An Assessment of the Status and Exploitation of Marine Turtles in Bermuda

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The full report is hosted in PDF format at the Project website: http://www.seaturtle.org/mtrg/projects/tcot/finalreport/

This project was implemented by the Marine Turtle Research Group (University of Exeter in Cornwall, UK), the Marine Conservation Society (UK), and Duke University (USA) in association with the Cayman Islands Department of Environment, Cayman Turtle Farm, and University of Cardiff (UK). This initial consortium was expanded to include a large number of organisations across the Overseas Territories.

5. Status and Exploitation of Marine Turtles in Bermuda

Contents

5.1. Summary and Recommendations

Summary

The nesting marine turtle populations that once used the beaches of Bermuda are now extinct. Currently, large numbers of juvenile green turtles are found in Bermuda's waters along with a smaller number of hawksbill turtles (see table 5.1.). Loggerheads and leatherbacks rarely visit Bermuda's waters. There are historical records of Kemp's ridleys from Bermuda, but none have been encountered in recent memory. A long-term green turtle monitoring project has been in operation in Bermuda for over 30 years and has produced valuable data on population structure, migrations, genetic identity and habitat use. Methodological variance over the three decades hinders interpretation of trend data on marine turtle abundance. Limited data regarding the perceptions of fishers and others subject to the TCOT socioeconomic questionnaire suggest that, although most species are generally perceived to have decreased in the long term, in the last 5 years the green turtle populations are generally perceived to have increased. Although formerly the site of a marine turtle fishery, turtles are no longer subject to direct harvest in Bermuda, although boat strikes, fatalities due to marine debris, incidental capture in marine fisheries and loss of sea grass habitat are considered threats to Bermuda's sea turtles worthy of further investigation.

Summary of Recommendations

TCOT recommends that the Government of Bermuda continue to take all necessary steps to ensure the sustained existence of populations of marine turtles in Bermuda and facilitate their recovery. Bermuda appears to have lost its nesting populations, but still hosts significant foraging aggregations of juvenile turtles, especially green turtles. Although quantitative trend data are lacking, the general abundance and perceptions thereof by fishers and others in Bermuda seem to suggest that current management is resulting in a population increase of the green turtle. We make a number of specific recommendations under the following general headings:

5.1.1. Systematic monitoring of marine turtle populations to determine trends in abundance

5.1.1.1. Additional effort is expended on orienting in-water capture work of the BTP towards yield of CPUE data for green turtles.

5.1.1.2. Monitoring efforts on hawksbill turtles should be expanded.

5.1.1.3. Continued monitoring should be carried out at main potential nesting sites to ensure possible positive results of the past headstarting experiment do not go unnoticed.

5.1.1.4. Extend monitoring of possible impacts of bycatch and marine debris.

5.1.2. Increase capacity for marine turtle management

5.1.2.1. Ensure the Department of Environmental Protection has the long-term capacity, staff and resources to carry out all enforcement and monitoring duties relevant to marine turtle management, including data collection, entry, management and analysis.

5.1.2.2. Continue and increase the regional capacity building role of the BTP training course.

Additionally, we make a major overarching recommendation to the UK Government to support the conservation and management of marine biodiversity in the UK OTs under the Environment Charters.

The Overseas Territories of the UK have long been acknowledged as being rich in biodiversity (Proctor & Fleming 1999). The small islands or island archipelagos of the Caribbean UK Overseas Territories currently do not or are unable to carry out sufficient monitoring, research, management and educational outreach required to ensure the sustainability of their marine and coastal natural resources. TCOT strongly recommends that the UK Government further contributes to marine biodiversity conservation and management in the UK Overseas Territories through provision of funding and expertise under the FCO/DfID Overseas Territories Environment Programme (OTEP), Defra's Darwin Initiative and through the provision of bespoke scholarships for tertiary education in biodiversity/conservation related subjects for citizens of the OTs. Additionally, much of the environmental legislation in the OTs is in need of revision to facilitate the conservation

Species	Nesting	Foraging	Harvest
Green Turtle (*Chelonia mydas*)	None since 1937	Juveniles present. Large numbers in some areas	Thought to be eliminated
Hawksbill Turtle *(Eretmochelys imbricata)*	None	Juveniles present Small numbers	Thought to be eliminated
Leatherback Turtle (*Dermochelys coriacea*)	None	Rarely encountered	None
Loggerhead Turtle (*Caretta caretta*)	One nest in 1990	Rarely encountered	None

Table 5.1. Marine turtle species present and summary of harvests in Bermuda.

of marine turtles and their habitats, and therefore TCOT strongly recommends that HMG provide the necessary support to the OTs to facilitate the required legislative amendments.

Specific Recommendations

5.1.1. Systematic monitoring of marine turtle populations to determine trends in abundance

5.1.1.1. Additional effort is expended on orienting in-water capture work of the BTP towards yield of CPUE data for green turtles.
In recent years, more effort has been focused on generating data that can be used to assess temporal changes in marine turtle abundance in Bermuda's waters. These efforts have not yet been able to generate sufficient trend data to show whether the current management regime in Bermuda is successful. Recent changes in sampling strategy should be examined critically to ensure that these efforts will generate data of sufficient power to detect trends. An integral part of this work should be the continued monitoring and linkage to the health and distribution of seagrass beds.

5.1.1.2. Monitoring efforts on hawksbill turtles should be expanded.
Bermuda hosts a small population of hawksbill turtles. Data on size distribution, genetic identity, maturity status and spatial distribution have been collected by the BTP and BAMZ through incidental captures and through strandings. Hawksbills are rarely caught in the net used to capture green turtles. Since 2000, the BTP has dedicated annual sampling effort to swimming transects of suitable habitat with teams of snorkelers, capturing hawksbills by hand. This has proven to be a successful technique, but apparent low density of this species in Bermuda precludes large sample size for study, and has hindered evaluation of population trends.

5.1.1.3. Continued monitoring should be carried out at main potential nesting sites to ensure possible positive results of the past headstarting experiment do not go unnoticed.
It is still possible that individuals translocated to Bermuda could return to nest. It is important that at least some monitoring is carried out around likely candidate beaches to ensure this does not go unrecorded. Given that green turtles leave substantial tracks and pits and they typically nest at least three times over 1-2 months in a season, it is unlikely that nesting would go unnoticed if beaches were checked at intervals of 1-2 weeks in June-August (the likely peak nesting months).

5.1.1.4. Extend monitoring of possible impacts of bycatch and marine debris.
Other than boat strike, the main threats to marine turtles in Bermuda's waters appear to be bycatch in marine fisheries, including both local fishers and those on international vessels operating on the high seas, and fatalities due to encounters with non-degradable marine debris (ingestion of plastics, entanglement in flotsam). These factors warrant further investigation.

5.1.2. Increase capacity for marine turtle management

5.1.2.1. Ensure the Department of Environmental Protection has the long-term capacity, staff and resources to carry out all enforcement and monitoring duties relevant to marine turtle management, including data collection, entry, management and analysis.
The staff of the Department of Environmental Protection carrying out the fieldwork of the Bermuda Turtle Project are well skilled in the field and data collection techniques needed for ongoing monitoring and research. However, although this initiative is relatively well resourced in comparison to many OTs, the BTP is reliant on outside donor and specialist scientific support. It is important for a long-term legacy of marine turtle monitoring and research that local ownership and co-management of data sets gathered with outside researchers are further developed to facilitate the enhancement of institutional memory and capability. This will insure against changes in capability of external workers to participate in the future.

