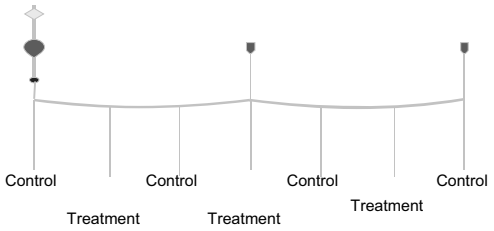
2001 Results

- **Effort and Catch: 8 vessels, 186 sets, 164,429 hooks – 142 loggerheads and 77 leatherbacks**
- **Blue-dyed Squid bait – no significant effect**
- **Move branch line 20 fathoms away from buoy - no significant effect for loggerheads**

  increased catch of leatherbacks
- **Daylight soak time – significant effect for *Caretta***

Experimental Design 2002-2003

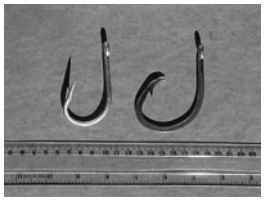
Set Configuration



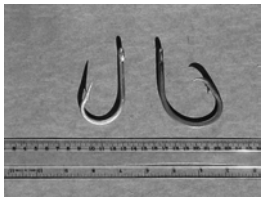
Control: J Hook, 9/0
25-30 Deg. Offset
w/ Squid Bait

Treatments:
Experimental Hooks
Experimental Baits

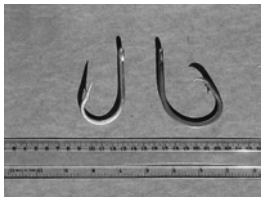
2002 Experiments



9/0 J & 18/0 non-offset circle



9/0 J & 18/0 10 º offset circle



9/0 J & 18/0 10 º offset circle

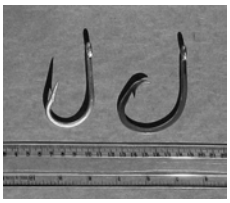
Squid

Squid

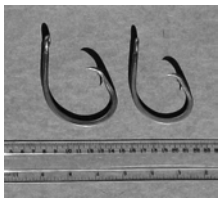
Mackerel

Goal for haulback completion was set 1 hr earlier than average observed during 2001

