Caribbean Environment Programme
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Sea Turtle Recovery Action Plan for Belize

Prepared by:

WIDECAST
Wider Caribbean Sea Turtle Recovery Team and Conservation Network

CEP Technical Report No. 18

1992

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For bibliographic purposes this document may be cited as:

Smith, Gregory W., Karen. L. Eckert, and Janet P. Gibson. 1992. WIDECAST Sea Turtle Recovery Action Plan for Belize (Karen L. Eckert, Editor). CEP Technical Report No. 18 UNEP Caribbean Environment Programme, Kingston, Jamaica. 86 p.

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Sea Turtle Recovery Action Plan for Belize

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PREFACE

Sea turtle stocks are declining throughout most of the Wider Caribbean region; in some areas the trends are dramatic and are likely to be irreversible during our lifetimes. According to the IUCN Conservation Monitoring Centre's *Red Data Book*, persistent over-exploitation, especially of adult females on the nesting beach, and the widespread collection of eggs are largely responsible for the endangered status of five sea turtle species occurring in the region and the threatened status of a sixth. In addition to direct harvest, sea turtles are accidentally captured in active or abandoned fishing gear, resulting in death to tens of thousands annually. Coral reef and sea grass degradation, oil spills, chemical waste, persistent plastic (and other) marine debris, high density coastal development, and an increase in ocean-based tourism have damaged or eliminated nesting beaches and feeding grounds. Population declines are complicated by the fact that causal factors are not always entirely indigenous. Because sea turtles are among the most migratory of all Caribbean fauna, what appears as a decline in a local population may be a direct consequence of the activities of peoples many hundreds of kilometers distant. Thus, while local conservation is crucial, action is also called for at the regional level.

In order to adequately protect migratory sea turtles and achieve the objectives of CEP's Regional Programme for Specially Protected Areas and Wildlife (SPAW), *The Strategy for the Development of the Caribbean Environment Programme (1990-1995)* calls for "the development of specific management plans for economically and ecologically important species", making particular reference to endangered, threatened, or vulnerable species of sea turtle. This is consistent with Article 10 of the Cartagena Convention (1983), which states that Contracting Parties shall "individually or jointly take all appropriate measures to protect ... the habitat of depleted, threatened or endangered species in the Convention area." Article 10 of the 1991 Protocol to the Cartagena Convention concerning Specially Protected Areas and Wildlife (SPAW Protocol) specifies that Parties "carry out recovery, management, planning and other measures to effect the survival of [endangered or threatened] species" and regulate or prohibit activities having "adverse effects on such species or their habitats". Article 11 of the SPAW Protocol declares that each Party "shall ensure total protection and recovery to the species of fauna listed in Annex II". All six species of Caribbean-occurring sea turtles were included in Annex II in 1991.

This CEP Technical Report is the sixth in a series of Sea Turtle Recovery Action Plans prepared by the Wider Caribbean Sea Turtle Recovery Team and Conservation Network (WIDECAST), an organization comprised of a regional team of sea turtle experts, local Country Co-ordinators, and an extensive network of interested citizens. The objective of the recovery action plan series is to assist Caribbean governments in the discharge of their obligations under the SPAW Protocol, and to promote a regional capability to implement scientifically sound sea turtle conservation programs by developing a technical understanding of sea turtle biology and management among local individuals and institutions. Each recovery action plan summarizes the known distribution of sea turtles, discusses major causes of mortality, evaluates the effectiveness of existing conservation laws, and prioritizes implementing measures for stock recovery. WIDECAST was founded in 1981 by Monitor International, 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 is an autonomous NGO, partially supported by the Caribbean Environment Programme.

ACKNOWLEDGEMENTS

This document could not have been written without the assistance of people throughout Belize. The authors would like to extend special appreciation to the staffs of Hol Chan Marine Reserve (especially James Azueta) and Belize Audubon Society for their support and interest in sea turtle conservation. The public awareness efforts and general invovlement of Sharon Matola (Belize Zoo), Lou Nicolait (Belize Centre for Environmental Studies), and Joy Grant (Programme for Belize) deserve special recognition. Jim Beveridge (*Seaing is Belizing*) volunteered his boat the "Lion" and his time to assist the senior author in national surveys of sea turtle nesting grounds in 1989 and again in 1990 -- without Jim's knowledge of Belizean waters, these important surveys could not have been undertaken. During the 1990 expedition, Ray and Liz Bowers kindly provided a tow, food, and shelter in "Reef Roamer II". More than 40 fishermen were interviewed for data and anecdotal knowledge of historical and contemporary sea turtle harvest. The information obtained from these interviewees was invaluable, especially from turtle fishermen Will Eiley, Charles Flowers, George Garbutt, Lester Garbutt, Wellington Garbutt, Nolan Jackson, Ralph Jackson, Florencio Lino, and Wilfred Young.

The ongoing support of the Fisheries Department, especially Vincent Gillett (Fisheries Administrator), Earl Young (Research Biologist) and Alfonso Avilez (Fisheries Technician), the Hon. Florencio Marin (Ministry of Natural Resources), and the media in matters of sea turtle conservation is greatly appreciated. Community-level initiatives on Ambergris Cay (Voluntary Sea Turtle Sanctuary) and Gales Point (Manatee Bar Hawksbill Turtle Conservation Project) have been successful because of the grassroots support of landowners and residents. In particular, Richard Slusher and Kevin Welch of Gales Point have been leaders in efforts (e.g., nest screening) to protect hawksbill turtles at Manatee Bar. Whiteridge Farms owners (especially Frank and Edith Eobois) provided accommodations to the senior author, land access, and use of facilities during Manatee Bar beach surveys. Funding for survey and research activities has been obtained from the U. S. Fish and Wildlife Service and Jo and Wayne Castleberry. Countless miles have been logged on the beaches of Ambergris Cay and Placencia by BAS volunteers and Earthquest in efforts to count nests and protect sea turtles. The authors and WIDECAST regional Recovery Team 1/ dedicate this document to the future, with the hope that sea turtles will remain an integral part of the native wildlife of Belize for many generations to come.

1/ The WIDECAST regional Recovery Team provided impetus for this document and critiqued earlier drafts. These persons are the following: Lic. Ana Cecilia Chaves (Costa Rica), Dr. Karen Eckert (USA), Jacques Fretey (France), John Fuller (Antigua), Molly Gaskin (Trinidad), Dr. Julia Horrocks (Barbados), Maria Teresa Koberg (Costa Rica), Dr. Peter Pritchard (USA), Dr. James Richardson (USA), and Dr. Georgita Ruiz (Mexico). The IUCN/SSC Marine Turtle Specialist Group (Dr. Karen Bjorndal, Chair) also provided useful comments on an earlier draft. Major financial support for WIDECAST has come from Monitor International, The Chelonia Institute, the UNEP Caribbean Environment Programme, and the U. S. National Marine Fisheries Service. Special appreciation is due Milton Kaufmann (President of Monitor International and Founder of WIDECAST) and Robert Truland (Trustee, The Chelonia Institute) for their unwavering personal commitment to WIDECAST since its inception more than a decade ago.

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ABSTRACT

There can be little doubt that sea turtles were once a prominent component of the fishing industry in Belize. Thousands of turtles were exported live from Belize in the late 1800's, in addition to those utilized domestically. In the early 1900's, as the value of tortoiseshell (hawksbill sea turtle shell) increased, the fishery concentrated on hawksbills in the southern cays. The shell industry was a profitable one, supporting at least two large schooners based at Tobacco Cay. There was no concern about the effect of the harvest on the resource. Indeed, in 1925 the Handbook of British Honduras described the number of sea turtles around Belize's cays as "inexhaustible". By the 1960's, however, it was clear that a century of uncontrolled harvest had left local populations greatly depleted.

In 1977, Fisheries Regulations were enacted to protect small juveniles, eggs, and nesting females; the hunting of turtles was prohibited between 1 June-31 August and the export of sea turtles and sea turtle products was banned. The new restrictions were an improvement over the former situation, but were inadequate to promote the recovery of declining stocks. Older fishermen attest to serious declines in the numbers of sea turtles during their lifetimes. Catch per unit effort has dropped and turtles are considerably smaller than they were as recently as a decade ago. Fisheries data indicate that the average weight of turtles landed fell 60% (from 163 to 67 kg) between 1982 and 1986. Not only are turtles fewer and smaller at sea, there are many examples of beaches that once supported nesting populations, but do so no longer. Today fewer than a dozen fishermen formally participate in the turtle fishery, and none relies on the turtles for a primary source of income. The authors estimate that 500-800 turtles, mostly adults, are legally sold in the markets each year. The clandestine catch is unquantified.

Five species of sea turtle are reported from the waters of Belize, but only three -- hawksbill (Eretmochelys imbricata), green (Chelonia mydas), and loggerhead (Caretta caretta) -- are routinely encountered. Leatherbacks (Dermochelys coriacea) and Kemp's ridleys (Lepidochelys kempi) are very rare. Nesting is reported on more than 30 cays, as well as at some mainland sites, but only three nesting concentrations are known. Each year, 40-70 loggerhead nests are laid on Ambergris Cay, 30-40 hawksbill nests are laid on the southernmost cays along the barrier reef, and 100-150 hawksbill nests are laid at Manatee Bar beach on the mainland. There are no known concentrations of green turtles; probably fewer than 20 nest each year. Foraging habitat is extensive along the 220 km barrier reef and around the numerous offshore cays.

The primary threats to sea turtles in Belize are the continued harvest of adults and large juveniles, the incidental catch of turtles in trawls and other fishing gear, nesting beach development, and the degradation of foraging grounds by anchoring, dredging, waste disposal, and pollution. A lack of enforcement capacity hinders efforts to conserve remaining populations. Large numbers of turtles are captured illegally (below minimum size and/or during the closed season). The collection of eggs (illegal at all times) has been estimated to be as high as 10,000 per year. The illegal export of hawksbill shell is believed to occur clandestinely at low levels and tortoiseshell jewelry is widely available to residents and tourists. Incidental capture and drowning in shrimp trawls, gill nets, and longlines is also a problem, with hundreds of turtles potentially captured in this manner every year.

In 1990, several conservation groups in Belize petitioned the Government to revise and strengthen sea turtle conservation legislation. A supporting letter was sent by WIDECAST in April 1991. In November 1991, the Minister of Agriculture and Fisheries announced his intention to comply with the appeal. As a result, the Fisheries (Amendment) Regulations of 1993 prohibit the collection and possession of sea turtle eggs, the take of sea turtles on land, the setting of turtle nets within 100 yards of shore, and the capture of green and loggerhead turtles larger than 60 cm (24 in) in shell length. Hawksbill turtles are fully protected at all times and the closed season has been extended to encompass the main mating and nesting periods (1 April to 31 October). The maximum size limits represent a compromise position and we hope that a moratorium on the harvest of all sea turtles will soon be declared. In the interim, protection of breeding-age adults is important to the long-term survival of Belize's turtles; very few turtles survive the decades required to attain sexual maturity and it is essential that they be allowed to reproduce.

In addition to halting the harvest of endangered sea turtles, other measures are recommended by this Recovery Action Plan. These include surveying potential nesting and foraging grounds, identifying important sites, and adequately protecting these sites from negative influences. In particular, a Marine Reserve in the Sapodilla Cays, a national system of moorings, and comprehensive coastal zone management legislation are seen as priorities. Voluntary Sanctuaries to protect important nesting beaches adjoining private lands on Ambergris Cay and at Manatee Bar are proposed as alternatives to public reserves. Sanctuary land owners agree to community guidelines, such as lighting that does not distract sea turtles, construction set-backs, protection of beach vegetation, a ban on beach sand mining, etc. In all protected areas, community involvement and strict enforcement of the rules will be required.