5.1.2.2. Continue and Increase the Regional Capacity Building Role of the BTP Training Course.
The importance of this initiative in regional capacity building cannot be underestimated. It has been well utilised to date by TCOT partners (see section 11). Given the wide genetic origins of marine turtles in Bermudan waters, it is possible that positive benefits of Bermuda-based capacity building efforts could be detected in Bermuda in the future. Given the excellent track record of this initiative, additional external funding would be well deserved and is highly likely.

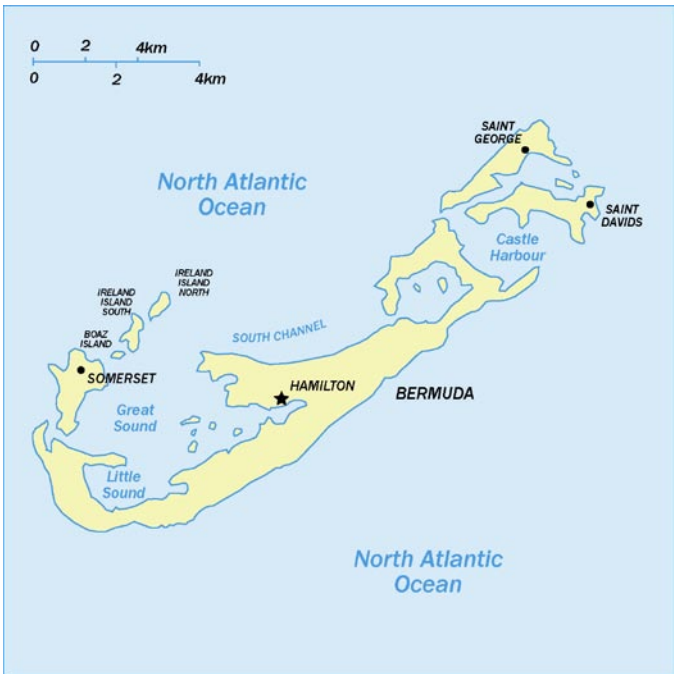

Figure 5.1. Map of Bermuda.

5.2. Geographic Overview

Bermuda (32°20'N, 64°45'W; Figure 5.1) is made up of approximately 180 limestone and coral islands and islets, 20 of which are inhabited. The eight largest islands - St George's Island, St David's Island, Bermuda Island, Somerset Island, Watford Island, Boaz Island, Ireland Island North, Ireland Island South - are connected by causeways and bridges. Total land area is 58.8 km^2 and the coastline is 150 km. The population is 64, 900 (July 2004 est.), and per capita GDP is $36,000 (2003 est.), the highest of the OTs. Tourism and international business are the main sectors of the economy. Over 500,000 tourists visit Bermuda each year, more than 80% of whom are from the USA.

Photo 5.1. Green turtle under X-ray at the Bermuda Aquarium Museum and Zoo Wildlife Rehabilitation Centre (Photo. J. Gray).

5.3. Historical Overview

Bermuda once had an assemblage of nesting as well as foraging green turtles. Murray (1991) gives the account of William Strachey, shipwrecked with other survivors in Bermuda in 1609:

"The tortoyse is a reasonable toothsam (some say) wholesome meat. I am sure our company liked the meate of them veerie well, and one Tortoyse would goe further amongst them, then three hogs. One Turtle (for so we called them) feated well a dozen Messes, appointing sixe to every Messe. It is such a kind of meat, as a man can neither absolutely call Fish nor Flesh, keeping most what in the water, and feeding upon Sea-grasse like a Heifer, in the bottome of the Coves and Bayes, and laying their Egges (of which wee would find five hundred at a time in the opening of a shee turtle) in the Sand by the shoare side, and so covering them close leave them to the hatching of the Sunne, like the Manati at Saint Dominique, which made the Spanish Friars (at their first arrival) make some scruple to eate them on a Friday, because in colour and taste the flesh is like morsells of Veale."

However, despite seminal protective legislation adopted in 1620, by the end of the 1800s the green turtle nesting population was significantly reduced and Bermudian turtle boats are reported to have fished as far afield as the Bahamas or even Ascension Island (Parsons 1962). The law failed to halt the destruction of the breeding colony and there has been no recorded wild nesting of green turtles in Bermuda since the 1930s. By 1937 there was no laying at all on the main islands although it was felt there may still be some laying on outlying islets (Babcock 1938). The construction of the International Airport in the 1940's led to widespread destruction of the islets in Castle Harbour, which is thought to have further worsened the situation.

5.4. Organisations Involved with Marine Turtles in Bermuda

Green turtles have been the focus of a tagging study initiated in 1968 by Dr. H. C. Frick II, a trustee of the Caribbean Conservation Corporation (CCC) in collaboration with the Bermuda Government Department of Agriculture and Fisheries. One of the first scientific investigations of green turtles on their foraging grounds, The Bermuda Turtle Project (BTP) continues today as a joint effort of the Bermuda Aquarium, Museum and Zoo (BAMZ) and the CCC. Drs. Anne and Peter Meylan, research associates of the CCC and the Bermuda Aquarium, serve as scientific directors of the project, and Jennifer Gray of the Aquarium serves as Project Coordinator. The team is assisted by other staff members of Bermuda's Department of Conservation Services, in addition to local and international students and volunteers from the community. For a fuller overview of the BTP see Section 5.6.2.

The Bermuda Aquarium Museum and Zoo collects important data on sea turtle health and mortality through information gathered in their Wildlife Rehabilitation Centre (WRC) and the Bermuda Sea Turtle Stranding Network. Stranding statistics gathered in Bermuda are shared with the Sea Turtle Stranding and Salvage Network (STSSN) coordinated by the National Marine Fisheries Service in the USA.

5.5. Status of Nesting Marine Turtles in Bermuda

Between 1967 and 1977, an attempt to re-establish a nesting population in Bermuda saw over 25,000 green turtle eggs flown in from Costa Rica and Surinam and buried on local beaches. The majority were buried on Nonsuch Island and at Howard's Bay on Castle Point. 18,000 hatchlings emerged from these nests. Although, other headstarting

In the last 5 years…

	Increasing	Decreasing	Same	Don't know	NR
Green	10	2	3	2	2
Leatherback	0	2	3	11	3
Loggerhead	1	6	1	9	2
Hawksbill	0	8	1	8	2

Since you can remember…

	Increasing	Decreasing	Same	Don't know	NR
Green	5	10	1	1	2
Leatherback	0	6	2	8	3
Loggerhead	0	10	0	7	2
Hawksbill	0	10	0	7	2

Table 5.2. Fisher perceptions of change in abundance of sea turtles in Bermuda waters over time (n=19 of 25 fishers who noticed changes).

projects around the world have received some level of success (see Mrosovsky in press for review), it may be that hatchlings deployed were either insufficient in number, had inappropriate sex ratios, or did not receive the behavioural cues that would allow re-establishment of a viable breeding population. It remains to be seen if the nesting population has been re-seeded.

In 1990, a loggerhead turtle nest with eggs was discovered on Clearwater Beach and was exposed by beach erosion. The clutch produced three healthy hatchlings. This was the first confirmed nesting of this species in Bermuda (Gray 1990a; 1990b). Given there has been no recorded nesting other than this one nest for over 5 decades, it is likely that all nesting populations of turtles that once used Bermuda are extirpated.