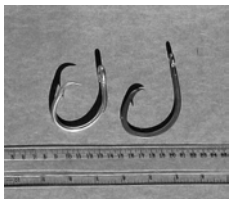
2003 Experiments



9/0 J & 18/0 non-offset circle



18/0 10º offset circle & 20/0 10º offset circle



16/0 offset circle & 18/0 non-offset circle

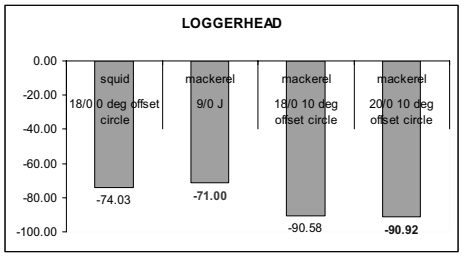
Swordfish Directed Sets

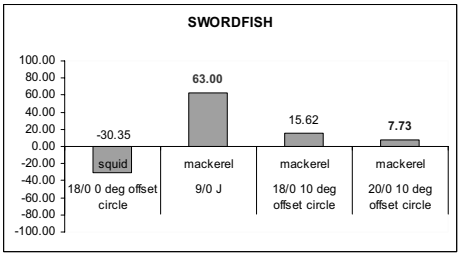
Tuna Sets

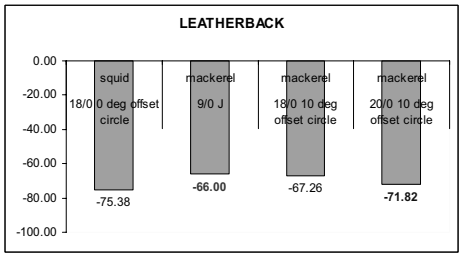
2002 & 2003 Results

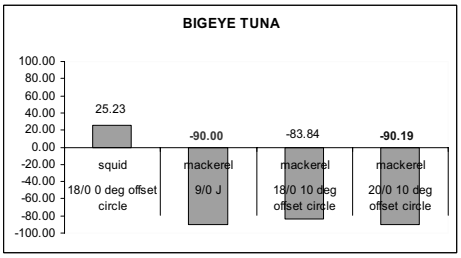
- Effort and catch (2002): 13 vessels, 489 sets, 427,385 hooks – 100 loggerheads and 158 leatherbacks
- Effort and catch (2003): 11 vessels, 539 sets, 578,050 hooks – 92 loggerheads, 79 leatherbacks, and 1 olive ridley
- Reduce daylight hook soak time (2002) – Not significant
- 18/0 (0° offset and 10° offset in 2002; only 0° offset in 2003) circle hooks with squid bait Significant reduction loggerheads and leatherbacks, decreased swordfish catch, increased tuna catch
- 18/0 (10° offset) circle hooks with mackerel bait
  Significant reduction loggerheads and leatherbacks, increased swordfish catch, decreased tuna catch
- 20/0 (10° offset) circle hooks with mackerel bait (2003)
  Significant reduction loggerheads and leatherbacks, increased swordfish catch, decreased tuna catch