Finally, because sea turtles are highly migratory, international cooperation in addition to local and national efforts are needed. Based on the capture of tagged turtles, it is clear that Belize shares its sea turtle resource with adjacent Mexico and Guatemala, as well as with nations as distant as Venezuela, the United States, and the Bahamas. Mexico has recently implemented legislation that completely bans the capture and sale of sea turtles or their products. Belize is undermining the efforts of Mexico by continuing to harvest sea turtles shared between the two countries. In addition to further strengthening national sea turtle conservation legislation, it is a recommendation of this Recovery Action Plan that Belize join its neighbours in ratifying the UNEP Convention on the Protection and Development of the Marine Environment of the Wider Caribbean Region (Cartagena Convention) and its Protocol concerning Specially Protected Areas and Wildlife.

The status of sea turtle stocks in Belize has been thoroughly reviewed in this document, and many implementing measures designed to promote their recovery have been introduced. Beyond serving as a national blueprint for conservation action on the part of government and non-government agencies and groups in Belize, national and international donors will find the Plan (which details a national Sea Turtle Conservation Programme and a 3-year budget) useful in guiding and prioritizing financial support for sea turtle protection efforts in Belize.

RESUMEN

No cabe duda de que las tortugas marinas desempeñaban en el pasado un papel importante en la industria pesquera de Belice. Miles de tortugas vivas se exportaron de Belice a fines del siglo diecinueve, además de las utilizadas a nivel nacional. A principios del siglo veinte, con el incremento en el valor de los careyes (el caparazón de la Tortuga Carey), la industria comenzó a concentrarse en la Tortuga Carey que se encontraba en los cayos del sur. La industria de los caparazones era muy rentable y podía mantener, por lo menos, dos goletas con base en el Cayo de Tobacco. Pero nadie se preocupaba del efecto de estas capturas sobre los recursos. En efecto, en 1925, la Guía de las Honduras Británicas indicaba que el número de tortugas marinas en los cayos de Belice era "inagotable". No obstante, llegados los años sesenta, estaba claro que cien años de capturas incontroladas habían dejado bastante agotada la población local.

En 1977 se promulgaron las Regulaciones Pesqueras para proteger a los ejemplares jóvenes de pequeño tamaño, huevos y hembras ponedoras; se prohibió la captura de tortugas entre el primero de junio y el 31 de agosto así como la exportación de tortugas marinas y sus productos. Las nuevas restricciones mejoraron la situación anterior pero no fueron suficiente para recuperar las menguantes reservas de tortugas. Los pescadores de mayor edad confirman que, durante sus vidas, han presenciado una reducción importante en el número de tortugas marinas. La cantidad por captura ha disminuido y las tortugas son mucho más pequeñas que hace tan solo diez años. Cifras del Ministerio de Pesca indican que el peso medio de las tortugas capturadas cayó en un 60% (de 163 kg a 67 kg) entre 1982 y 1986. No sólo las tortugas marinas son menos numerosas y de menor tamaño, sino que muchas playas que solían tener poblaciones ponedoras ahora ya no las tienen. Hoy en día menos de doce pescadores participan formalmente en la industria de la pesca de tortugas y ninguno de ellos depende de las tortugas como fuente principal de ingresos. Los autores calculan que entre 500 y 800 tortugas, adultas en su mayor parte, se venden legalmente en los mercados cada año. No se puede cuantificar la captura ilegal.

Se sabe que en las aguas de Belice hay cinco especies de tortugas, pero sólo abundan tres: la Tortuga Carey (Eretmochelys imbricata), la Tortuga Verde (Chelonia mydas), y la Caguama (Caretta caretta). La Tortuga Tora (Dermochelys coriacea) y la Tortuga Lora (Lepidochelys kempi) escasean mucho. Se ha comprobado que las tortugas anidan en más de 30 isletas, así como en algunos puntos en tierra firme, pero se conocen sólo tres concentraciones de anidamientos. Cada año se hacen entre 40 y 70 nidos de Caguama en el Cayo de Ambergris, entre 30 y 40 de las Tortugas Carey en los cayos más meridionales, a lo largo de labarrera de arrecifes, y de 100 y 150 de las Tortugas Carey en tierra firme en la playa de Manatee Bar. No se conocen concentraciones de Tortugas Verdes, y probablemente se hagan menos de 20 nidos al año. A lo largo de la barrera de arrecifes de 220 kilómetros de longitud se extienden hábitats de forraje y alrededor de los numerosos cayos que se hallan a escasa distancia de la costa.

Las principales amenazas a las tortugas marinas de Belice son la captura incesante de adultos y de ejemplares jóvenes de gran tamaño, la captura fortuita de tortugas en las redes de arrastre y otros artes de pesca, la urbanización de las playas ponedoras y la degradación de las tierras de forraje causada por las anclas, las obras de dragado, el vertido de desechos y la contaminación. La falta de recursos para aplicar las leyes está menoscabando los esfuerzos para

conservar las poblaciones sobrevivientes. Muchas tortugas se capturan de maneras ilegales (por ser más pequeñas que el tamaño mínimo y/o durante la veda). Se estima que la captura de huevos, que está siempre prohibida, puede alcanzar cifras tan elevadas como los 10.000 anuales. Se cree que la exportación ilegal de los caparazones de Tortugas Carey se lleva a cabo de modo clandestino y a pequeña escala y las joyas hechas con estos caparazones se encuentran fácilmente en el mercado, tanto para residentes como para turistas. Otros problemas incluyen la captura fortuita de las tortugas y su muerte en las redes barrederas para camarones, o en redes de enmalle, y el uso de palangres. Centenares de tortugas se capturan potencialmente de esta forma cada año.

En 1990, varios grupos conservasionistas en Belice pidieron al Gobierno que revisara y fortaleciera la legislación para la conservación de las tortugas marinas. Una carta de apoyo fue enviada por WIDECAST en abril de 1991. En noviembre de 1991, el Ministerio de Agricultura y Pesca anunció su intención de complir con esta solicitud. Como resultado, los Reglamentos de Pesca (Enmienda) de 1993 prohiben la recolección y posesión de huevos de tortugas marinas, la captura de tortugas marinas en tierra, la colocación de grandes redes para tortugas dentro de 90 mt (100 yardas) de la costa, y la captura de las Tortugas Verdes y Tortugas de Mar de más de 60 cm (24 pulgadas) de longitud del caparacho. Las Tortugas Carey están protegidas totalmente todo el tiempo y la época de veda ha sido ampliada para incluir la mayor parte del período de apareamiento y anidamiento (1o de abril al 31 de octubre). Los limites de tamaño máximo representan una posición de compromiso y confiamos que una moratoria sobre la captura de todas las tortugas marinas sea declarada muy pronto. Entre tanto, la proteccion de los adultos en edad de reproducción es importante para la supervivencia a largo plazo de las tortugas de Belice; muy pocas tortugas sobreviven las decadas necesarias para alcanzar su madurez sexual y es esencial que se les permita reproducirse.

Además de terminar con la captura de las tortugas marinas amenazadas, se recomiendan otras medidas en este Plan de Acción de Recuperación. Estas incluyen la observación de tierras potenciales para el anidamiento y el forraje, la identificación de lugares importantes y su protección adecuada de cualquier influencia negativa. En particular, se ha dado prioridad a una Reserva Marina en los Cayos de Sapodilla, a un sistema nacional de amarres, y a la promulgación de leyes globales sobre la gestión de áreas costeras. Como alternativa a las reservas públicas, se proponen Santuarios Libres para proteger las playas de anidamiento importantes adyacentes a terrenos privados en el Cayo de Ambergris y en la playa de Manatee Bar. Los propietarios de los santuarios están de acuerdo con las directivas comunitarias sobre, por ejemplo, luces costeras que no desorienten a las tortugas marinas, retrasos en la construcción, protección de la vegetación de playa, prohibición de la extracción de arena de playa, etc. En todas las áreas protegidas, la participación comunitaria y la aplicación rigurosa de las reglas serán necesarias.

Para concluir, como las tortugas marinas migran mucho, además de los esfuerzos comunitarios y nacionales, hay que añadir la necesidad de la cooperación internacional. A juzgar por las capturas de tortugas marcadas, está claro que Belice comparte los recursos de tortugas con los países vecinos de México y Guatemala, así como con países lejanos como Venezuela, los Estados Unidos y las Bahamas. México acaba de poner en vigor una ley que prohíbe toda captura y venta de tortugas marinas y sus productos. Al continuar capturando las tortugas marinas que pertenecen a los dos países, Belice está socavando los esfuerzos de México.

Además de continuar fortaleciendo la legislación nacional para la conservación de la tortuga marina, es una recomendación de este Plan de Acción que Belice siga el ejemplo de sus vecinos y ratifique el convenio del PNUMA sobre la Protección y el Desarrollo del Medio Ambiente Marino de la Región del Gran Caribe (Convenio de Cartagena) y su Protocolo sobre de Areas y Flora y Fauna Silvestres Especialmente Protegidas (SPAW).

Este documento ha revisado a fondo el estatus de las reservas de tortugas marinas en Belice y ha introducido varias medidas de acción dirigidas a promover su recuperación. Más allá de servir de anteproyecto de la acción conservadora de agencias y grupos gubermentales y no gubermentales de Belice, el Plan (que detalla un Programa Nacional para la Conservación de las Tortugas Marinas y un presupuesto de 3 años) será útil para donantes nacionales e internacionales porque guiará y dará prioridad al apoyo financiero para los esfuerzos de protección de las tortugas marinas en Belice.

RESUME

Il n'y a aucun doute que, dans le passé, les tortues de mer ont figuré de manière importante dans l'industrie de la pêche au Bélize. Des milliers de tortues étaient exportées, vivantes, du pays à la fin du 19ème siècle, en plus de celles qui ont alimenté le marché local. Au début du siècle actuel, avec l'augmentation du prix de la carapace des tortues, (plus précisément, celle de la tortue à écaille) l'exportation s'est concentrée sur la tortue à écaille des bancs de sable du sud. Cette industrie étant assez importante, au moins deux schooners basés au banc de sable de Tobacco menaient en permanence cette activité. Aucune attention n'a été prêtée à l'effet de cette exploitation sur les populations de tortues. En effet, en 1925, le Manuel de la pêche en Honduras britannique a décrit le nombre de tortues de mer sur les bancs du Honduras britannique comme étant "inépuisable". Au début des années soixante, il était évident qu'une décennie de récolte incontrôlée avait réduit énormément les populations de tortues.

En 1977, des règlements relatifs à la pêche ont été mis en place pour protéger les jeunes, les oeufs et les femelles en reproduction. La prise de tortues était interdite du 1er juin au 31 août chaque année ainsi que l'exportation des tortues de mer et leurs sous-produits. Bien que la nouvelle législation ait amélioré la situation, elle était insuffisante pour freiner la réduction des populations de tortues. Les pêcheurs plus âgés témoignent de la baisse importante du nombre de tortues de mer au cours des années. Les prises à chaque sortie sont en baisse et les tortues sont plus petites que celles qui étaient capturées il y a une décennie. Les informations relatives à la pêche indiquent que le poids moyen des tortues capturées a baissé de 60% (de 163 kg à 67 kg) entre 1982 et 1986. Les tortues ne sont pas seulement plus petites et moins nombreuses, mais beaucoup de plages n'accueillaient plus les tortues en reproduction. Aujourd'hui, moins de douze pêcheurs exercent l'activité de la pêche de tortues et aucun d'entre eux ne vit de la prise des tortues. Il est estimé qu'entre 500 et 800 tortues, dont la plupart sont des adultes, sont vendues de manière légale dans les marchés chaque année. La prise clandestine ne peut être quantifiée.