As in all TCOT countries, as part of the TCOT Socioeconomic Questionnaire (SEQ) respondents were asked about changes in numbers of nesting turtles over time. All respondents but one were aware that turtles do not nest in Bermuda. Some respondents were unsure whether or not there may have been nesters within their lifetimes, but all but one knew that there had been none in the last five years. Thus, awareness of the lack of marine turtle nesting activity among respondents was high.

Photo 5.2. Sport Diver Ron Porter captures a hawksbill turtle for the Bermuda Turtle Project (Photo: J. Gray).

Photo 5.3. Pelagic phase hawksbill turtles are encountered in Bermuda's waters (Photo: J. Gray).

Recommendation

5.1.1.3. Continued monitoring should be carried out at main potential nesting sites to ensure possible positive results of the past headstarting experiment do not go unnoticed.
It is still possible that individuals translocated to Bermuda could return to nest. It is important that at least some monitoring is carried out around likely candidate beaches to ensure this does not go unrecorded. Given that green turtles leave substantial tracks and pits and they typically nest at least three times over 1-2 months in a season, it is unlikely that nesting would go unnoticed if beaches were checked at intervals of 2 weeks in June-August (the likely peak nesting months).

5.6. Status of Foraging Marine Turtles in Bermuda

5.6.1. Data gathered from the TCOT Socioeconomic Questionnaire (TCOT SEQ)

In-water turtle work was well developed in Bermuda before the instigation of TCOT and TCOT staff merely visited as guests of the Bermuda Turtle Project. BTP has been working extensively on foraging marine turtles for several decades (see below). BTP volunteer Jennifer Constable executed the TCOT SEQ in Bermuda and much useful information was gathered from fishers.

Fisher opinions on trends in turtle numbers were solicited in two separate questions on the TCOT SEQ. Q24 asked fishers about changes in abundance for all species they fish, in the last five years and since they started fishing. Five fishers were former turtle fishers, although one fished in Australia and one in Jamaica, so the responses of these two individuals regarding trends were excluded. All three who fished turtles in Bermuda believed that the number of turtles had decreased since they started fishing. One believed turtles had increased in the last 5 years, and two responded that they didn't know (both had retired from fishing for almost 10 years). While these fishers were hesitant to comment on recent trends, their explanations for change suggest they view things positively. Reasons cited for changes in abundance were better management and laws protecting turtles. One fisher suggested overpopulation in Bermuda contributed to declines.

All questionnaire respondents were also asked about changes in numbers of turtles seen in territorial waters over time (in the last five years and since they can remember), both in general and for specific species (Q104). Results are presented for fishers in general, and then for the surveyed population as a whole. Of the 25 fishers interviewed, 19 commented on their perception of the patterns of turtle abundance over time. Their perceptions of change of individual species are shown in Table 5.2.

The fishers gave little indication as to what they thought with regard to turtles in general, and rather commented on individual species. Of 15 who provided an opinion on green turtle abundance, 10 felt that green turtles had increased over the past five years, with 2 citing a decrease and 3 suggesting no change (2 fishers did not know and 2 did not respond for green turtles). In contrast, when comparing trends for as long as they could remember, 10 of 16 who provided an opinion felt that green turtles had decreased. Only one fisher contended that greens had decreased both in the short and long term. For leatherbacks, most fishers who commented felt that they had decreased in the long term, and decreased or stayed the same in the short term. The majority of fishers felt that loggerheads and hawksbills had decreased in the short and long term.

For the surveyed population as a whole, 37 respondents (52%) noticed a change in general, while 34 (48%) did not.

In the last 5 years…

	Increasing	Decreasing	Same	Don't know	NR
Green	21	5	3	3	39
Leatherback	0	2	6	19	44
Loggerhead	1	8	5	16	41
Hawksbill	1	12	5	12	41

Since you can remember…

	Increasing	Decreasing	Same	Don't know	NR
Green	10	17	3	2	39
Leatherback	0	6	5	16	44
Loggerhead	0	12	4	14	41
Hawksbill	0	14	5	11	41

Table 5.3. Perceptions of change in abundance of sea turtle in Bermuda waters over time (n=71 respondents)

Photo 5.4. Collection ofturtle net (Photo: J.Gray).

Views of all respondents for specific species and in general are shown in table 5.3. In general, respondents who saw a change believed that turtles had increased over the past 5 years, but decreased since they could remember. However, perceived trends were different for some specific species. Leatherback, loggerhead and hawksbill turtles were believed to have decreased in the last 5 years and since respondents could remember. For green turtles, however, most respondents believed them to have increased in the last 5 year (n=21) rather than decreased (n=5). Over the longer time frame (since you can remember), most people believed green turtles had decreased (n=17), but many also believed they had increased (n=10).

Respondents were asked about reasons for the perceived increase or decrease in the number of turtles found in OT waters. Responses varied, but protection was the reason (n=8) cited most often as supporting increases with the only other reason cited being decreased fishing effort. Reasons for decreased numbers included: changing habitat, pollution, overpopulation, environmental pressure, hunting elsewhere, over-harvest, and increased consumption.

Photo 5.5. Capture of juvenile green turtle (Photo: J. Gray).

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Photo 5.6. Loading of turtles onto research vessel (Photo: J. Gray).

Photo 5.7. Bermuda Turtle Project captures lined up in their beds on board the research vessel awaiting data collection (Photo. J. Gray).

5.6.1. Overviewing the work of the Bermuda Turtle Project

Peter Meylan, Anne Meylan and Jennifer Gray write:

Today, only immature green turtles and hawksbills inhabit the island's extensive shallow-water habitats. Greens and hawksbills arrive in Bermuda waters after having spent several years as post-hatchlings in the open ocean. They stay in Bermuda until they move on to an adult foraging ground where they will mature. Greens, leatherbacks, hawksbills, and loggerheads are sighted in the offshore Bermuda habitat. Here we outline the work of the BTP:

5.6.2.1. Project mission/description

The project's mission is to further the understanding of the biology of highly migratory, endangered marine turtles in order to promote their conservation in Bermuda and worldwide. The project provides what is arguably the best window on the post-pelagic, near-shore developmental stage of green turtles anywhere in the world. Turtles on Bermuda's extensive sea grass pastures are captured for study using a modification of the turtle fishing method that was historically employed in the Bermuda turtle fishery. A 2000-ft. entrapment net is set at study sites around the Bermuda Platform, and entangled turtles are removed by

teams of snorkelers and taken aboard a research vessel for study. Between 1992 and 2003, 448 sets were made with the net at 40 sites representing the various suitable marine habitats around Bermuda.

Sampling efforts between 1968 and 1991 were reported on a daily basis rather than by individual set numbers. As of December 2003, the Bermuda Turtle Project has collected data from 2,262 green turtles, approximately 100 hawksbills, and 43 loggerheads. Most of the green turtles were captured in the entrapment net, whereas the majority of hawksbills and loggerheads were obtained from recreational divers or as live or dead strandings. These records provide data on population structure and trends, genetic identity, sex ratios, growth rates, site fidelity, and migratory patterns. The project has made approximately 729 recaptures of its tagged green turtles in Bermudian waters, providing a large and robust data set on growth rates and movements of free-ranging, immature green turtles. Only two hawksbill recaptures have been made in Bermuda waters.