Effect of Treatments Relative to Control

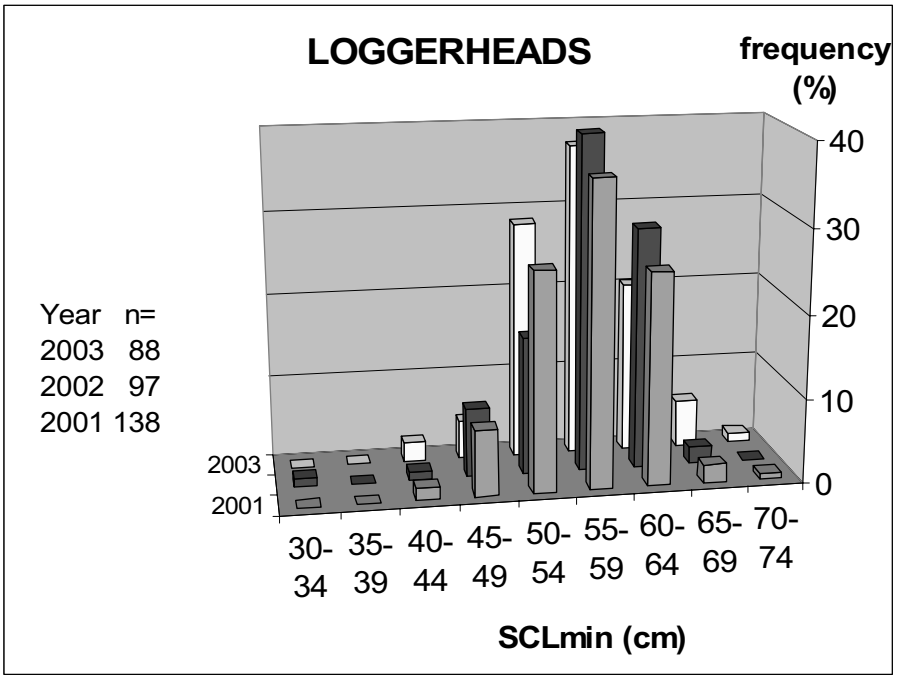


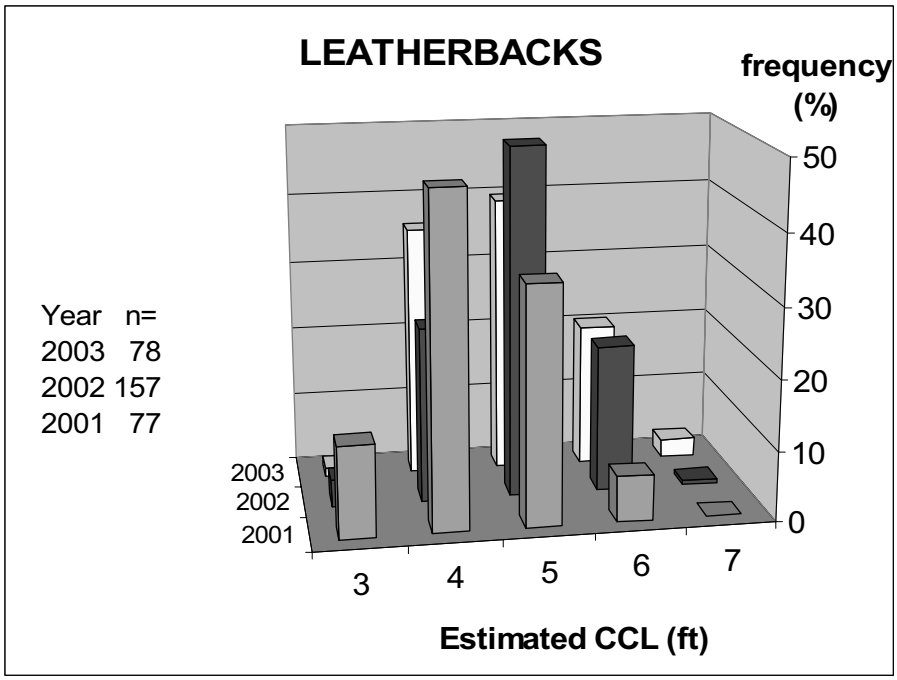


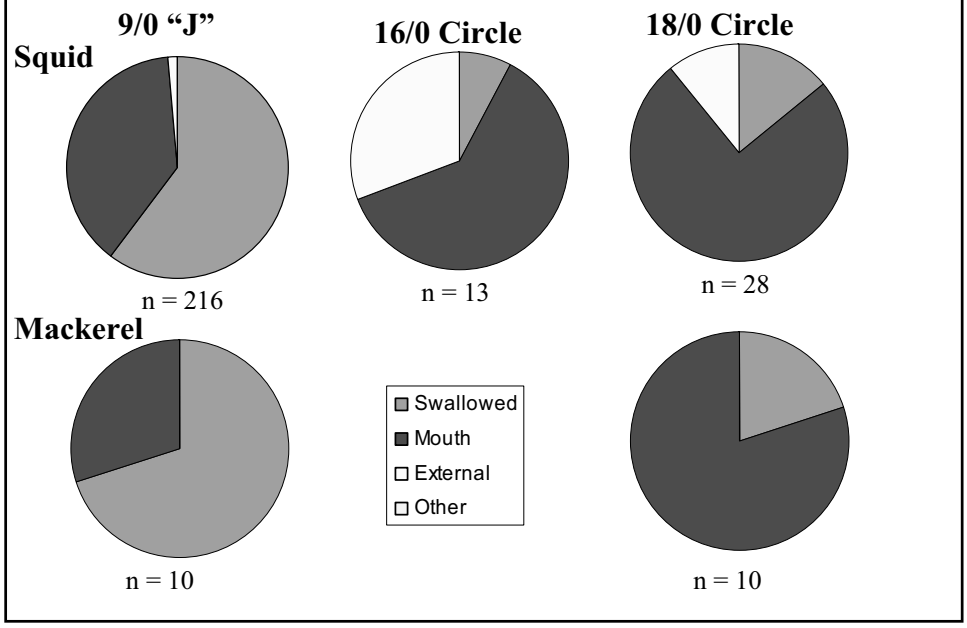


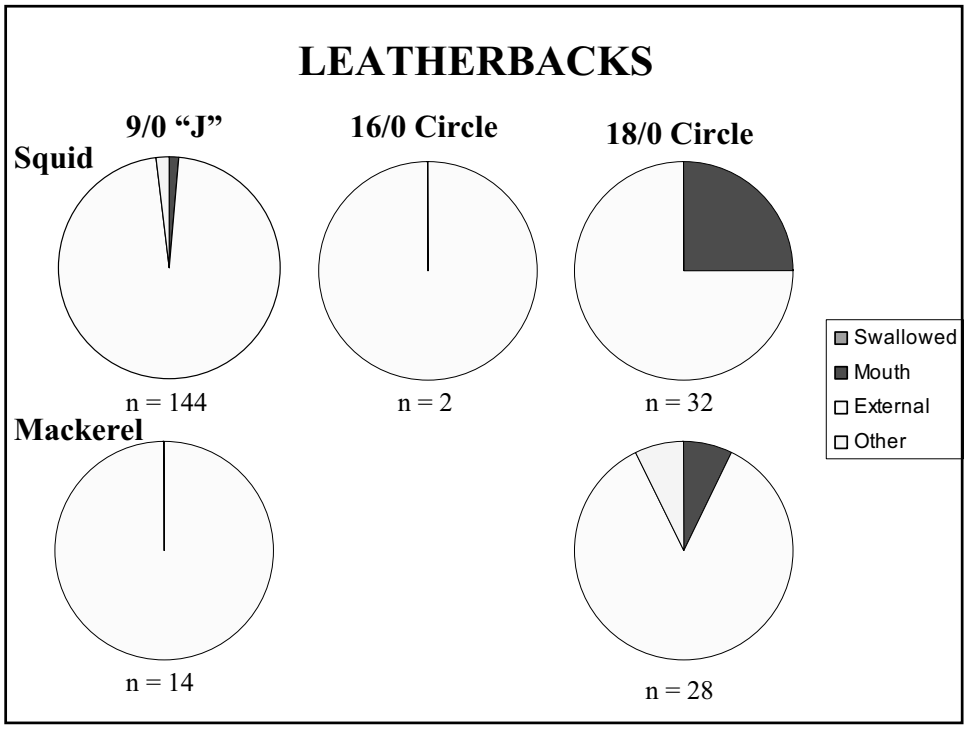


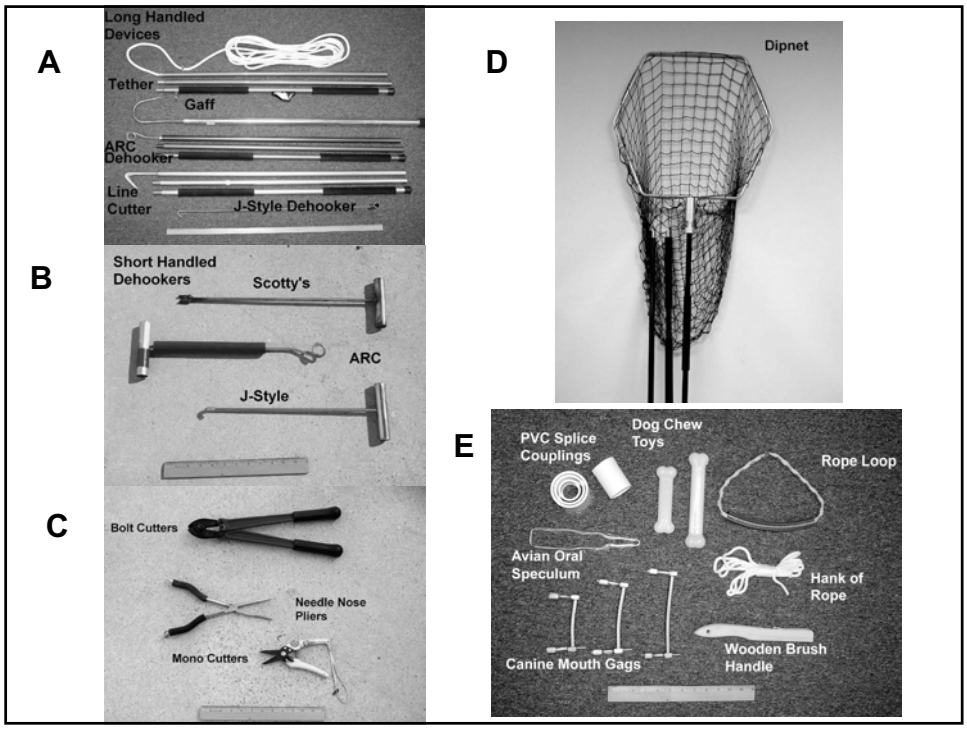
results for combined 2002-2003, unless noted: 2002 only 2003 only




LEATHERBACKS
frequency (%)
50
40
30
20
10
0
Year n=
2003 78
2002 157
2001 77
2003
2002
2001
3
4
5
6
7
Estimated CCL (ft)


LOGGERHEADS
9/0 "J"
16/0 Circle
18/0 Circle
Squid
n = 216
n = 13
n = 28
Mackerel
n = 10
n = 10
Swallowed
Mouth
External
Other


LEATHERBACKS
9/0 "J"
16/0 Circle
18/0 Circle
Squid
n = 144
n = 2
n = 32
Mackerel
n = 14
n = 28
Swallowed
Mouth
External
Other


A
Long Handled Devices
Tether
Gaff
ARC Dehooker
Line Cutter
J-Style Dehooker
B
Short Handled Dehookers
Scotty's
ARC
J-Style
C
Bolt Cutters
Needle Nose Pliers
Mono Cutters
D
Dipnet
E
PVC Splice Couplings
Dog Chew Toys
Rope Loop
Avian Oral Speculum
Hank of Rope
Canine Mouth Gags
Wooden Brush Handle