Les eaux du Bélize accueillent cinq espèces de tortues de mer, mais seulement trois d'en-tre elles s'y trouvent régulièrement. Il s'agit de la tortue à écaille (Eretmochelys imbricata), la tortue verte (Chelonia mydas) et la tortue cahouanne (Caretta caretta). La tortue luth (Dermochelys coriacea) et la tortue de Kemp (Lepidochelys kempi) sont très rares. La reproduction se déroule sur plus de 30 bancs de sable et dans des sites terrestres mais seules trois concentrations de nids sont connues. Chaque année, entre 40 et 70 nids sont faits par les tortues cahouanne sur le Banc de sable d'Ambergris Cay, 30-40 nids de tortues à écailles sont faits sur les quais à l'extrême sud au long de barrières coralliennes, et 100-150 nids de tortues à écailles sont faits sur la plage de Manatee Bar sur le continent. Aucune concentration de tortues vertes n'est connue car moins de vingt font leurs nids chaque année. Il y a de nombreux habitats d'alimentation tout au long du récif corallien de 220 km et autour des nombreux sables de banc au large.

Les principales menaces aux tortues de mer au Bélize sont la capture continue des adultes et des grands jeunes, la prise accidentelle des tortues dans des filets et autres équipements de pêche, la mise en valeur des plages où pondent les tortues et la dégradation des sites d'alimentation par le mouillage, le dragage, l'évacuation des déchets et la pollution. Un manque

de capacité pour garantir l'application des règlements freinent les efforts pour préserver les populationsrestantes. Un grand nombre de tortues est capturé de manière illégale (au-dessous de la taille minimale et/ou pendant la saison fermée). La collecte illégale d'oeufs (qui est formellement interdite) a été estimée à 10 000 oeufs/an. L'exportation illégale de la carapace de la tortue à écaille se déroule clandestinement à un niveau réduit et les bijoux faits de la carapace des tortues sont disponibles pour les résidents ainsi que pour les touristes. La capture accidentelle et la noyade des tortues à l'aide de chaluts crevettiers, filets maillants et palancres posent un problème particulier car des centaines des tortues sont capturées potentielment de cette manière chaque année.

En 1990, plusieurs groupes de protection en Belize ont prié le Gouvernement de réviser et de renforcer la législation relative à la protection des tortues de mer. Une lettre d'appui a été envoyée par WIDECAST en avril 1991. En novembre 1991, le Ministre de l'agriculture et de la pêche a annoncé son intention d'observer les réclamations. Comme résultat, la législation de 1993 sur la pêche (corrigée) interdit la collecte et la possession des oeufs de tortues de mer, la capture de tortues de mer sur terre, l'instauration des nids de tortues à près de 100 yards du rivage, et la capture des tortues vertes et des tortues cahouannes plus grandes que 60 cm (24 pouces) de longueur. Les tortues à écailles sont protégées jusqu'au bout et la saison fermée a été prolongée pour couvrir la période principale d'accouplement et de ponte (du 1er avril au 31 octobre). La limite de grosseur maximale représente une position de compromis et nous souhaitons qu'un moratorium de la récolte de toutes tortues de mer sera bientôt déclaré. Dans l'attente, il est important de protéger les adultes en âge de se reproduire pour la survie à long terme des tortues du Belize; très peu de tortues survivent le nombre de décennies nécessaires pour atteindre la maturité sexuelle et il est primordial de les permettre de se reproduire.

En plus de l'interdiction du ramassage des tortues de mer menacées, d'autres mesures sont recommandées par ce Plan d'action de sauvetage. Il s'agit de la surveillance des terrains de ponte et d'alimentation éventuels, de l'identification des sites importants et la protection adé-quate de ces derniers de toute influence négative. A cet égard, la Réserve marine du banc de Sapodilla, un système national de mouillage et une législation détaillée relative à la gestion de la zone côtière seront considérés comme des mesures prioritaires. La création de sanctuaires vol-ontaires pour la protection des plages de reproduction importantes connexes aux terrains privés de Banc de sable d'Ambergis et dans la Baie du Lamentin sont proposés comme des alternatives aux réserves publiques. Les propriétaires de ces terrains accepteraient les directives proposées, telles que l'éclairage qui ne perturberait pas les tortues de mer, l'arrêt de la construction, la protection de la végétation des plages, l'interdiction de l'exploitation du sable des plages, etc. Dans les zones protégées la participation de la communauté locale et l'application stricte de la règlementation seront nécessaires.

Enfin, étant donné que les tortues de mer sont de grands migrateurs, la coopération internationale ainsi que des efforts nationaux et locaux seront nécessaires. Il est évident, vu que les tortues portant des étiquettes sont également capturées, que Bélize partage ses populations de tortues avec des pays voisins tels que le Mexique et le Guatemala ainsi qu'avec des pays aussi distants que le Venezuela, les Etats-Unis et les Bahamas. Le Mexique a récemment mis en application une législation qui interdit formellement la capture et la vente des tortues de mer et de leurs produits. Bélize porte préjudice aux efforts du Mexique en continuant de capturer les

tortues de mer qui sont partagés par les deux pays. De plus, pour reforcer la législation relative à la protection nationale des tortues de mer, le Plan d'action pour la sauvegarde des tortues de mer recommande qu'il se joigne à ses voisins en ratifiant la Convention du PNUE sur la protection et la mise en valeur du milieu marin de la région des Caraïbes (Convention de Carthagène) et de son Protocole relatif aux zones et à la vie sauvage spécialement protégées (SPAW).

La situation des populations de tortues de mer au Bélize a été passée en revue en détail dans le présent document et beaucoup de mesures d'application visant à promouvoir leur sauvegarde ont été introduites. Au-delà de sa fonction de directive nationale pour des actions de conservation entreprises par les agences et groupes gouvernementaux et non-gouvernmentaux au Bélize, les donateurs nationaux et internationaux trouveront dans le Plan (qui donnent les détails sur le Programme pour la conservation des tortues de mer ainsi que sur un budget de 3 ans) des informations utiles leur permettant d'établir un ordre de priorité pour le financement des efforts de sauvegarde des tortues de mer au Bélize.

I. INTRODUCTION

Situated south of the Yucatan peninsula, Belize (Figure 1) has 22,963 km^2 of land area (including 689 km^2 on 450 offshore cays), 280 km of coastline, 23,657 km^2 of territorial sea extending 20 km into the Caribbean Sea, and a spectacular barrier reef that is second in length only to Australia's Great Barrier Reef. The barrier reef extends 220 km from the Mexican border to the Sapodilla Cays. Along Ambergris Cay the barrier reef is only a few hundred metres offshore, whereas it is more than 40 km offshore at Placencia (Figures 2a,b). Seaward of the barrier reef, the continental margin is a series of discontinuous marine ridges with NNE-SSW orientation. On two of these ridges coral atolls have developed, separated by waters 360-1100 m deep. A third atoll (Turneffe Islands) is situated between Lighthouse Reef and the barrier reef. Seaward of the marine ridge supporting Glover's and Lighthouse Reefs is an escarpment descending more than 4,000 m into the Cayman Trough (Hartshorn et al., 1984). Though physically located in Central America, Belize has strong cultural and economic ties with the Caribbean, especially the former British colonies comprising the Caribbean Community. Belize gained its independence from Great Britain in 1981.

There can be little doubt that sea turtles were once a prominent component of the fishing industry in Belize. Turtle hunting "constituted the most important form of Colonial fishing" in Belize for 250 years (ca. 1650-1900) and buccaneers catching turtles and manatees were most likely the first Europeans to settle in Belize (Craig, 1966). Both green turtles and hawksbills were actively hunted during this period. Henderson (1809, *in* Craig, 1966) reported that sea turtles were mostly eaten locally and were "preferred by the settlers". In the latter part of the 19th century, large numbers of green turtles, usually weighing less than 60 lb (27 kg) each, were transported alive to England. During the late 1860's, some 2,000 to 6,000 live turtles were exported from Belize annually. By the 1890's, these exports had dwindled to 50-150 turtles annually. Records indicate that the local demand was great enough to require the import of 2,307 turtles in 1887 (Handbook of British Honduras, 1888). Demand remained high throughout the twentieth century. During the 1980's, an estimated 1,000 turtles were legally landed and sold each year (section 3.3). The illegal catch was (and remains) unquantified. In 1925, the Handbook of British Honduras described the number of sea turtles around Belize's cays as "inexhaustible". Today sea turtles are endangered in the Caribbean Sea (Groombridge, 1982) and local fishermen reminisce about the days when turtles were much more abundant, both on the nesting beaches and at sea, than they are now.

As the value of turtle shell, and hawksbill shell in particular, increased, hunters turned to using nets instead of harpoons to avoid damaging the valuable scutes (=shell plates). According to Craig (1966), "substantial fortunes were made in British Honduras [now Belize] when the market for turtle shell was expanding". The industry was well organized. Investors advanced money to boat owners for repairs and the purchase of equipment in return for an exclusive option to buy their catch at a favourable price. Based on interviews with elderly fishermen, Smith (1989) was able to gather specific information about the sea turtle industry in the early 1900's. The fishery concentrated on hawksbills and at that time was centered in the southern cays. Fishermen placed their nets at sites (called "set spots" or "sets") well known to catch turtles, usually sleeping or resting areas. Only the shells were sold, usually at Brodies, and they brought a high price (B$ 10-40/lb). It was a large industry, supporting at least two 60-70 ft schooners

based at Tobacco Cay. The schooners took local fishermen with 16 ft (5 m) cat boats on board and fished for hawksbills in Belizean waters and beyond, apparently traveling as far south as Nicaragua.

By the 1960's, sea turtle populations appeared greatly depleted and few fishermen continued to focus their efforts on catching turtles. Those who participated in the fishery typically netted greens, hawksbills, and loggerheads during the mating season (March-April) and often with the use of wooden decoys to attract and ensnare males. Rebel (1974) reported that the meat from a large loggerhead was worth about $25.00 [N.B. we assume US$]. All three species could also be captured during the nesting season by placing entangling nets just offshore the nesting beaches (Craig, 1966). At the time of Rebel's (1974) writing, "approximately 75% of ... turtles [were] caught in nets, about 25% [were] harpooned, and a few [were] turned on the beaches." We estimate that 500-800 turtles (mostly adults) were sold legally in local markets in 1990, of which some 60% were greens, 30% were loggerheads, and 10% were hawksbills. Informed opinion is that the illegal catch (mostly small juveniles speared by divers) may be nearly equivalent to the reported catch. International trade, especially in hawksbill shell, was significant until recently; sources indicate it continues at low volume clandestinely. The Fisheries Regulations of 1977 were enacted to protect small juveniles at sea, eggs, and nesting females on the beach; a short closed season was declared (1 June-31 August) and the export of sea turtles and their products was banned. Revised legislation was adopted in 1993 (see section 4.21).

Miller (1984) estimated there were 20-30 "full-time turtle fishermen"; Gillett (1987) estimated 15-20. Today at most 10 fishermen routinely set nets for turtles. In addition, those who hunt lobster, conch or finfish will take a turtle if they come across one, turtles are sometimes chased with skiffs and then hooked once they tire, and mating turtles are grabbed or harpooned opportunistically. With more than 3,000 licensed fishermen in Belize and lobster season lasting eight months, it is very possible that large numbers of hawksbills are taken incidental to the lobster fishery (Smith, 1989). Fishermen often camp on small coral cays during their two or three days at sea and in light of local habits concerning the use of turtles, it would be surprising if they did not consume turtles and/or their eggs whenever adult females emerge onto these cays to nest. Almost nothing is known regarding the extent of the illegal subsistence take of turtles at sea or on the nesting beaches. Divers are definitely catching young turtles, particularly hawksbills and greens, which rest under ledges and coral heads. Also, some are taken in fish traps. Finally, it has been estimated that 10,000 eggs are taken each year, despite the fact that such collection is prohibited by law (Miller, 1984).