All turtles captured by the Bermuda Turtle Project are studied using a standardized protocol (Meylan *et al.*1992; 1994; 1999; 2003). All are measured, weighed, and tagged. Each tag bears a unique number, a reward message and the return address of a tag clearing house at the University of Florida in Gainesville, Florida. Since 2001, turtles smaller than 35 cm in carapace length have also been tagged with an internal PIT tag. Blood samples are taken from each turtle for hormone assays that reveal the sex of the turtle by measuring the amount of testosterone in the blood. A separate blood sample or skin biopsy is preserved for DNA sequencing. Captured turtles are released at their initial capture site within an hour or two.

5.6.2.2. Population structure.
Green turtles captured by the Bermuda Turtle Project have varied in minimum straight carapace length at first observation from 22.3 to 81.0 cm (mean±SD; 48.79±12.61, n=1924) and in weight from 1.0 to 86.2 kg (20.27±14.79, n =1927). Although a small number of the green turtles captured are larger than the minimum size at sexual maturity, laparoscopy of a sample of more than 100 individuals suggests that none are mature.

5.6.2.3. Population trends.
The capture method used by the Bermuda Turtle Project involves the setting of an entrapment net on sea grass beds at sites around Bermuda where green turtles are known to feed. Approximately 40 sites have been sampled over the course of the project, including a core group of sites representing various habitat types that has been routinely sampled throughout the 36-year project. From 1992 through 2003, this amounted to 448 sets, averaging 37 sets per year. Since 1992, the same net has been used for every set and the total number of turtles captured per set has been recorded providing a potential data set for catch-per-unit-effort (CPUE) analysis. However, there is a large amount of variance associated with the data. Some of it can be reduced by restricting the sample to data for the most frequently sampled month (August, n=182 samples) and only the most frequently sampled sites. But other important sources of variation in the capture data remain, such as ambient conditions (time of day, sea state, current, turbidity, water temperature) and learning behaviour on the part of turtles (i.e., turtles that have been captured before may be more successful at evading the net). Unfortunately, we have little control over these variables.

Other variance is likely to be introduced by parameters associated with our netting protocol, such as the stealth used in approaching and initiating the set, exact placement of the net on the grass bed, the speed at which the net is deployed, degree and speed of closure of each set, and whether the lead line of the net remains on the bottom throughout the set. We are addressing these procedural sources of variation in several ways, including making

Photo 5.8. Blood sampling (Photo BTP).

Photo 5.9. Release of tagged turtle (Photo. J. Gray).

some uniform “blind” sets during each sampling session at net site locations that have enough “landmarks” that we can encompass approximately the same area of the sea grass bed each time. Although we currently employ a high-quality GPS unit, it is difficult to use it to set the net exactly in the same place each time. Another directive of the netting protocol for trend evaluation is that the net site is approached directly (not crossed) and the net is deployed upon arrival at a designated starting spot regardless of whether turtles are seen in the area. This is not always the case in other sets because we sometimes reconnoitre an area and delay setting until turtles are sighted, attempting to maximize the number of turtles captured (i.e., to get new tags put on, to recapture turtles for growth and movement studies) or targeting large animals for deployment of satellite transmitters. The specific methodology we have adopted for sets designed to yield trend data should begin to remove at least some of the causes of variation and provide a robust measure of trends in green turtle abundance in Bermuda.

5.6.2.4. Genetics.
For information on genetics of turtles in Bermuda waters **see section 10.5**

5.6.2.5. Developmental migration
Tag returns: Upon reaching a shell length of approximately 65-70 cm, green turtles depart from Bermuda and migrate to distant foraging grounds where they will complete their development and become sexually mature. External tags allow researchers to determine the locations of these distant foraging grounds. To date, 71 green turtles and one hawksbill tagged by the project in Bermuda have been recaptured in other countries in the western Atlantic, including Nicaragua, Panama, Colombia, Venezuela, Cuba, the Dominican Republic, Grenada, St. Lucia, and the United States. Over two-thirds of the green turtle recaptures have been made in Nicaragua, reflecting travel of approximately 2500 km in straight-line distance. We believe that the turtles take up residence on the extensive shallow grass beds off the coast of this country. This region is the primary source of mature adult green turtles in the western Caribbean. From this area, mature turtles undertake reproductive migrations to the nesting beach where they were born, completing a long and complex life cycle.

5.6.2.6. Satellite telemetry
The exact routes of migratory travel and other aspects of migratory and residential behaviour are studied using satellite telemetry. Small transmitters mounted on the backs of the turtles communicate with ARGOS satellites to provide BTP researchers with geographic coordinates, temperature, and diving behaviour. Five satellite transmitters have been deployed in Bermuda through 2003, four of which indicated only local movements around Bermuda. In the fifth experiment, a female green turtle given the name “Bermudiana,” travelled from Bermuda to the Dominican Republic and Haiti, and then on to the eastern tip of Cuba, where she was captured by fishers.

Photo 5.10. Release of turtle for satellite tracking (Photo: J. Gray).

5.6.2.7. Outputs
Publications resulting from the Bermuda Turtle Project, as well as publications about marine turtles in Bermuda, are listed in Appendix 11.5 as an integrated part of the TCOT Bibliography. Results of research conducted on marine turtles in Bermuda as part of the Bermuda Turtle Project are regularly presented at international symposia and at various regional meetings, including the International Symposia on Sea Turtle Biology and Conservation, the USFWS/NMFS Hawksbill Protocol Meeting in Miami, annual WIDECAST meetings, the CITES Wider Caribbean Hawksbill Turtle Dialogue Meetings, and the meeting on Population Models for the West Atlantic Green Turtle (Cayman Islands). Data from the Bermuda Turtle Project contributed to Bermuda’s most recent State of the Environment Report, and they have been used to help make coastal and management decisions. Manuscripts on the importance of the Bermuda green turtle and hawksbill aggregations to the understanding of near-shore (neritic) developmental habitats and on the genetic composition of the Bermuda green turtle aggregation are close to submission.

5.6.2.8. Data management
Data generated by the Bermuda Turtle Project are maintained in a SAS 8.02 database on a server that is backed up daily with files stored at a remote location. The server is extensively guarded against viruses. Each individual turtle is assigned a Primary Tag Number under which all records are stored and accessed. Different types of records are coded according to observation type, including first observation, recapture, foreign recapture and stranding. All tags ever placed on an individual turtle are associated with the Primary Tag Number, including PIT tags. Spatial data are maintained in an ARCVIEW Geographic Information System to allow mapping and analysis. Data on all biological

Photo 5.11. The 2002 course attendees.

samples (blood, serum, tissues) are managed in Excel, as are foreign recapture records and set information. We hope to merge all current databases into a single Access database with several relational databases. This will avoid annual license fees associated with SAS and will make the data more accessible. Stranding data are maintained at the Bermuda Aquarium and are linked by Primary Tag Numbers in all cases where the turtles receive a tag and are released.