Fishery Observer Data

Gulf of Mexico (Garrison, 2003)
Canadian Atlantic waters (Javitech, 2002)

- Relative to 9/0 "J" hooks 16/0 circle hooks do not reduce CPUE of pelagic/oceanic stage loggerhead turtles when using squid bait.
- Compared to 7/0 & 8/0 "J" hooks 16/0 circle hooks do reduce interactions with loggerhead turtles
- No loggerhead turtle interactions have been recorded in Gulf of Mexico yellowfin tuna fishery (1992-2002) using sardine and herring bait with 15/0 and 16/0 circle hooks

Fishery Observer Data

Gulf of Mexico (Garrison, 2003)
Canadian Atlantic waters (Javitech, 2002)

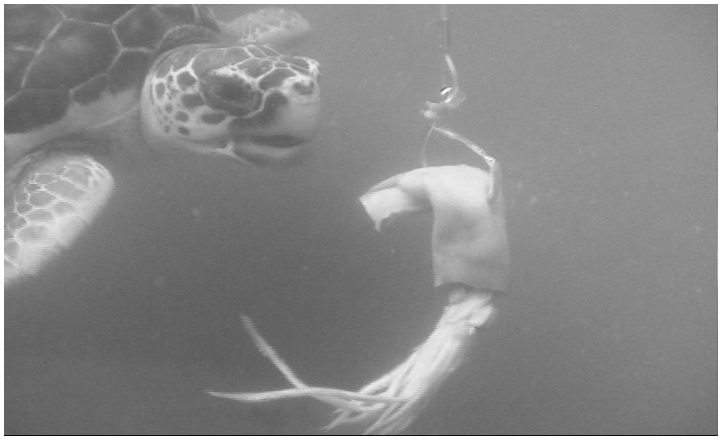
- Canadian observer data indicates a 94% reduction in leatherback CPUE with 16/0 circle hooks when compared to "J" hooks
- GOM data indicates lower average leatherback catch rate with circle hooks when compared to "J" hooks
- Recent increase in leatherback interaction rates in GOM has been associated with increase proportion of fishery using "J" hooks and squid bait

Effect of Hook Size on Ingestion of Hooks by Loggerhead Sea Turtles

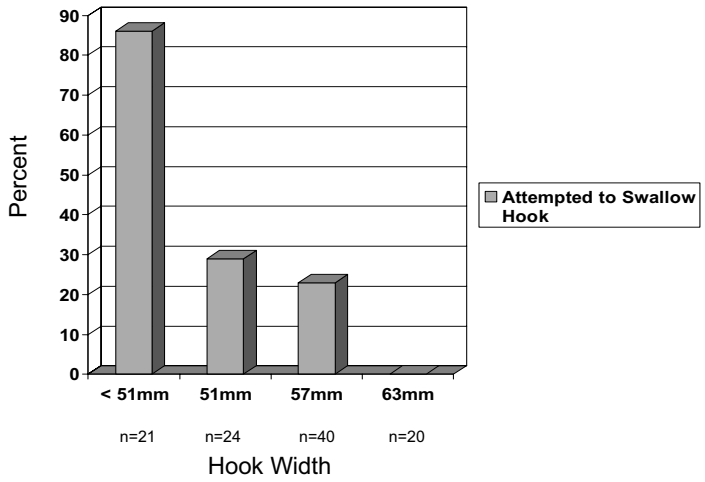
John W. Watson, Bret D. Hataway, and
Charles E. Bergmann

June, 2003

Squid Bait Rigging



Effect of Hook Width on Ingestion of Hooks by Loggerhead Turtles (40-60 cm Length)



Summary of Logistic Regression Analysis on Hook Swallowing Attempts

Hook Dimensions

Hook Type	Hook Width	Hook Length
9/0 J	41 mm	78 mm
9/0 Tuna	33 mm	78 mm
10/0 Tuna	38 mm	86 mm
11/0 J	51 mm	98 mm
16/0 Circle	51 mm	73 mm
11/0 MJ	56 mm	86 mm
18/0 Circle	57 mm	86 mm
12/0 J	57 mm	111 mm
14/0 J	63 mm	130 mm
20/0 Circle	63 mm	100 mm