Older fishermen interviewed by Smith (1989) attested to "definite changes in the numbers of sea turtles." Some who had been lighthouse keepers or had grown up on Half Moon Cay remembered 8-10 nests per week, or hundreds per season, or so many green turtles that they were digging up previously laid eggs and even nesting during the day. Northern Two Cays (Sandbore and Northern Cay) are also reported to have had hundreds of green turtles nesting in decades past; 15 were seen on the beach one night 15-20 years ago. Today nesting is rare, with fewer than 10 nests reported per year. Similarly, the Sapodilla Cays, especially Hunting, Nicolas and Lime Cays, once had large numbers of hawksbills nesting, so many that they, too, unavoidably excavated existing nests during egg-laying. One source estimated at least 100 hawksbill nests in the Pompion-Ranguana-Sapodilla Cays area; another indicated maybe 60 nests

on Nicolas Cay alone (Smith, 1989). Today the Sapodilla Cays are still relatively important nesting areas, but numbers are well below described historical levels. In 1990, fewer than 20 nests had been laid on the Sapodilla Cays by mid-September. Younger fishermen interviewed were less certain of a decrease in the numbers of sea turtles, though they usually thought there had been some decline. In general, local fishermen believe that the take of young turtles by divers is responsible for the observed decline in turtle numbers.

Gillett (1987) recommended a four point plan to the Second Western Atlantic Turtle Symposium "if we wish to conserve our marine turtles." First, a public education programme to inform residents and visitors about the laws protecting sea turtles, and the necessity of conserving depleted marine resources. Second, resources and facilities are needed to enable the government to enforce existing sea turtle protection laws. Third, "comprehensive research activities" are needed so as to devise a management programme, including the best way to utilize the resource and prevent its over-exploitation. Finally, the government must economically improve the local fishing industry. The wisdom of this agenda endures to the present day and is supported by this Sea Turtle Recovery Action Plan. The objectives of this Plan are to (1) compile existing data on the status and distribution of sea turtles in Belize, (2) assess the role of sea turtles in the culture and economy, (3) discuss contemporary factors threatening sea turtles and their habitats, (4) provide resource and habitat management recommendations, as well as solutions to existing threats, and (5) review existing national and international laws protecting sea turtles, suggesting improvements where desirable.

Based on background information provided in this document and the many recommendations contained herein, a national sea turtle programme and budget has been outlined in section 4.6. The programme recognises and supports the many sea turtle conservation efforts already underway in Belize (e.g., field surveys, public education, designation of protected areas, constraints on coastal construction) and prioritizes future activities. What is most needed is (1) an unconditional ban on the harvest of sea turtles and their eggs and (2) the long-term protection of nesting beaches and foraging areas. We hope the Fisheries (Amendment) Regulations of 1993, which protect hawksbill turtles and eggs (all species) year-around and impose a seven-month annual closed season on green and loggerhead turtles, will soon lead to a national moratorium on sea turtle harvest. Studies designed to assess habitat usage, determine stock origins, and evaluate the extent to which stocks are shared internationally are also needed. Field surveys to identify critical habitat should be undertaken so that informed decisions regarding protected areas can be made. In addition to serving as a national blueprint for conservation action on the part of government and non-government agencies and groups in Belize, it is hoped that national and international donors will find the programme outline and recommendations useful in guiding and prioritizing financial support for sea turtle conservation programmes in Belize.

II. STATUS AND DISTRIBUTION OF SEA TURTLES IN BELIZE

In the Caribbean Sea, five species of sea turtle are recognized as *Endangered* and a sixth, the loggerhead turtle, as *Vulnerable* by the World Conservation Union (IUCN) (Groombridge, 1982). Sea turtles are harvested throughout the region for meat, shell, oil, and skins. They are accidentally captured in active or abandoned fishing gear, resulting in the death of tens of thousands of turtles each year. Oil spills, chemical waste and persistent plastic debris, as well as

the ongoing degradation of important nesting beaches and feeding grounds, also threaten the continued existence of Caribbean populations. Three species of sea turtle are routinely encountered in Belize between the coast and the barrier reef: the hawksbill (Eretmochelys imbricata), green turtle (Chelonia mydas), and loggerhead (Caretta caretta). In addition, older fishermen recall having seen one or two extremely large, black, "ugly" turtles in their youth. Their descriptions clearly refer to an occasional leatherback turtle (Dermochelys coriacea) venturing inside the barrier reef. There are undocumented reports of Kemp's ridleys.

Three nesting concentrations of loggerheads and hawksbills are known. Each year, 40-70 nests are laid by loggerheads on Ambergris Cay, 30-40 hawksbill nests are laid on the southernmost cays along the barrier reef, and more than 100 hawksbill nests are laid in the Manatee Bar area on the mainland (see Figures 2a and 2b for locations). There are no known concentrations of green turtle nests; historical rookeries have been decimated. Fewer than five green turtles nest on Ambergris Cay each year, and perhaps fewer than 20 per year in the rest of the nation. Extensive foraging habitat is available, including coral reefs and sea grass meadows. Given the extent and near pristine condition of many of the reefs even today, Belize has the potential for harbouring a large hawksbill population.

2.1 Caretta caretta, Loggerhead Sea Turtle

Residents refer to the loggerhead as "logga" or "cahuama" and recognise it by the large head and thick, somewhat tapered carapace (=shell) often encrusted by barnacles. Nesting females in Florida USA average 92 cm in shell length (straight-line, nuchal notch to posterior tip) (range 81-110 cm; n=194) and 116 kg (255 lb) (range 71.7-180.7 kg; n=261) (Ehrhart and Yoder, 1978). There are typically five pair of lateral scutes (=shell plates) (Figure 3). The large head and strong jaws are necessary adaptations to a diet of mollusks and hard-shelled crabs; sponges, tunicates, fishes, and plants are also eaten (Dodd, 1988). In Belize, Craig (1966) examined stomach contents from nine loggerheads and found they had been "feeding exclusively on spiny lobster and soldier crabs". Carr et al. (1982) concluded that juvenile loggerheads were more numerous in the south than along the northern coast, and that the "most abundant mature turtles in residence are loggerheads." The latter conclusion is indirectly supported by 1980-1982 data showing that loggerheads were landed more often than were green turtles or hawksbills (Miller, 1984). Smith (1989) stated that "medium to large" loggerheads occur in Belizean waters year around, but larger numbers seem to migrate in during the mating and nesting season. Loggerheads previously tagged in Florida and the Bahamas have been captured in Belize. Nesting populations may be shared with adjoining stocks in the Yucatan Peninsula.

Loggerheads are seen mating March through May along the outer reef (Smith, 1989) and subsequently nest at Ambergris Cay (Table 1), Glover's Reef, Lighthouse Reef, and at scattered locations throughout the offshore cays from May through August (Table 2). Nesting on Ambergris Cay (the most studied nesting site) is nocturnal and typically occurs on the dry beach platform, rarely in the tidal zone and rarely in the vegetation. In low-lying areas, females may crawl up into supralittoral grassy vegetation, apparently in an effort to locate suitably dry substrate. Nests laid in low-lying areas or too close to the water line are periodically wave-washed; this reduces hatch success. There is also some loss of eggs to erosion. Based on data collected elsewhere in the Western Atlantic, each female would be expected to deposit 1-6

clutches averaging 120 eggs each at 12-14 day intervals during the nesting season (summarized by Dodd, 1988). Individual turtles do not generally nest every year. Most females return to the nesting beach every second or third year, although remigration intervals as long as seven years have been reported (e.g., Richardson et al., 1978; Bjorndal et al., 1983). Moll (1985) observed two loggerheads nesting on Placencia Peninsula and was told by resident fishermen that both loggerheads and greens "nest along sparsely inhabited sections of the peninsula throughout the summer." Offshore, males are commonly seen by SCUBA divers cruising just outside the barrier reef from late March through May. The males are curious and have been known to approach within a few feet to investigate divers (James Azueta, Hol Chan Marine Reserve, pers. comm.).

Miller (1984) estimated that an average of 40 females nested in Belize annually during 1979-1982. Based on the number of nests counted in recent years, the annual nesting population is probably somewhat less than 40. Ambergris Cay is clearly the most important site. We estimate that the cay receives about half of all loggerhead nests laid. During a 1990 survey of Ambergris Cay, 95 crawls, including at least 33 nests, were documented between 14 May and 25 August; hatch success averaged about 68% (n=18, range 9-93%) (Smith, 1990a). Elsewhere in the region nesting is reported from the Caribbean coasts of Mexico and Central America, the Atlantic coast of South America from Venezuela to Brazil, and selected eastern Caribbean islands (summarized by Dodd, 1988). The largest rookeries in the world are located in Florida (Atlantic coast, USA) and on Masirah Island (Oman).

Some residents believe that there are two 'types' of loggerhead living in Belizean waters. The larger of the two (the "regular" loggerhead) is usually found on the front side of the reef and the smaller, fatter type (the "mainland", "river", or "white eye" loggerhead) consumes an abundance of conch, lives near river mouths and close to the mainland, and bites (Smith, 1989). It is likely that these two 'types' refer to size classes of the same species and suggest that preferred habitats differ among life stages. It is not known whether the numbers of loggerheads inhabiting the waters of Belize have remained constant, increased or declined over the years. However, it is clear that Belize provides nesting habitat to gravid females, as well as potentially important developmental habitat to juveniles. Adults, juveniles, and eggs are harvested (see section 3.3). Two loggerheads turned while nesting on South Water Cay in 1989 were later re-leased after a tourist paid B$ 150 [N.B. B$ 1 = US$ 0.50] each for them (Smith, 1989).

2.2 <u>Chelonia</u> <u>mydas</u>, Green Sea Turtle

The green turtle, usually referred to as "turtle" or "tur'kle", is recognized by its round, blunt beak with serrated cutting edges and carapace plates (=scutes) that do not overlap one another (cf. hawksbill, section 2.4) (Figure 3). There is one pair of prominent scales situated between the eyes. At Tortuguero, Costa Rica, an important green turtle nesting beach south of Belize, breeding females average 100.2 cm straight-line carapace length (sd=5.0 cm, n=2,107) (Bjorndal and Carr, 1989). In Belize, green turtles have been seen mating "on the front side of the reef". They nest in low density on several offshore cays, including Northern Two Cays, Half Moon Cay, Long Cay (Glover's Reef), Ambergris Cay (Smith, 1989, 1990b), and the southern cays (Table 2). Miller (1984) estimated that an average of 19 females nested in Belize annually from 1979-1982. The species is considerably rarer today than in the past when Northern Two Cays and Half Moon Cay apparently received hundreds of nests per year (see Introduction). Carr

et al. (1982) reported several sites where the species formerly nested but now does so only sporadically, or not at all. Average nest frequency is not known, but in 1991 a lone green turtle nested six times in a 40-ft section of beach on Ambergris Cay (6-7 green turtle nests were laid there in 1989; none in 1990). On the basis of information available from other areas, 2-6 nests (125-150 eggs each) are probably laid per female every 2-3 years. In Belize the primary nesting season extends from June through August.