5.6.2.9. Conservation role

One of the most significant conservation contributions of the Bermuda Turtle Project is the International Course on the Biology and Conservation of Sea Turtles that is taught each year in conjunction with the summer sampling session. Over the eight years this course has been offered, it has served 87 students from countries bordering the Caribbean Sea and western Atlantic Ocean. These have included Anguilla, Belize, Bermuda, Bonaire, the British Virgin Islands, Canada, the Cayman Islands, Costa Rica, Cuba, Grenada, India, Jamaica, the Netherlands, Nicaragua, St. Lucia, the Turks and Caicos Islands, UK, USA and Venezuela. The course consists of lectures, discussions of assigned readings, two weeks of field experience capturing turtles and collecting data, and a hands-on anatomy session in which dead, stranded turtles recovered by the Aquarium through their stranding programme are examined. The course prepares students to establish or expand upon sea turtle monitoring and research programs in their home countries. Many of them return home and serve in decision-making positions in their governments where they are able to apply their conservation training. Most of the students in the 2003 course were funded by a grant from the U.K. Foreign and Commonwealth Office Environment Fund for the Overseas Territories.

The Bermuda Turtle Project plays a prominent role in Bermuda as a flagship programme of the Bermuda Aquarium. It is frequently featured in island magazines, newspapers, and film documentaries. The project's website <htpp://www.cccturtle.org/bermuda/>, hosted by CCC, received 69,727 page visits during 2003. Project Coordinator Jennifer Gray is a frequent speaker at schools around the island, as well as conservation and civic groups. An Educator's Guide about

Photo 5.12. Class in session (Photo P. Richardson).

Photo 5.13.Stomach contents of a juvenile hawksbill turtle that died from ingestion of plastic debris. BAMZ Sea Turtle Stranding and Salvage Network (Photo J. Gray).

Bermuda sea turtles was produced in collaboration with the CCC and distributed to Bermuda schools. Environmental education goals of the Bermuda Turtle Project are furthered by the involvement of volunteers in the programme. In 2003, 47 volunteers donated a total of 1962 hours of their time, and learned much about these endangered animals. The volunteers included international students, Friends of the Bermuda Aquarium interns, Bermuda Aquarium Museum and Zoo registered volunteers, and a number of professionals including lawyers, doctors, nurses and policemen from around the island.

Bermuda has a long history of commerce and population exchange with the countries of the Atlantic Basin. The sea turtles of Bermuda are a living symbol of this interconnection among peoples and cultures. In fact, the very survival of these endangered animals depends on international cooperation and stewardship.

End section by Meylan, Meylan and Gray

5.6.3. Threats to marine turtles in Bermuda waters
The main threats to marine turtles in Bermuda include incidental catch in fisheries, interaction with marine debris, boat strikes (see Section 5.7.6 below), and habitat loss (J. Gray (BAMZ) pers. comm. 2004).

Recommendations

5.1.1.1. Additional effort is expended on orienting in-water capture work of the BTP towards yield of CPUE data for green turtles.
In recent years, more effort has been focused on generating data that can be used to assess temporal changes in marine turtle abundance in Bermuda. These efforts have not yet been able to generate sufficient trend data to show whether the current management regime in Bermuda is successful. Recent changes in sampling strategy should be examined critically to ensure that these efforts will generate data of sufficient power to detect trends. An integral part of this work should be the continued monitoring of the health of seagrass beds.

5.1.1.2. Monitoring efforts on hawksbill turtles should be expanded.
Bermuda hosts a small population of hawksbill turtles. Data on size distribution, genetic identity maturity status and spatial distribution have been collected by the BTP and BAMZ through incidental captures and through strandings. Hawksbills are rarely caught in the net used to capture green turtles. Since 2000, the BTP has dedicated annual sampling effort to swimming transects of suitable habitat with teams of snorkelers, capturing hawksbills by hand. This has proven to be a successful technique, but apparent low density of this species in Bermuda precludes large sample size for study, and has hindered evaluation of population trends.

5.1.1.3. Extend monitoring of possible impacts of bycatch and marine debris.
Other than boat strike, the main threats to marine turtles in Bermuda's waters appear to be bycatch in marine fisheries, including both local fishers and those on international vessels operating on the high seas, and fatalities due to encounters with non-degradable marine debris (ingestion of plastics, entanglement in flotsam). These factors warrant further investigation.

Measures of direct exploitation	**Past**	**Present**	**Never**
By life stage			
Females on beaches	0	0	0
Eggs from beach	0	0	0
Turtles in water (intentional)	3[1]	0	0
Turtles in water (incidental)	15		0
By product			
Meat			
Fishers who sell meat	0	0	0
Meat vendors	0	0	0
Meat consumers	20	0	0
Eggs* **			
Collectors who sell eggs	0	0	0
Egg vendors consumers	0	0	0
Egg consumers	2[2]	0	0
Non-edible			
Fishers who sell shells	0	0	0
Shell vendors	0	0	0
Shell consumers	6	1	0
Measures of indirect exploitation			
Turtles indirectly used in business	1		
Total interviews	**71**		

Table 5.4. Numbers of exploiters per category, in the past and present. Notes: (1) A total of 5 fishers identified themselves as former turtle fishers. However, 2 of these fished turtles while resident in other countries, 1 in Australia and 1 in Jamaica. Therefore, they are excluded from this overview. (2) Two respondents identified themselves as former turtle egg collectors. However, 1 collected eggs while resident in the Philippines, and the other while in Australia. Thus, they are excluded from this overview.

Photo 5.14. Green turtle entangled in cargo netting, BAMZ Sea Turtle Stranding and Salvage Network (Photo J. Gray).

5.7. Direct Use of Marine Turtles in Bermuda

5.7.1. Overview

The degree of protective legislation afforded turtles in Bermuda has been progressive. The earliest known legislation protecting marine turtles was passed by the First Bermuda Assembly in 1620 and prohibited the taking of young turtles. The act protected all turtles of less the 18" breadth or diameter in any bay, harbour, sound or at sea to a distance of five leagues around the island. The penalty was15lb of tobacco – half went to government and half to the informer. In 1937 there was a prohibition on taking turtles under 20lb. The Board of Trade (Fisheries) regulations (1947) enforced a restriction on the take of turtles during the month of June in any year. The Fisheries Regulations (1963) enforced a restriction on the take of any turtle of a weight smaller than 40lb. An order made under the Fisheries Act (1972) implemented a moratorium on the take of all turtles for a five year period. This moratorium was never lifted, but replaced with the Fisheries Protected Species order of 1978. To this end sea turtles in Bermuda have enjoyed complete protection from direct take since the act commenced on April 1, 1973.

Data on use of marine turtles in Bermuda were gathered by integrating published information, project partners, and using the TCOT Socioeconomic Questionnaire or SEQ (see Section 2; Appendix 2.1). In Bermuda, 71 questionnaires were completed and a breakdown of the number of interviewees and categories of exploitation gathered is digested in table 5.4, with a full digest of actual data gathered circulated to donors and local partners.

5.7.2. Harvest of nesting adults

Given the nesting population was extinct or a remnant by the 1930s, it is not surprising that no evidence of recent adult female exploitation was unearthed.

5.7.3. Harvest of eggs

Although no egg collection was recorded by any of the TCOT interviewees, 9 respondents reported egg harvesting by their parents and grandparents as continuing until the 1920s. Eggs were collected at various places around the Island.