Summary of Atlantic Longline Research

- Relative to 9/0 "J" hooks 18/0 circle hooks significantly reduced sea turtle bycatch
- 16/0 circle hooks reduced cpue of loggerhead turtles compared to 7/0 and 8/0 "J" hooks, but not compared to 9/0 "J" hooks
- 16/0 circle hooks may significantly reduce loggerhead cpue when used with fish bait (sardines and herring) rather than squid bait
- Circle hooks engaged in the jaw and less often were swallowed by cheloniid turtles than "J" hooks and post hooking mortality associated with a mouth hook is estimated to be lower than a swallowed hook

Summary of Atlantic Longline Research

- Effective gear and techniques were developed to safely remove longline gear from entangled, foul hooked, and mouth hooked turtles
- Hooks with a width larger than 51mm have the potential to significantly reduce mortality of loggerhead turtles
- Circle hooks (16/0 and 18/0) significantly reduced leatherback bycatch
- Mackerel bait (200 – 500 gram) significantly reduced turtle bycatch when compared to squid bait
- Mackerel bait significantly reduced catch of bigeye tuna when compared to squid bait

Summary of Atlantic Longline Research

- Mackerel bait significantly increased catch of swordfish but this effect may be restricted to cold waters
- Circle hooks with squid bait significantly reduced swordfish catch
- CPUE of bigeye tuna was nominally increased with 18/0 circle hooks using squid bait
- CPUE of yellowfin tuna was reduced with 18/0 circle hooks with sardine bait when compared with 16/0 circle hooks with sardine bait
- Hook timer and other data indicates loggerhead turtle interactions with longline gear occur during daylight hours and leatherback interactions occur during nightime hours

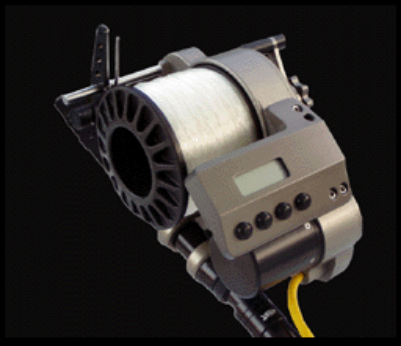
LINDGREN-PITMAN, INC.

Manufacturer of Commercial Fishing Equipment & Monofilament
2615 N.E. 5th Avenue, Pompano Beach, Florida 33064
*(954)943-4243 * Fax (954)943-7877*
E-mail: sales@lindgren-pitman.com

Made in U.S.A.

Established 1975

LINDGREN-PITMAN S-1200



US & Foreign Patents Pending

The Lindgren-Pitman LP S-1200 is a rugged high capacity electric fishing reel that brings state-of-the-art technical advances to fishing. Increased efficiency from new technology allows high performance with 12 volts D.C. input. This level of performance was not previously available at 12 volts. The electronics provides for many new features not available before including a counter and stop at top automatic operation.

The all new cantilever spool design allows for a completely sealed drive system for long reliable, maintenance free use. The gear driven level winder line wraps automatically for hands off carefree retrieval. It is the most rugged and ergonomically designed electric reel available with a long list of features including:

- High Power state-of-the-art 12 VDC motor operation
- Electronic Control and Switching.
- Electronic Counter
- Stop at Top Mode
- Simple Controls
- Hands Off Hauling
- Gear Driven Level Winder
- Ergonomic Cantilever Design
- Electronics Sealed with Inert Gas Atmosphere
- Titanium Spool* Endures Any Type or Size of Fishing Line
- Anodized Aluminum Alloy Construction
- Changeable Spool Design
- 2 Stage Drag System
- External Preset Drag Control & Vernier Control
- Smooth Wide Span Drag Control (180 degrees)
- 0 to 60 lb. Plus Drag Capability
- Designed for Continuous Fishing in Deep Water for Large Fish
- All Line Usable Spool Design
- High Line Capacity Spool
- Standard or Downrigger Style Rods Available

*(Optional)

**Approximate line capacity

MM	Inches	Yards	Example
0.8	0.031	2000	1200 +++ 200 lb. Hi tech fiber line
0.9	0.035	1500	1000 yds 100 lb. Test wire line
1.0	0.039	1200	100 lb test monofilament
1.2	0.047	880	2.2 lbs of 150 - 175 lb test monofilament
1.4	0.055	650	2.2 lbs of 225 - 250 lb. test monofilament