Individual green turtles do not remain in Belizean waters throughout their lives. Hatchlings emerge from their nests, scurry to the sea, orient offshore in a swimming frenzy that persists over a period of days, and ultimately enter offshore convergences and weed lines. It is well known, for example, that Sargassum seaweed rafts shelter hatchling green turtles and also harbour a diverse, specialized fauna, including many kinds of small fishes, crustaceans, worms, mollusks, tunicates, and coelenterates; these may provide food for the young turtles (Carr, 1987a). The turtles remain epipelagic (surface dwelling in the open sea) for an unknown period of time (perhaps 1-3 years) before taking up residence in continental shelf habitats. After leaving the open sea, they feed primarily on sea grasses such as Thalassia testudinum (Bjorndal, 1982, 1985), commonly referred to as "turtle grass", which grows in relatively shallow water. Field studies indicate that individual turtles maintain feeding "scars" by returning to the same area of sea grass meadow to forage each day (Ogden et al., 1983). These scars, or grazing plots, are maintained by regular cropping for several months and the more digestible newer growth (higher in protein, lower in lignin) is preferred (Bjorndal, 1980). When the cropped grasses show signs of stress (blade thinning, increased inter-nodal distance), the turtle apparently abandons the scar and moves on to form another.

Green turtles travel extensively during the first decades of their lives and in the years preceding reproductive maturity take up temporary residence in many locations (Carr et al., 1978). They may travel thousands of kilometers in the Caribbean Sea before the urge to reproduce impels them to migrate to mating and nesting grounds, the latter presumed to be their natal (=birth) beach. Caribbean green turtles reach sexual maturity at an estimated 18-36 years of age (reviewed by Frazer and Ladner, 1986). After reproducing, there is some evidence that turtles return to resident foraging grounds (=feeding areas). Therefore, the movements of adult turtles are likely to be less extensive than those of juveniles, since adults move seasonally between relatively fixed feeding and breeding areas. In Belizean waters, green turtles of varying sizes are observed foraging throughout the year. The offshore habitat, protected by the barrier reef, apparently provides good foraging areas with plentiful sea grasses. These waters are unquestionably important habitat for green turtles. Schools of 12-50 green turtles swimming together, usually seen inside the reef, were reported by many persons during recent interviews (Smith, 1989). Several sightings, mostly in sea grass meadows, were documented by Smith and co-workers during recent habitat surveys (Smith, 1989, 1990b).

Many of the green turtles encountered in Belizean waters are probably migrants. Tagged juveniles from Florida (Witham, 1980) and adults from Mexico and Costa Rica (Smith, 1990b) have been caught. [N.B. Most turtle fishermen do not bother to return the tags, usually saying that they sent one back once and never received any reply.] Turtle fishermen report concentrations arriving in November and departing in March. One resident reported a school of 1,000 or more in the open ocean between Glover's and Lighthouse Reef, migrating south about 9 years

ago. While such estimates cannot easily be validated, there is an impression among fishermen in southern Belize that a pulse of green turtles moves through their waters seasonally. The turtles are described as the "big turtles from Mexico". When the turtles migrate in during the winter they aggregate on grassy banks about 18 feet (5.5 m) deep near the Robinson Point area where one fishermen, Will Eiley, catches 8-10 turtles per week during the open season. They also concentrate and are caught (by setting nets where they gather to sleep during the night) in the Mullins River area, Monkey River area, and south toward Punta Gorda near the coast (Smith, 1989). Based on recent in-depth interviews with turtle fishermen (Smith, 1990b), the annual harvest is estimated to include several hundred green turtles.

Some persons believe that there are actually two 'types' of green turtle present in coastal waters. One type (the "Mexican" or "travelling" turtle) is described as being much larger with green skin; the other smaller with white skin (Smith, 1989). As with the loggerhead (section 2.1), these 'types' no doubt represent size classes of the same species. Thus, Belize provides the green turtle with nesting habitat and also developmental habitat for juvenile age classes. Many local fishermen recall the release of "thousands" of young green turtles in Belizean waters in the past and one man interviewed had actually participated in their release. These stories most likely refer to the activities of "Operation Green Turtle", an international effort coordinated by the late Dr. Archie Carr that released countless young captive-raised green turtles at selected sites throughout the Caribbean in an effort to increase populations in the region. The long-term repercussions of these releases, pro or con, have not been evaluated.

2.3 **Dermochelys coriacea**, Leatherback Sea Turtle

Leatherbacks, locally referred to as "three-keel" or "trunk" turtles, are the largest of the sea turtles. Females nesting in the Caribbean typically weigh 300-500 kg (650-1100 lb). The largest leatherback on record is a male that stranded on the coast of Wales in 1988 and weighed 916 kg (2015 lb) (Morgan, 1989). The species is easily distinguished from other sea turtles because it lacks a bony shell, having instead a slightly flexible skin-covered carapace. The smooth, black skin is spotted with pale yellow or white. The carapace is strongly tapered, measures 130-165 cm (straight-line) total length, and is raised into seven prominent ridges (Figure 3). Powerful front flippers extend nearly the length of the body. Adults are accomplished divers, having been recorded at depths exceeding 1,000 m in waters off St. Croix, USVI (Eckert et al., 1989). Leatherbacks feed predominantly on jellyfish and other soft-bodied prey (Den Hartog and Van Nierop, 1984; Davenport and Balazs, 1991). They are found in the tropics, as well as in cold Canadian and European waters; they have the most extensive range of any reptile.

Leatherbacks are rarely encountered in Belize and are not known to nest. It is doubtful that they were ever common in the area. The extensive barrier reef formation probably acts as an effective deterrent, since this "soft-shelled" turtle is easily abraded and injured. Individuals may enter near shore waters only by accident. One person mentioned during a recent interview that he had once been given a "10-12 inch" juvenile found near shore (Smith, 1989). The turtle was placed in a tank and subsequently died. An adult washed ashore dead 6-10 years ago on Turneffe Atoll (G. W. Miller, pers. comm., 1990). Several sightings have been reported outside the barrier reef by divers. Carr et al. (1982) reported that adult leatherbacks are "occasionally sighted, usually 20-25 miles off the mainland, where they appear to be migrating."

2.4 Eretmochelys imbricata, Hawksbill Sea Turtle

Hawksbills, sometimes referred to as "oxbulls", of varying sizes are present in the reefs year around. The species is distinguished by a narrow, pointed beak which presumably it uses to pry sponges and other soft-bodied organisms from the reef. The carapace is often posteriorly serrated and the carapace scutes overlap, like shingles on a roof (Figure 3). Two pair of scales are located directly between the eyes (cf. one pair in green turtles, a variable number in loggerheads). Adults rarely exceed 80 kg (175 lb) and a straight-line carapace length of about 90 cm (Pritchard et al., 1983; Witzell, 1983). Bright mottled colouration (brown, orange, gold) is common. Seasonal egg-laying occurs on several sandy beaches. During a recent national survey, 26 of 30 sites where nesting occurred had hawksbill or suspected hawksbill nests (Smith, 1990b).

Hawksbills are "spongivores" feeding on reef-associated sponges in the Caribbean region. Sponges contributed 95.3% of the total dry mass of all food items in digestive tract samples from 61 animals from seven Caribbean countries (Meylan, 1988). In Belize, many turtle fishermen describe finding the remains of sponges in the digestive systems of hawksbills they have caught. Local fishermen have also observed hawksbills feeding on seasonally abundant jellyfish, referred to as "thimbles". The barrier reef appears to be an excellent foraging ground for hawksbill turtles. Individuals in all size classes occur in Belizean waters throughout the year. At the present time, juveniles are described as common on the reef and directly behind it. Glover's Reef in particular has been described as having "lots of small hawksbills" (Smith, 1989). Nonetheless, one fisherman who has fished Glover's Reef for 50 years, including netting hawksbills, reports that hawksbills are now relatively scarce (Ralph Jackson, pers. comm.).

Hawksbills have proven difficult to study and little is known about Caribbean populations. Gravid females often nest on isolated beaches, sometimes flanked by exposed coral and rock. Nests are generally concealed in beach vegetation and except for a faint asymmetrical crawl (ca. 0.7 m wide) leading to and from the ocean, there is seldom any obvious evidence of the visit unless the eggs have been exhumed by predators. In Belize, hawksbills are seen mating at the same time (March-May) as other sea turtles along the outer reef and offshore some of the outer southern cays (Smith, 1989). Recent ground surveys have defined the nesting season as May to October "and possibly November" (Smith, 1990b). There was a definite peak in nesting activity in late August and early September 1991 at Manatee Bar, the largest hawksbill colony in Belize (Smith, 1991). Average clutch size is unknown, but is reported to be 127.8 eggs (range 64-175, n=33) in Barbados (Horrocks et al., 1989), 142.7 eggs (n=75) on Buck Island, St. Croix (Hillis, 1992), and about 150 eggs (range 65-215, n=255) in Antigua (Corliss et al., 1989). The hawksbill study in Antigua has revealed that females nest an average of five times per year at two-week intervals (Richardson et al., 1989).

Moll (1985) concluded that hawksbills are solitary nesters in Belize, with "no evidence of nesting concentrations anywhere", and that most nesting occurred on the offshore cays of the barrier reef (mostly the Sapodilla Group), rather than on the mainland. However, it has now been demonstrated that Manatee River Bar, a Special Development Area on the mainland (Table 3), is a particularly good rookery and that Belize as a whole may support 200-250 hawksbill nests per year on the cays and mainland (Table 2). Based on an annual frequency of five nests

per female, we can estimate that 40-50 hawksbills nest each year in Belize. Numbers of crawls (including successful and unsuccessful nesting attempts) are much higher than the reported numbers of nests because in some areas a female fails many times, usually due to roots or hard sand, before egg-laying is successful. During the 1989 national survey, for example, 24 failed hawksbill nesting attempts were reported on Long Coco Cay and only one successful nest. Similarly, 34 "false nests" were reported on Frank's Cay in the Sapodilla Group; apparently there were no successful nests on that cay (Smith, 1989).

On 23 September 1990, 160 nests were counted on an 8 km stretch of beach south of the Manatee River Bar. The count was accurate (although not representative of the entire season since nesting was still occurring) because nests were "marked" by the presence of eggshells surrounding a cavity excavated by small mammals. In 1991, a more thorough survey (15 May - 1 November) documented 108 nests on the same 8 km. On average, fewer than one nest per night was recorded during May through mid-August, 1-2+ nests per night in September, and again fewer than one nest per night in October (Smith, 1991). An intensive study of hawksbills at Jumby Bay, Antigua (West Indies), found that females deposited about 700 eggs per season; with predator-free hatch success averaging about 80%, each female was able to produce about 560 hatchlings (Corliss et al., 1989). From these data we estimate that 22-25 hawksbills produced >15,000 eggs at Manatee Bar in 1991. Unfortunately, virtually all the eggs laid are destroyed by predators (section 3.2).

There are few places in the Caribbean Sea that can claim the density of hawksbill nests documented near Manatee Bar (cf. Meylan, 1989). To the south, an estimated 380-760 hawksbill nests are laid per year on the Manabique Peninsula, about 50 km of beach that comprise the Caribbean coast of Guatemala (Rosales-Loessener, 1987). To the north, as many as 1000+ nests are laid annually on the Yucatan Peninsula, Mexico. A recent review by Frazier (1992) indicated 150 to >300 nests per year in Campeche (Isla Aguada-Chenkán; possibly this is only 50% of the annual total), >50 nests at Celestun-El Palmar, 200-400 nests at Las Coloradas-El Cuyo, and about 200 on Isla Holbox. Other regionally important colonies may exist in Nicaragua and Panama; some of the Eastern Caribbean islands (e.g., Mona Island, Puerto Rico; the Grenadines; Long Island, Antigua) may also be significant. Cuba is no doubt of regional importance, but little is known of nest density or the current status of hawksbill populations there (Groombridge and Luxmoore, 1989).