5.7.4.Harvests of turtles at sea

In 1902 there were 8 boats commercially fishing turtles, but this had reduced to 2 boats by 1937 (Babcock 1938). By 1970, there were only a handful of part-time turtle fishers with a total recorded catch of 26 turtles, all green turtles (Rebel 1974). Legal turtle harvests in Bermuda continued until 1972 and former turtle fishers have been targeted as part of the TCOT SEQ to gain their insights. We interviewed three past turtle fishers, all over 65 years of age, and all retired, because of legislative change (n=2) and/or ill health (n=2). All three fishers preferred green turtles. Nets were used by all fishers, to catch both green and hawksbill turtles. No other methods were reported. The sizes of turtles reported captured are consistent with the small to medium sized juveniles found in Bermuda waters (around 50 lbs each), with low numbers (<30 per fisher) being captured per season. Turtle fishing, as suggested in the literature (Rebel 1974), appears not to have been a very important part of the economic activity in recent decades.

Although no fishers admitted to taking marine turtles in recent times, some interviewed as part of the TCOT SEQ suggested that turtles were still taken illegally, although through incidental rather than intentional capture (see section 5.7.6. below). Of 13 fishers who believed that other fishers catch turtles incidentally, 8 thought that some green turtles were kept. There have been no recent prosecutions for infringements of the laws governing turtle harvest, and members of the Bermuda Turtle Project were sceptical about these findings. They believe that if such illegal take occurs, it undoubtedly involves a very few turtles per year (J. Gray (BAMZ) pers. comm. 2004).

Awareness regarding Bermuda's Reef Preserves and Protected Areas is promoted in an attractive FCO funded leaflet (Appendix 5.1) that shows locations of protected areas and stipulates that line fishing, spear-fishing and lobster diving are prohibited. Contravening these laws carries a fine of up to $5000 and/or imprisonment. Awareness of laws protecting turtles appears to be low. Fifty-three

Photo 5.15. Green turtle strangled by monofilament fishing line (Photo J. Gray).

respondents to the TCOT SEQ stated they were aware of laws regarding turtle fishing, and 23 said they were aware of laws regarding the purchase and sale of turtle products. However, only 6 and 4 individuals could provide examples of laws for fishing and purchase/sale respectively. Lack of awareness of specifics of the laws is likely a reflection of their lack of impact on individuals; as there is little to no demand for marine turtle products (see next paragraph), there is little incentive for people to know the specifics of laws restricting consumption.

Although there were no reports of current turtle product consumption, 20 respondents to the TCOT SEQ reported that they formerly consumed meat products. However, 14 of these had eaten turtle somewhere else, on holiday, infrequently (or only once), and one ate it more regularly while living in Indonesia. Five of the respondents consumed turtle meat in Bermuda, 4 regularly and one on holiday occasions, before it became illegal.

Photo 5.16. Turtle Warning Sign (Photo J. Constable).

Photo 5.17. Green turtle carapace repair following boat strike, BAMZ Wildlife Rehabilitation Centre (Photo J. Gray).

5.7.5. Trade in shells and shell products

None of the fishers in the survey recorded selling whole shells or worked shell and no respondents reported current usage of such items in Bermuda. Three respondents reported using the whole shells, but only one of these while in Bermuda (an 86 year old man who stopped when it became illegal). Five respondents reported using worked shell; again, 3 of these used shell while outside of Bermuda, one used it in Bermuda (and is now opposed to such use), and the final respondent inherited tortoise shell items from her grandmother.

5.7.6. Incidental take

i) Incidental catch in marine fisheries

Ministry of Environment (2000) statistics suggest that in 1999, there were 213 registered commercial fishing vessels and 23 licensed charter-fishing vessels. These numbers appear to be relatively similar in recent years (J. Gray (BAMZ) pers. comm. 2004). The level of turtle by-catch by these fisheries has not been assessed, but is thought to be insignificant (J. Gray (BAMZ) pers. comm. 2004). A necropsy of a stranded loggerhead turtle in 2000 by the Bermuda Aquarium revealed a long-line hook embedded in the animal's oesophagus (J. Gray (BAMZ) pers. comm. 2004**;** Weidner *et al.* 2001). Presently there are only two local long-liners in active use. One fisher reports that they never incidentally caught a sea turtle, as they set at night with well weighted, fast sinking lines (J. Constable (BTP) pers. comm. 2004) It is thought that foreign registered long-liners operate in Bermuda's territorial waters, but as the local government lacks an enforcement vessel, pirate fishing can carry on with impunity.

In the TCOT SEQ, 15 (of 26) fishers recorded incidental take as part of marine fishing activities. The methodologies involved were net fishing for bait fish (n=8), using other nets (n=4), and using rod and hand lines (n=3). Most fishers indicated that these were unusual occurrences, once (n=12), twice (n=2) or three times per year (n=1). Most said turtles were alive when caught and that they were released. Under existing laws, these turtles should be reported to local Fisheries Authorities or the Bermuda Turtle Project, but there are few records of fishers doing this (J. Gray (BAMZ) pers. comm. 2004)**.** The species most often captured were green turtles although loggerheads and hawksbills were also captured.

Year	Total Stranded	Entanglement	Ingestion of plastic	Boat Strike
1999	30	3	2	6
2000	30	1	1	2
2001	33	4	3	7
2002	23	2	3	1
2003	17	3	0	1

Table 5.5. Numbers of stranded turtles for each year 1999-2003 and the number where entaglement, ingestion of plastic and boat strike were thought to be primary cause of mortality. Data are provided courtesy of Jennifer Gray, Bermuda Turtle Project.

ii) Boat Strike

A more prevalent issue in Bermuda has been boat injury and death of turtles due to boat collisions in recent years. As of August 2004, there were 4,243 pleasure boats registered in Bermuda with 6,583 on file. This is an increase of 100 vessels since 2003. There are 5,170 registered moorings, which also represents and increase of 100 since 2003 (J. Gray (BAMZ) pers. comm. 2004). This has led to production of a "Turtle Alert" leaflet (Appendix 5.2) and the provision of sea turtle warning signs at 33 (22 installed 2004) known trouble spots. This is thought to have been beneficial in raising awareness and there may be modest signs that increased awareness is having the desired effect. There are many cases where cause of death cannot be confirmed even though boat collisions are suspected (e.g. boat collision can inflict damage on a floating corpse after the animal has died of other causes), and this must be borne in mind when interpreting the data in table 5.5. The incidence of boat strike is worth bearing in mind when considering the other OTs, where stranding networks do not operate. All of the OTs are highly dependent on tourism, much of it water based. As tourism continues to grow in the region, Bermuda's experience with its education program may inform education activities in other OTs.

iii) Entanglement and ingestion of marine debris

While boat strikes have been a threat and concern for more than a decade in these islands data suggest that entanglement in and ingestion of marine debris is increasing. Most entanglements involve monofilament fishing line left in the environment by local shoreline fishers. Ingestion of debris most often involves the consumption of small bits of weathered and broken plastic pieces and styrene pellets and occasionally involves ingestion of monofilament. The Marine Environmental Committee of the Bermuda National Trust has implemented a monofilament recycling programme and has installed receptacles at popular fishing spots around the island to encourage Bermudians to keep discarded fishing line out of the environment.

Recommendation

5.1.1.4. Extend monitoring of possible impacts of bycatch and marine debris.

Other than boat strike, the main threats to marine turtles in Bermuda's waters appear to be bycatch in marine fisheries, including both local fishers and those on international vessels operating on the high seas, and fatalities due to encounters with non-degradable marine debris (ingestion of plastics, entanglement in flotsam). These factors warrant further investigation.