Designed for Commercial Use

Cape Cod Bluefin Fishing Videos

Low Resolution .wmv

5.4 mb

High Resolution .wmv

14.1 mb

Recommend Windows Media Player 9 or Later

Appendix IV
Working Group Participants [2]

WORKING GROUP I: REGULATORY OPTIONS
Chairperson(s): Indar Ramnarine
Rapporteur: Indar Ramnarine
Members:
Gervais Alkins
Risha Alleyne
Egbert Awai
Terrence Beddoe
Sarsha Franklin
Ann-Marie Jobity
Jon Lien
Lori Lee Lum
Neela Maharaj
Nemme McSweeny
Saheed Mohammed
Stephen Poon
Angela Ramsey
Franklyn Roberts
Sherwin Ruiz
William Trim

WORKING GROUP II: GEAR OPTIONS
Chairperson(s): Ron Kastelein
Rapporteur: Carl Baptiste
Members:
Erol Ceasar
Ruth Davis
Lara Ferreira
Salim Gool
Nicholas Hopkins
Gian Carlo Lalsingh
Arthur Potts
Nadia Ramphal
Wendy Thomas
Richard Wallace

WORKING GROUP III: FISHING METHODS AND TECHNIQUES
Chairperson(s): Peter Glodon
Rapporteur: (Fisheries)
Members:
Tanya Clovis
Franklin Roberts
Dennis Sammy
William Trim
Paul Winger

WORKING GROUP IV: GEAR OPTIONS
Chairperson(s): Stephen McClatchee, Len Peters
Rapporteur: Scott Eckert
Members:
Hope Brock
Carlos Drews
Allys Forte
Sherma Gomez
Anderson Inniss
Emile Louis
Cecil McLean
Danny Melville
John Mitchell
Mervin Sendall
Michelle Picov-Gill
Renwick Roberts
Earl Samuel
Reginold Samuel
Jacqueline A. Telfer
Philip Walsh

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[2] Participation in the Working Groups was not as accurately documented as it could have been. We apologize to those who participated in these discussions but, for whatever reason, did not have their name recorded on the Group roster. Based on per diem records, at least five (5) additional fishermen participated in the various Working Groups, but did not record their names or affiliations.

WIDECAST

Wider Caribbean Sea Turtle Conservation Network

"Working together to build a future where all inhabitants of the Wider Caribbean Region, human and sea turtle alike, can live together in balance."

The Wider Caribbean Sea Turtle Conservation Network (WIDECAST) is a volunteer expert network and Partner Organization to the U.N. Environment Programme's Caribbean Environment Programme. WIDECAST was founded in 1981 in response to a recommendation by the IUCN/CCA *Meeting of Non-Governmental Caribbean Organizations on Living Resources Conservation for Sustainable Development in the Wider Caribbean* (Santo Domingo, 26-29 August 1981) that a "Wider Caribbean Sea Turtle Recovery Action Plan should be prepared ... consistent with the Action Plan for the Caribbean Environment Programme."

WIDECAST's vision for achieving a regional recovery action plan has focused on bringing the best available science to bear on sea turtle management and conservation, empowering stakeholders to make effective use of that science in the policy-making process, and providing a mechanism and a framework for cooperation within and among nations. By involving stakeholders at all levels and encouraging policy-oriented research, WIDECAST puts science to practical use in conserving biodiversity and advocates for grassroots involvement in decision-making and project implementation.

Through information exchange and training, WIDECAST promotes strong linkages between science, policy, and public participation in the design and implementation of conservation actions. The network recommends standards for range state adoption, develops pilot projects, provides technical assistance, supports initiatives that build capacity within participating countries and institutions, and promotes coordination among Caribbean countries in the collection, sharing and use of biodiversity data. Working closely with local communities and resource managers, the network has developed standard management guidelines and criteria that emphasize best practices and sustainability, ensuring that current utilization practices, whether consumptive or non-consumptive, do not undermine sea turtle survival over the long term.

With Country Coordinators in more than 40 Caribbean States and territories, WIDECAST has been instrumental in facilitating complementary conservation action across range states, strengthening and harmonizing legislation, encouraging community involvement, and raising public awareness of the endangered status of the region's six species of migratory sea turtles. Country Coordinators are drawn from both the governmental and non-governmental sectors, and must have sea turtle research and/or management experience and responsibility.

WWW.WIDECAST.ORG