The status of the hawksbill is precarious throughout the Wider Caribbean. In a recent review, Groombridge and Luxmoore (1989) concluded that "around half of the known nesting populations are known or suspected to be in decline; in particular, the entire Western Atlantic-Caribbean region is greatly depleted." In a report prepared for the Second Western Atlantic Turtle Symposium, Meylan (1989) wrote that nearly all Caribbean countries receive fewer than 100 nesting females per year. With so few known nesting concentrations, Belize clearly has a vital role to play in the conservation of this endangered turtle.

2.5 <u>Lepidochelys</u> <u>kempi</u>, Kemp's Ridley Sea Turtle

The extent to which Kemp's ridleys enter our waters is unknown. During a recent interview, a young fishermen noted that he had seen two Kemp's ridleys and that he had identi-

fied them with "the help of a book". Many fishermen report catching "bastard" turtles (Smith, 1989). The diminutive Kemp's ridley is gray in colour as an immature and primarily olive green as an adult (Pritchard et al., 1983). The carapace is round, often as wide as it is long, and carapace scutes do not overlap one another (cf. hawksbill sea turtle, section 2.4). According to Ross et al. (1989), adults weigh 60-90 lb (27-41 kg) and have a shell length of 23-30 inches (58-76 cm). The species is carnivorous and eats mostly crabs, but also preys upon other crustaceans, shellfish, jellyfish, sea urchins, starfish, and fish. With the exception of a single recapture from Caribbean Nicaragua of a "head-started" individual (Manzella et al., 1991), which may have displayed altered behaviour due to having been held captive during its first year (Woody, 1991), Kemp's ridleys appear to be confined to the Gulf of Mexico and temperate northern Atlantic. Unarguably the most endangered sea turtle in the world, the total adult population is thought to number no more than 900 females and an unknown number of males (Ross et al., 1989). The species nests almost exclusively in the state of Tamaulipas, Mexico.

2.6 Lepidochelys olivacea, Olive Ridley Sea Turtle

There are no records of olive ridleys foraging or nesting in Belize, nor would the species be expected to occur. Olive ridleys are similar in appearance to Kemp's ridleys (section 2.5), having a nearly round carapace (width about 90% of the length) and an adult colour of olive green or brown dorsally and yellowish white ventrally. The turtle rarely exceeds 100 lb (45 kg) (Pritchard et al., 1983). Each front flipper bears a single claw, the horny beak may be finely serrated, and carapace scutes do not overlap one another. The lateral scutes (those to either side of the median on the shell) are divided into 5-9 pairs, considerably more than other sea turtles which typically have 4-5 pairs. In the western Atlantic, olive ridleys have been reported from Brazil northward to Venezuela (Pritchard, 1969) but significant levels of nesting appear to occur only in Suriname, primarily at Eilanti Beach (Schulz, 1975). Olive ridleys nesting in Suriname have declined considerably in recent years from about 3,000 nests per year in the late 1960's to fewer than 600 nests per year today (Reichart and Fretey, 1992). Incidental catch and drowning in shrimp trawls has been implicated in their demise. Diffuse nesting occurs in northwestern Guyana and in French Guiana (Reichart, 1989).

III. STRESSES ON SEA TURTLES IN BELIZE

3.1 Destruction or Modification of Habitat

The entire coast of Belize is protected by the second largest barrier reef in the world and its associated coral cays. Immediately seaward are three oceanic atolls -- Glover's Reef, Light-house Reef, and the Turneffe Islands. Much of the coral reef ecosystem exists in a relatively pristine state, due to the country's small population (ca. 200,000) and emerging state of development. While destruction or modification of sea turtle habitat is not yet serious on a national scale, troubling trends are becoming apparent. Contemporary destruction of coastal habitats, often to service a growing tourist industry, presents an obvious challenge to sea turtle conservation. There are many examples of beachfront development compromising nesting beaches, such as at Tobacco and South West cays where the entire shoreline of both cays consists of buildings or seawalls. Sea turtle nesting was once commonplace on these cays, but is

rare today. Low sea turtle nest density on Ambergris Cay has been attributed to the long presence of man (Carr et al., 1982).

Beachfront development has brought an increase in artificial lighting, human activity, and pollution associated with sewage and waste disposal to once isolated nesting grounds. Litter and ocean-borne debris are serious problems on some beaches. Lights shining on the beach at night distract emerging hatchlings and lead them away from the sea (section 4.132). Also, hawksbills have been found to nest within supralittoral vegetation (section 2.4) and shoreline developers usually clear away such vegetation in order to obtain sandy beaches. Loss of beach vegetation may deter nesting females, or may concentrate nesting around remaining "islands" of vegetation, potentially making it easier for predators to find the eggs. Furthermore, removing stabilizing vegetation invites coastal erosion. The need for raw material for construction has resulted in sand mining operations at the mouth of the Sibun River where sediments are dredged by divers from the seabed in shallow water and transported by boat to Belize City. The cumulative effect of this constant activity has been the erosion of down-current nesting habitat (section 4.131).

In a recent article in the Marine Turtle Newsletter, Smith (1992) noted that a type of development which would be compatible with sea turtle nesting is already a growing part of Belize's tourism industry. Small, environmentally conscious hotels located on large tracks of private land and reserves that use kerosene lanterns and cater to 'eco-tourists' would not only be compatible with sea turtles, but could actually enhance sea turtle recovery by helping to protect nests and increase public awareness. Further, since there are hundreds of kilometers of shore-front property in Belize where sea turtles do not nest that are suitable for large hotels, condominiums and subdivisions, it seems all the more logical to safeguard the few sites where endangered sea turtle species are able to successfully lay their eggs. There are fewer than a half dozen known sites in the Caribbean where a person can walk a beach and find over 100 hawksbill nests. One of those beaches (Manatee Bar) is in Belize. This is a national treasure that should be earnestly protected.

In addition to the protection of nesting beaches, degradation of nearshore waters and coral reefs must be guarded against. It is expected that agricultural expansion will occur as Belize attempts to raise its currently modest standard of living. Unless crop land is cleared and planted properly, erosion and runoff will result in an increased sediment load in nearshore waters. Cloudy water (turbidity) can reduce the productivity of coral reefs and sea grass meadows, eventually badly harming these systems. The runoff of herbicides, pesticides and other pollutants should be closely monitored (section 4.146). The need for clear boat channels (unobstructed access) has already brought about isolated attempts to dredge or dynamite portions of living reef (sections 4.141, 4.147). Increased boat traffic threatens sea grasses and coral reefs with anchor damage, resulting in reduced foraging area for both green turtles and hawksbills (section 4.147), as well as degradation from sewage effluent and careless waste disposal. An increase in the number of divers visiting our coral reef ecosystem stresses the resource by collecting, handling, and trampling the coral. Finally, persistent vessel groundings on the barrier reef have caused localized damage. The reef is not only important to the survival of endangered sea turtles but because of its role in commercial fisheries and tourism, severe reef degradation would be "a direct blow to the first and third leading economic sectors in Belize" (Young et al., 1992).

3.2 Disease or Predation

The full extent to which disease and predation effect sea turtle populations in Belize has not been determined. Natural causes of mortality in sea turtles differ among life stages. Eggs are lost to beach erosion, as well as to native predators. Smith (1990a) observed ants entering loggerhead turtle nests on Ambergris Cay and attacking both eggs and hatchlings; fly larvae were also present in some nests feeding on rotten eggs and dead hatchlings. A survey of 8 km of beach at Manatee Bar revealed that 100 of 108 (92%) hawksbill nests laid in 1991 were depredated by raccoons and, probably, coatimundis (Smith, 1991). Hatchlings are typically lost to feral and exotic animals, crabs, ants, night herons, lizards, sea birds, and reef fishes. Precise estimates of the annual losses of hatchlings to beach predators are not available, but attacks on hatchlings by hermit crabs and "wish-willy" lizards (Ctenosaura similis) have been observed (Smith, 1990a) and Miller (1984) reported that birds, crabs, and predatory fishes all consume hatchlings in Belize. Juveniles and adults presumably fall prey to offshore predators such as sharks. An adult or sub-adult turtle was once found in the stomach of a 12-14 ft tiger shark caught near Half Moon Cay (Jim Beveridge, Cay Caulker, pers. comm.).

Marine turtle fibropapilloma, a potentially lethal tumor disease, has been seen in green turtles in the Belize City market (J. Beveridge, pers. comm.). Some turtle fishermen report catching green turtles with papillomas (locally called warts) so abundant that they would not sell or eat the turtle. Dr. Karen Eckert of WIDECAST also observed several cases of fibropapilloma in green turtles offered for sale in the Belize City market in 1990. She reported her observations to Dr. Theodore Aranda, Belize Minister of Health, in a detailed letter dated 25 July 1990. Green turtle fibropapilloma has been documented extensively in Florida (Ehrhart, 1991) and has more recently been found in Curaçao (Jacobson, 1990) and Venezuela (Guada et al., 1991). The cause of this debilitating and often fatal disease is unknown. The full extent to which the disease afflicts green turtles in Belize is not known. The authors are not aware of any scientific studies showing ill effects to consumers; nevertheless, it is never wise to eat diseased meat. Diseased turtles should be returned to the sea.

3.3 Over-utilization

Over-utilization in the past has most certainly caused the observed decline of sea turtle stocks in Belize. By historical standards exploitation eased during the 20th century, but netting activities continued to concentrate near mating and nesting grounds where adults congregate. As a consequence, populations have not been given a chance to recover. Until very recently it was legal to hunt all species of sea turtle in Belizean waters, although there were size and seasonal restrictions; hawksbills are now fully protected (see section 4.21). Sea turtles are commonly sold in the public market (Tables 4 and 5) and represent a relatively inexpensive source of protein. Although the public markets apparently did not allow undersized turtles to be sold [cf. Fisheries Regulations, 1977], fishermen sometimes kept the small turtles for their own consumption or held them captive for a time before butchering. It is illegal to possess sea turtle eggs, but they are generally consumed whenever they are found and "red eggs" (i.e., unshelled eggs taken from the oviducts of slaughtered females) are considered a delicacy by some. Gillett (1987) reported heavy human exploitation of eggs at a popular nesting beach (Rocky Point) on Ambergris Cay which continued until beach patrols were initiated in 1989.

According to Rebel (1974), 7131 lb (3241 kg) of loggerhead turtle meat, 4346 lb (1975 kg) of green turtle meat, and 1110 lb (504 kg) of hawksbill turtle meat were sold within the colony, then British Honduras, in 1945. Also according to Rebel, 8800 lb (19,360 kg) of loggerhead meat was exported to the USA in 1969 and again in 1970. Gil Rosado (quoted in Rebel, 1974) estimated that the local consumption of sea turtles, presumably in the early 1970's, was 5000 lb (2273 kg) of loggerhead, 1000 lb (455 kg) of green turtle, and 2500 lb (1136 kg) of hawksbill per year. The numbers of turtles represented was not specified. Based on market surveys and reports from fishermen, Miller (1984) determined that approximately 1,000 turtles (all three species) were legally landed each year between 1980-1982. Also based on market surveys and reports from fishermen, Gillett (1987) reported 979 turtles landed in 1986:

Species	Year: 1982	1981	1980	1986
Loggerhead	400	425	415	--
Green turtle	280	325	350	--
Hawksbill	325	370	360	--
Total	1005	1120	1125	979

Based on data provided by Miller (1984) and Gillett (1987), the average weight of sea turtles landed declined an alarming 60% between 1982 and 1986 from 163.0 kg to 66.7 kg (Tables 4 and 5).