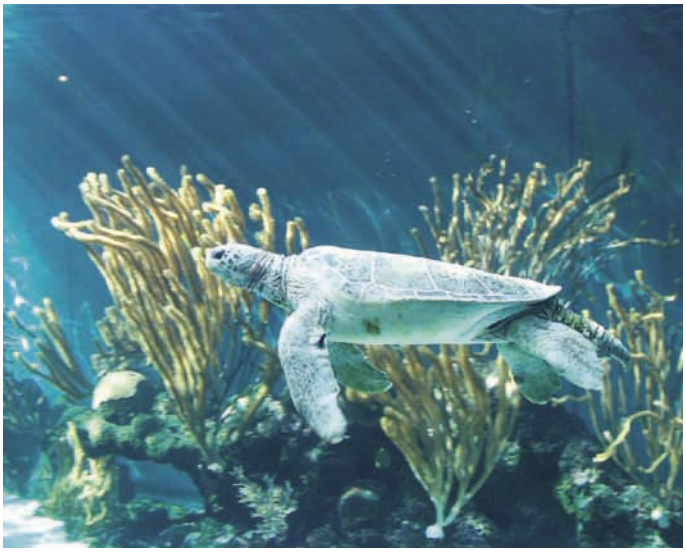


Photo 5.18. Green turtle "Dick" on exhibit in the North Rock Exhibit at the BAMZ (Photo J. Gray).

5.8 Indirect Use

5.8.1. Turtle watching on beaches

Not applicable.

5.8.2. Dive tourism/snorkel tours

The dive tourism sector in Bermuda is significant, with some 6 dive operators and an estimated 15-20 000 dives per year. In informal discussions operators reported seeing them (hawksbills at the western breakers area and very rarely a leatherback) infrequently while diving. However, turtles were sighted regularly from the dive boat going to and from dive sites (M. Burke (Blue Water Divers) pers. comm. 2004). Dive operators approached by TCOT were interested in participating in Caribbean Turtlewatch, however, they pointed out that they rarely saw turtles on their dives. None were surveyed as part of the SEQ.

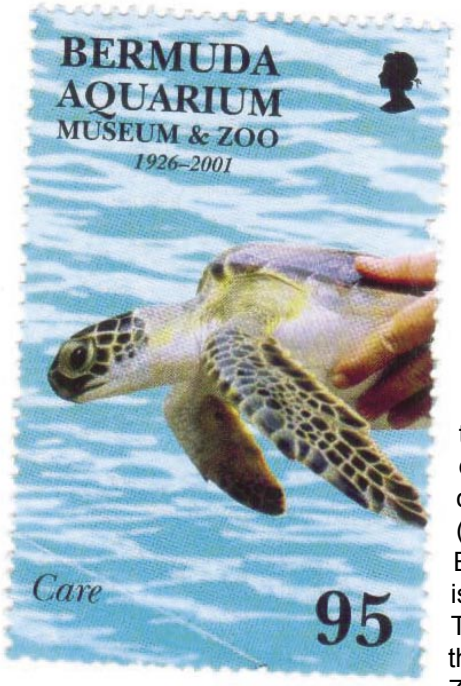
There are approx 25 boat cruise operators in Bermuda, but none of these highlight turtles in their advertising or in logos. Indeed turtles in Bermuda are very wary and it would be difficult if not impossible for a snorkel tour to get close enough to see them with any satisfaction.

Despite the fact that turtles are not advertised in tours, a large number of tour operators take visitors to turtle foraging grounds to enjoy sea turtles. One Helmet Diving operator visits such a site at the end of their dive to spend twenty minutes counting surfacing turtles with clients. The areas known as "Vixen" and "Fort St. Catherine" are visited daily, in season, by numerous tour operators who are specifically sharing the sea turtle experience with clients. One tour operator has a vessel named "*Chelonia*". Thus, while boat operators were not included in the TCOT SEQ sample, it is apparent that the sea turtles of Bermuda are highlighted in such tours. (J. Gray (BAMZ) pers. comm. 2004).

5.8.3. Aquaria Holding Captive Turtles

There are three places in Bermuda where green turtles are held in captivity.

1. BAMZ has eight accessioned green turtles in addition to a variable number of rehabilitating animals. Three of the accessioned turtles came from eggs laid by a Devil's Hole Aquarium female, which were translocated and hatched at BAMZ in 1988. One (MB534) was hatched on Nonsuch Island in 1972 after egg translocation from Costa Rica. Another (BP3577) was donated to BAMZ in 1987 and had been kept in a private pond for thirty years prior. The remaining three turtles are of unknown origin and have been captive at BAMZ in excess of four decades (Gray 1989). BAMZ has a large number of visitors (105,413 in 2001; (J. Gray (BAMZ) pers. comm. 2004).



2. Devil's Hole Aquarium is a smaller aquarium run in conjunction with a real estate firm, which shows 6 turtles. It is one of the oldest tourist attractions in Bermuda situated in a limestone sinkhole drowned by the post-glacial rise in sea level. The water is 35 feet deep and there are extensive underwater recesses and tidal connections to Harrington Sound. Ever since the 1880s it has been stocked with a variety of fish and turtles. In 1970 and again in 1971, there was mating and laying by the green turtles held, but, as there was no beach, the turtles laid in the water where the eggs sank to the bottom. In 1974-1975 an artificial beach was created (Wingate 1975). In 1976 there was a successful laying in Devil's Hole and the eggs were transferred to Nonsuch Island (Wingate 1976, 1977). No hatchlings resulted (Wingate 1977). Another clutch was laid on August 4, 1988, and the eggs were transferred to an artificial beach in the turtle enclosure at BAMZ. The eggs hatched on September 28th (60 days incubation). There were 58 hatchlings; 7 of these hatchlings were retained at the Aquarium. The remaining hatchlings were released at Church Bay, Southampton on September 29, 1988. Of the retained 7 turtles, 4 were returned to Devil's Hole Aquarium and 3 were retained at BAMZ. Presently, 1 hawksbill and 5 green turtles are on view at Devil's Hole. Devil's Hole suffered significant structural damage during Hurricane Fabian in September 2003. It is not known what its annual visitor numbers are, but they are undoubtedly considerably less than BAMZ.

3. Tom Moore's National Park has one large male green turtle and a second not yet identified smaller turtle in an inland saltwater pond known as Walsingham Pond. The origin of these animals is unclear. It was noted in 2003, by an employee of Tom Moore's Tavern, that the animals were transferred from the restaurant's lobster holding crawl to the pond some seventeen years ago when the restaurant was renovated and the crawl removed. After Hurricane Fabian, there were no sightings of the turtles for 4 months and they were feared dead. However the large male was discovered in a cave in January 2004 – it was weighed and had not lost any weight. It has been returned to Walsingham Pond the second smaller turtle was sighted in July 2004 (J. Gray (BAMZ) pers. comm. 2004).

5.8.4. Other marketing/cultural uses

Weidner *et al.* (2001) state that '*there is considerable interest in turtles on Bermuda by the public and the environmental community*'. Perhaps surprisingly, despite the large foraging populations of marine turtles in Bermudan waters and its well-developed tourist industry, there are no companies that use turtles as a logo (See 5.8.2). Turtles have appeared on Bermuda postage stamps, and there is the one tour boat named '*Chelonia*.'. Turtle orientated items are available in the gift shop of Bermuda Aquarium and Zoo, but are no more prevalent than at any other zoo or aquarium. In the TCOT SEQ, nobody recorded using turtles to promote their business in Bermuda. As discussed in section 5.9 below, few TCOT SEQ respondents felt that turtles were culturally or economically valuable in Bermuda.

5.9. Attitudes to Conservation

The TCOT SEQ sought to assess overall attitudes towards conservation of marine turtles, and options for marine turtle management which could be compared to opinions in other OT's. Respondents could agree, disagree, or have no opinion. In some cases, they could choose 'not applicable'. While full details of responses to these questions will be circulated to donors and local partners**,** basic results are summarized here. The most common response is cited. In general, most respondents agreed that:

- It is important that sea turtles exist in the future (94%)
- Turtles should be protected, regardless of their use to humans (85%)
- Turtles play an important ecological role in our natural environment (75%)
- As turtles are migratory, they should be managed in cooperation with neighbouring states (75%)
- The government needs to actively work to protect turtles (70%)
- Existing marine turtle laws are effectively enforced (66%)

Photo 5.19. Jennifer Gray (BTP/BAMZ) gives Bermuda Report at TCOT Workshop (Photo. S.Ranger).

Photo 5.20. Participants of the BTP International Field Course 2003 joined by Minister of the Environment; The Hon. Neletha D. Butterfield JP, MP (back row 5th from left) (Photo BTP).

Caymanian Compass

Established 1965

MONDAY 18th AUGUST 2003

Turtle conservation updated

Boundary report due end of month

Photo 5.21. Publicity for BTP in Cayman

Most people disagreed with the following statements:

- Turtle are economically valuable in this OT (94%)
- Turtles are culturally valuable in this OT (92%)
- The government needs to do more to ensure that existing laws protecting marine turtles are effectively enforced (48% disagreed, 25% agreed, and 27% had no opinion)

Opinions of respondents were almost equally split regarding the following statement:

- Some income from tourism should be used to support marine turtle conservation efforts (41% yes, 39% no)

As turtle fishing and consumption is illegal in Bermuda, most people deemed the following questions irrelevant (dominant agreement or disagree also shown in brackets):

- Turtle fishing should be unregulated (69% NA, and a further 31% disagreed with the statement)
- Turtle fishing should be stopped until more information is known on the size and health of the populations (68% NA, but 5 people agreed with the statement, perhaps indicating their unfamiliarity with existing laws)
- Local people should be allowed to catch and eat sea turtle, provided it doesn't threaten the regional population (68% NA, but 14% agreed with this statement)
- Tourists should be allowed to purchase sea turtle shell and take it home with them (65% NA, and a further 28% disagreed with the statement)
- Turtles should be used as both a tourist attraction and a source of food (65% NA, and a further 23% disagreed with the statement)
- Turtles should be used as a tourist attraction rather than as a source of food (63% NA, and a further 23% agreed with this statement)
- Local people should be allowed to purchase sea turtle meat (62% NA, and 21% disagreed with this statement)

The results indicate broad support for existing turtle conservation laws among respondents. There is satisfaction with existing law enforcement. Reflecting the lack of use of marine turtles in Bermuda (both direct and indirect), turtles were considered neither economically nor culturally valuable, by most respondents.

Cursory analysis of results by stakeholder group indicate that, while there are some areas of disagreement amongst stakeholders, these are few. For example, fishers as a group generally agree with the responses of the surveyed population as a whole. There is only one question for which the majority of fishers feel differently:

- Some income from tourism should be used to support sea turtle conservation (while surveyed population as a whole was split on this, most fishers disagreed with it).

5.10. Capacity Building and Outreach Activities During TCOT

5.10.1. Capacity building

There was little capacity building needed in Bermuda. Involvement of the BTP in the project did facilitate regional networking within the UK OT's as part of the TCOT Workshop in Grand Cayman and the BTP team were involved in the collaborative writing of a successful grant bid to HMG, which may increase chances of future success.

5.10.2. Outreach activities

Levels of awareness regarding the presence and status of turtles in Bermuda were high and there were no TCOT public awareness raising events as part of the 2 short visits to Bermuda by TCOT staff. The receipt of the FCO grant to fund the training of TCOT representatives from other OT's stimulated some press interest in Bermuda and abroad, leading to several media outputs which served to raise the local and international profile of the BTP.

Recommendations

5.1.2.1. Ensure the Department of Conservation Services has the long-term capacity, staff and resources to carry out all enforcement and monitoring duties relevant to marine turtle management, including data collection, entry, management and analysis.

The staff of Conservation Services carrying out the fieldwork of the Bermuda Turtle Project are well skilled in the field and data collection techniques needed for ongoing monitoring and research. However, although this initiative is relatively well resourced in comparison to many OT's, the BTP is reliant on outside donor and specialist scientific support. It is important for a long-term legacy of marine turtle monitoring and research that local ownership and co-management of data sets gathered with outside researchers are further developed to facilitate the enhancement of institutional memory and capability. This will insure against changes in capability of external workers to participate in the future.

5.2.1.2. Continue and Increase the Regional Capacity Building Role of the BTP Training Course.

The importance of this initiative in regional capacity building cannot be underestimated. It has been well utilised to date by TCOT partners (see section 11). Given the wide genetic origins of marine turtles in Bermudan waters, it is possible that positive benefits of Bermuda-based capacity building efforts could be detected in Bermuda in the future. Given the excellent track record of this initiative, additional external funding would be well deserved and is highly likely.

Additionally, we make a major overarching recommendation to the UK Government to support the conservation and management of marine biodiversity in the UK OTs under the Environment Charters.

The Overseas Territories of the UK have long been acknowledged as being rich in biodiversity (Proctor & Fleming 1999). The small islands or island archipelagos of the Caribbean UK Overseas Territories currently do not or are unable to carry out sufficient monitoring, research, management and educational outreach required to ensure the sustainability of their marine and coastal natural resources. TCOT strongly recommends that the UK Government further contributes to marine biodiversity conservation and management in the UK Overseas Territories through provision of funding and expertise under the FCO/DfID Overseas Territories Environment Programme (OTEP), Defra's Darwin Initiative and through the provision of bespoke scholarships for tertiary education in biodiversity/conservation related subjects for citizens of the OTs. Additionally, much of the environmental legislation in the OTs is in need of revision to facilitate the conservation of marine turtles and their habitats, and therefore TCOT strongly recommends that HMG provide the necessary support to the OTs to facilitate the required legislative amendments.

Photo. 5.22. Emblematic of Bermuda's commitment to sea turtle conservation is the involvement of Minister of the Environment, The Hon. Neletha D. Butterfield, JP, MP. (Photo BTP).

Photo 5.23. Community involvement in conservation is encouraged by the Bermuda Turtle Project. Rehabilitated hawksbill turtle "Sophie" with finder Sophie Farrow prior to release of the animal (Photo J. Gray).

5.11. Acknowledgements

The TCOT SEQ could not have been carried out without the commitment and hard work of volunteer, Jennifer Constable who also reviewed drafts of this chapter. The TCOT team would like to gratefully acknowledge the generous collaboration of Jennifer Gray, Anne Meylan, Peter Meylan and Jack Ward in the compilation and review of this chapter. We would like to additionally thank Jennifer Gray for her generosity in sharing her images. Brendan Godley would like to thank the Draycott family for their hospitality during his stay. Additional constructive review was offered by Nick Pilcher (IUCN-MTSG), James Abbott, Liz English Andrew Kesteloot, Zoe Meletis, and Jennifer Silver all assisted with TCOT SEQ under the supervision of Lisa Campbell.

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