Based on visits to Belize in June and July 1983, and again from January to April 1984, during which time information about the status, distribution, and level of exploitation of the Belizean turtle fauna was investigated by ground patrol, aerial survey, and personal interviews with turtle fishermen, vendors of turtle meat and products, and government officials involved in sea turtle protection, Moll (1985) reported that green, hawksbill and loggerhead turtles were all exploited, the ban on egg collection was widely ignored, turtles were taken for meat during the closed season, and tortoiseshell curios and jewelry found a "ready market" among tourists from abroad. He explained that the meat was used for both private consumption and commercial sale, with the green turtle being the most prized in coastal markets and restaurants. The meat of loggerheads was apparently less favoured, but Moll witnessed four loggerheads caught outside the reef at Ambergris Cay during March 1984; all were brought into San Pedro to be butchered. One commercial turtle fishermen from Mullins River reported that he caught four to five turtles (mainly greens) per week during the legal season by setting nets near rock piles in the turtle grass beds near shore (Moll, 1985).

Hawksbill meat is not as preferred as that of the green turtle, but still hawksbills are killed and sold for both meat and shell. Despite a ban on the taking of juveniles, Moll (1985) observed that "beautifully patterned young specimens are stuffed and sold as wall decorations. A sizable population of locally collected hawksbills decorate the town of San Pedro [Ambergris Cay], since almost every shop and hotel has several adorning their walls. American tourists are the main purchasers of tortoiseshell products here; they are either unaware or unconcerned that

sea turtle products may not be legally imported into the USA. ... Eggs may not be legally harvested in Belize, but the ban is widely ignored. Eggs of all three species are gathered whenever possible and used privately or sold. In 1982, Honduran and Guatemalan citizens paid US$ 1.00 per dozen for sea turtle eggs gathered at Placencia and smuggled across their respective borders for sale (G. W. Miller, pers. comm.). ... Enforcement of laws is difficult due to the lack of manpower and boats swift enough to overtake poachers, and the extensive areas that must be patrolled. Sea turtles taken during the closed season are not openly marketed, but are butchered and the meat sold in small packages door to door (G. W. Miller, pers. comm.)."

Gillett (1987) summarized the situation this way: "turtles [are] being exploited for their eggs, meat and shell. Turtles are being netted by local fishermen and a considerable trade in turtle eggs and turtles is allegedly being conducted by illegal fishermen from those countries south of our borders. These activities, and the extent to which they exploit the resource, [are unquantified because] they operate from the southern cays which are mostly uninhabited and isolated. Although our traditional national fishermen are not solely dependent on the catch of turtles for their livelihood, there is a thriving trade in turtle products. Other lobster and conch fishermen do take turtles when available as incidental catch. Marine turtles are also being caught in the nets of the shrimp trawlers operating in our waters. However, there are no reports of turtles being washed up on shore." In Placencia Village, Smith (1989) reported that large turtles caught mainly by fishermen from Monkey River were dressed and sold locally from the beach early in the morning at B$ 1.00-1.50/lb (two green and a loggerhead were observed there during a 1989 field survey). In San Pedro, large turtles are sold at B$ 3.50-5.00/lb, mostly to restaurants for tourist meals.

During a 1990 national survey of nesting grounds, more than 40 people, mostly fishermen and several past or present turtle fishermen, were interviewed. The information supplied provides the most up-to-date picture of the utilization of sea turtles in Belize. Will Eiley sets his nets near English Cay Channel and catches 200-300 turtles per year, mostly greens. Charles Flowers fishes near Mullins River and catches 200+ turtles per year, again mostly greens. George Garbutt fishes near Monkey River; he was not able to provide an accurate estimate of his annual take, but it is "mostly greens". Wellington Garbutt was also fishing near the Monkey River and catching 50-60 turtles per year, mostly greens and loggerheads with an occasional (perhaps five per year) hawksbill. Wilfred Young and his brother fish near Punta Negra and catch as many as 60 turtles per year; green, loggerhead, and hawksbill are landed in roughly equal numbers. Florencio Lino fishes near Punta Gorda, catching 60-100 turtles per year, mostly greens. Of nine other turtle fishermen interviewed, only one intended to fish for turtles in the future. Another fisherman, Mr. Coleman, reportedly began setting nets for turtle only recently (near Southern Long Cay) and was not interviewed.

In addition to the harvest described above, other turtles, mostly loggerheads and hawksbills, are opportunistically landed by harpoon, hook, or spear and some are brought to market. Based on all these data, we estimate that 500-800 turtles (mostly adults) are sold legally in local markets in Belize each year, of which some 60% are greens, 30% are loggerheads, and 10% are hawksbills -- a reversal from data a decade ago showing that loggerheads were the dominant market species (cf. Miller, 1984). All the men interviewed said that they caught many more females than males. None of the turtle fishermen are totally dependent on turtles; they also

harvest snapper, snook, lobster, conch, and/or other finfish. Fewer than a dozen fishermen set nets specifically for sea turtles, but opportunistic take, including the take of turtles caught in fish nets or grabbed by divers, is not uncommon. The illegal exploitation of eggs has been estimated at 10,000 annually (Miller, 1984). One fisherman living on Frank's Cay (Sapodilla Cays) reportedly regularly poaches eggs and has up to 500 at one time which he sells for B$ 5-6 per dozen to tourists coming to the islands (Smith, 1990b).

In 1990, several non-government conservation groups in Belize became concerned enough about the local status of the hawksbill turtle that they lobbied the government to implement an indefinite moratorium on the take of this species. In a letter to the government (Appendix I), they noted that interviews with fishermen had revealed that hawksbill shells were being bought in Belize, stockpiled, and then illegally exported to Japan. Further, as tourism has increased, so have the numbers of shops selling hawksbill jewelry to tourists. The harvest of hawksbills for export, whether clandestinely to Japan or indirectly through foreign tourists, constitutes an important aspect of utilization. The commercial harvest of turtles for export has been ongoing for many decades. Rebel (1974) noted that the exportation of hawksbill shell "was once a fairly substantial enterprise, with nearly all the shell being exported to England" and he cited these data: in 1937, 2576 lb ($5,318) were exported; in 1938, 1457 lb ($2,919); in 1939, 1211 lb ($2,078); in 1940, 319 lb ($482); and in 1941, 850 lb ($1,131). A Placencia Fishermen's Co-operative exported "many hawksbills" to France in the mid 1970's and according to former Fisheries Unit Laboratory Administrator, Mr. G. Winston Miller, "this trade caused a noticeable decline in the Belizean hawksbill population" (Moll, 1985).

In the mid-1980's, the export of bekko (=hawksbill shell) to Japan soared. According to Milliken and Tokunaga (1987) relatively small volumes (0-702 kg/yr) of bekko were imported to Japan from Belize between 1970 and 1982. Then, after a brief downward trend (538 kg in 1983 and none in 1984), a dramatic rise in imports was reported in Japanese Customs statistics (1195 kg in 1985 and 2231 kg in 1986). More alarming is the fact that records kept by Japanese shell dealers (as opposed to Customs officials) showed that a total of 1628 kg, 3240 kg and 3280 kg were imported from Belize in the three years 1984-1986 (Milliken and Tokunaga, 1987), suggesting that government statistics may have been seriously underestimating the real trade volume. The sudden increase in the volume of hawksbill shell exported to Japan during the last decade has been attributed to the confused status of CITES in Belize during the early 1980's, despite the fact that Belize became a full Party to the Convention in September 1981. Of the approximately 5,200 Belizean hawksbills required to supply Japan with bekko from 1970-1982, more than 4,000 were harvested after 1981 (Milliken and Tokunaga, 1987). Reliable reports (multiple sources) indicate that trade in hawksbill shell from Belize continues illegally.

3.4 Inadequate Regulatory Mechanisms

There is little doubt that the present reduced numbers of sea turtles are attributable to the absence of adequate regulatory mechanisms in the past. The Fisheries Regulations of 1977 attempted to correct this situation. The 1977 regulations prohibited the possession or taking of turtles from 1 June to 31 August each year, a time period thought to encompass the most important portion of the nesting season [N.B. recent surveys indicate that the mating and nesting season extends from April through November]. The taking of turtles whilst they were on shore

was banned at all times, both on the mainland and on the cays. Nets, seines and other instruments "for the purpose or with the intent of taking turtles" were prohibited within 100 yards of shore. The taking, possession, buying or selling of greens and hawksbills under 50 pounds and of loggerheads under 30 pounds became illegal. The export of turtles and of articles made from turtle parts was also prohibited, except with a license granted by the Minister responsible for Fisheries. Four species (loggerhead, green, hawksbill, leatherback) were briefly fully protected by the Wildlife Protection Act of 1981, but protected status was revoked on 25 January 1982 because it conflicted with the Fisheries Regulations (see section 4.21).

While the provisions of the Fisheries Regulations of 1977 represented a regulatory improvement over a wholly unregulated harvest, the continued take of large juveniles and adults worked against the recovery of sea turtle populations. Further, conservation legislation has always been nearly impossible to enforce due to insufficient manpower and a vast expanse of territory. A decline in local sea turtle stocks, attributed to a combination of legal and illegal take and a lack of enforcement capability, prompted a recent review of sea turtle regulations. In 1990, the Belize Audubon Society, the Programme For Belize, and the Belize Center for Environmental Studies petitioned Government to strengthen sea turtle conservation laws (Appendix I). In response, the Fisheries (Amendment) Regulations of 1993 will include (1) year-around protection for hawksbills, (2) maximum size limits (60 cm/24 inch shell length) for green and loggerhead turtles in order to protect large juveniles and breeding-age adults, and (3) an extend-ed closed season (1 April-31 October). Earlier provisions against the take of eggs, the take of turtles on land, and the setting of nets within 100 yards of shore will be retained.

Historically inadequate regulatory mechanisms are also apparent in the protection of critical habitat. In recognition that a holistic coastal zone management plan should be prepared for Belize, a Coastal Resources Management Workshop was held in San Pedro, Ambergris Cay, in August 1989. The Workshop was hosted by the Hol Chan Marine Reserve and the Belize Fisheries Department, in collaboration with Wildlife Conservation International, and covered three major areas of concern: (1) the management of marine reserves, (2) marine research and education, and (3) coastal zone management. The Workshop also focused on the reality that if a marine conservation ethic is to flourish in Belize, it is essential that a cadre of trained Belizeans be available to assume the management responsibilities of this "most valuable natural heritage." Finally, as the country is at the crossroads of development, the Workshop deemed it imperative that a comprehensive coastal resources planning strategy be prepared in order to allow development to progress in a planned manner whilst at the same time safeguarding the integrity of the coastal system. The final recommendations of this successful Workshop (attended by 55 experts from nine countries) led to a national Coastal Zone Management (CZM) Project, a significant advancement in regulatory mechanisms as they pertain to habitat.

3.5 Other Natural or Man-made Factors

In addition to the effects of development that directly threaten coral reefs, sea grass beds and cays, Belize is hit by a hurricane on average once every 30 years. Although only 5% of the hurricanes recorded in the tropical Atlantic Ocean reached Belize between 1886-1978, the country has "a history of devastating encounters" with these tropical storms, a history that finally led to the relocation of the capital from Belize City to Belmopan, some 80 km inland, in 1971

(Hartshorn et al., 1984). These events have the potential to destroy incubating eggs, as well as completely erase foraging and nesting grounds. In some instances, entire cays have been washed away by hurricanes. Although such catastrophes were unlikely to threaten the continued existence of sea turtles when populations were larger, future disasters may have a much greater effect on now-depleted populations. Routine storms also wash-out sea turtle nests. In 1990, a resident reported that "about five" turtle nests on a mainland beach just north of South Stann Creek were lost to erosion following an August storm (Smith, 1990b). Other dangers are periodically reported, such as when a post-nesting hawksbill fell into a well at Blue Marlin Lodge (South Water Cay) in late August 1989; she was released the next day (Smith, 1989).

An as yet unquantified threat to sea turtles in Belize is their entrapment in active or abandoned fishing gear. For example, gillnets pose a threat to hawksbills nesting in the Manatee Bar area. Although it is illegal to set nets within 100 yards of nesting beaches to catch sea turtles, it is not prohibited to set nets in these areas for fish. Gillnets were set in waters adjoining the Manatee Bar nesting beach on 3 September and again on 10 October 1991 (Smith, 1992). In addition, several hundred sea turtles are believed to be captured accidentally in shrimp trawls each year and other gear, such lobster pots and long lines, also pose a potential threat (see section 4.27). With ever-increasing numbers of residents and tourists enjoying water sports, debilitating or fatal encounters with motor boats, surfboards, sail boats and personal watercraft ('jet skis') may become more frequent.

IV. SOLUTIONS TO STRESSES ON SEA TURTLES IN BELIZE

4.1 Manage and Protect Habitat

It is intuitive that protecting sea turtles and their eggs from harm is only the first step in our commitment to their survival. Important foraging and nesting habitat must also be afforded protection. Identifying and managing essential habitat is discussed in sections 4.11 and 4.12. The protection of beaches or marine areas important to sea turtles need not imply closure to the public. Guidelines for compatible development are proposed in sections 4.13 and 4.14.

4.11 Identify essential habitat

Identifying habitats important to the survival of marine turtles in Belize is not easily accomplished. Belize includes some 280 km of mainland coastline (1,381 km if the offshore cays and exposed reef are included; Miller, 1984) and 23,657 km^2 of territorial sea extending 20 km into the Caribbean Sea (Hartshorn et al., 1984). Some very useful surveys have been done of the geomorphology, flora, and general features of the Belize barrier reef and offshore atolls (e.g., Vermeer, 1959; Stoddart, 1962; Dillon and Vedder, 1973; Wantland and Pusey, 1975; James and Ginsburg, 1979; Stoddart et al., 1982), but none of these have indicated the use of this expansive environment by sea turtles. Turtle grass (Thalassia testudinum) is the principal ground cover of the Barrier Platform and the Northern Shelf Lagoon. Percent coverage varies according to ambient conditions from dense, almost monocultural meadows to sparser flats where algae (e.g., Halimeda, Penicillus, Turbinaria, Padina, Gonolithion, Amphiroa) and small corals are numerous (Perkins, 1983).

In general, sea grass meadows provide important forage to green turtles (section 2.2), while coral reefs, mangroves, and/or river mouths serve as feeding areas for loggerheads (section 2.1) and hawksbills (section 2.4). Coral and rock structures also provide refugia for sea turtles of all species (except the leatherback, which is not common in Belize). Marine areas utilized by feeding or resting sea turtles may be identified by soliciting observations from fisher-men and recreational divers who frequent specific areas repetitively over time (section 4.111). In addition, biologists (e.g., those based at Carrie Bow Cay) studying sea grass or coral reef ecosystems should be encouraged to record turtle sightings, fecal material, "grazing scars" (section 2.2), and other evidence of sea turtle activity. Preliminary survey data indicate that the area between Middle Long Cay and English Cay Channel is frequented by green turtles foraging on sea grass at 3-7 m (Smith, 1990b).

Most of the sandy beaches in Belize are associated with the offshore cays of the barrier reef, rather than on the mainland. Much of the mainland coast is low mangrove swamp and is unsuitable for sea turtle nesting. Moll (1985) found during aerial surveys in July 1983 that even where there appeared to be suitable habitat on the mainland (central and southern coastline), little sea turtle activity was observed. Nonetheless, some mainland beaches, such as that at Manatee Bar, have recently been found to support large numbers of nesting hawksbills (Smith, 1991). In order to identify important nesting beaches, systematic ground and/or aerial surveys will be necessary in order to quantify the distribution of nesting activity. Beaches which appear to be ideal for turtle nesting do not necessarily support nesting. The reasons for this are not always clear, but presumably involve both the subtleties of nest site selection and historical levels of exploitation.

4.111 Survey foraging areas

Belize provides extensive foraging grounds (sea grass, coral reef) to several species of marine turtle. The following habitat description is quoted from Perkins (1983): "The Belize Barrier Reef is the second largest in the world and the greatest manifestation of the coral reef ecosystem in the Western Hemisphere for its size, unique array of reef types, and luxuriance of corals thriving in such a pristine condition. Ecologically and aesthetically, its integrity is virtually unmarred. Forming a nearly continuous bulwark for [220 km] along the continental shelf edge, the Belize Barrier Reef provides sustenance and physical security to the entire country. Immediately seaward are three oceanic atolls including Glover's Reef, which is unparalleled in the Caribbean for its development, variety of reef types, and biotic diversity. In the calm waters of the lagoon behind the barrier reef is a flourishing complex of patch reefs and sea grass meadows, a maze of unusual shelf atolls, known as faroes, and some unique offshore mangrove cays whose origins are marine."

To systematically survey the coastal water of mainland Belize would be difficult enough, but add in the large number of offshore cays, atolls, and the vast size and complexity of the barrier reef and the task becomes monumental. Neither the government nor the private sector has the financial means or the manpower to conduct such a survey. Divers who lead SCUBA or snorkeling trips for tourists often visit the same area repeatedly and should be encouraged to keep records of turtles sighted on their trips as a means of monitoring stocks in localized areas. Similarly, informal surveys should be initiated with the support of interested fishermen, boaters,

and/or photographers. Marine reserve managers, such as at Hol Chan, will be encouraged to keep a log of sea turtle sightings. Studies undertaken to assess biodiversity, evaluate potential Marine Park or Reserve sites, document the effects of pollution or siltation, etc. should include records of turtle activity. The ongoing CZM Unit coral reef monitoring project has already undertaken to report sea turtle sightings; this project will eventually monitor 30 or more sites.

Some preliminary data are already available. For example, during two recent nesting beach surveys, observers were transported from cay to cay by sailboat. Turtle sightings en route were recorded. Greens, loggerheads, and hawksbills were all observed, mostly in "coral and sand" or "sea grass" (see Smith, 1989, 1990b for details). When data indicate that particular reef or sea grass communities are important to sea turtles, these areas should become the focus of systematic surveys to ascertain the abundance and distribution of the species involved, as well as the threats present. Destructive activities, such as dynamiting and indiscriminate anchoring, should be prohibited in foraging areas. Areas with relatively higher concentrations of turtles should be candidates for protected status. Survey data should be assembled, maintained and updated by a designated government agency or non-government group.

4.112 Survey nesting habitat

Ground and aerial surveys initiated in 1982 for the Western Atlantic Turtle Symposium (WATS I) were the first general survey done for marine turtles in Belize and resulted in valuable data (see Miller, 1984). In 1989 (3-24 September), Greg Smith and Jim Beveridge of the Belize Audubon Society organized a ground survey of areas described as sea turtle nesting beaches by Perkins (1983) and/or Miller (1984). Only Lighthouse Reef and Glover's Reef atolls were excluded from the effort. In addition, 23 interviews, primarily with fishermen, were conducted throughout the survey to gather information on possible nesting sites and general knowledge of sea turtles in Belize. A follow-up national survey covering more than 1,300 km was conducted in 1990 (10-29 July, 9-30 September, 5-6 November). During this time most of the cays in Belize were checked by sail boat for potential nesting beaches, which were then ground surveyed. More than 40 fishermen and knowledgeable residents, 16 of them past or present turtle fishermen, were interviewed. Areas not included in the 1990 survey were the coast south of Punta Gorda, the coast north of Manatee Bar, and the Turneffe Islands south of Calabash Cay (Smith, 1990b). In 1991, an important hawksbill nesting beach on the mainland beach at Manatee Bar was patrolled irregularly between 15 May and 1 November to record sea turtle nesting activity (Smith, 1991). Seasonal surveys of sea turtle nesting on Ambergris Cay have been ongoing since 1989.

The most important nesting beaches for sea turtles are now known to be located on Ambergris Cay, on the southern outer cays from Silk Cay to the Sapodilla Cays, and on the mainland at Manatee Bar. Preliminary reports indicate that Lighthouse Reef atoll and the mainland peninsula of Placencia may also be significant in some years. Twenty-four cays were reported to support sea turtle nesting by Gillett (1987) and more recent surveys have documented nesting on at least 30 cays (Table 2). Despite the laudable survey efforts to date, some of which are on-going, it is impossible to envision one person or group, including the government, with the time and resources needed to survey all potential nesting habitat. Thus, it would be most useful if residents could be inspired to survey beaches close to their homes or businesses. Beach

patrol by police officers and British Defense Forces presently stationed in the Sapodilla Cays should be encouraged. Youth or civic/conservation groups could perhaps be mobilized to walk accessible mainland beaches during the day on a regular basis, at least weekly, from 1 May to 30 November. All evidence of sea turtle activity (usually a crawl, or signs of egg poaching) should be recorded during these walks; of course volunteers must receive some preliminary training in order to distinguish one species from another on the basis of crawl characteristics (section 4.55). Ground surveys are believed to be more effective than aerial surveys, especially in places where the protective barrier reef limits exposed, unvegetated beach sand to <2 m (Smith, 1990b). All data should be assembled, maintained and updated by a designated government agency or non-government group.

Important beaches should be considered candidates for Park or Reserve status. For these beaches, management plans should be constructed (section 4.12), proximal development should follow guidelines discussed in section 4.13, and coastal landlords should be required to support sea turtle monitoring and enhancement programmes on adjoining nesting beaches. In the U. S. Virgin Islands, developers must design and submit sea turtle monitoring programmes for their area developments as a prerequisite to gaining building permits (Eckert, 1989a). There are sound economic reasons for protecting important nesting beaches, including the long-term physical stability of the coastline and the current interest in "eco-tourism". There are a growing number of examples of hotels in the Caribbean who are using sea turtles to attract eco-tourists and finding the idea to be immensely successful. In some cases, a naturalist is employed full time to lead guests on "turtle walks" and ensure that turtles are not disturbed (e.g., Fuller et al., 1992).

4.12 Develop area-specific management plans

A number of marine protected areas are either in existence or have been proposed, including Hol Chan Marine Reserve at Ambergris Cay, Half Moon Cay National Monument on Lighthouse Reef, and proposed sites at Glover's Reef Atoll, Laughing Bird Cay, Sapodilla Cays, the Tobacco Reef area off Dangriga (including South Water Cay, Carrie Bow Cay, Wee Wee Cay, and possibly Tobacco Cay), and a manatee biosphere in Northern and Southern Lagoons (Young et al., 1992; see also Table 3). In addition, recommendations have been made to declare the world's second largest barrier reef ecosystem a World Heritage Site/Biosphere Reserve. The idea of establishing Sea Turtle Refuges specifically for the protection of nesting or foraging turtles should also be explored. Sound management techniques need not wait for the enactment of formal Park status, however. Area-specific management may involve a wide array of options in addition to (or in place of) full protected status. These could include appropriate beachfront lighting; a ban on the removal of beach vegetation, sand mining, littering, recreational vehicles, and horses on the beach; the closure of a beach during nighttime hours, or even low-technology manipulative options such as the establishment of a hatchery for eggs threatened by erosion or predators. The first step is to identify areas deserving of special management status. The second step is to implement specific solutions to imposing threats, based on recommendations in this Recovery Action Plan.

It is a recommendation of this Recovery Action Plan that two areas in particular, the Sapodilla Cays and Manatee Bar, be given priority attention for Reserve status because of their critical importance to hawksbill turtles. Hawksbill nesting has declined significantly nationwide

(see Introduction) and the legal and illegal take of eggs and turtles is implicated in the species' demise. In addition to Sapodilla Cays residents, some of which are avid poachers, the cays also host large numbers of tourists every year. Hotels are planned on Nicholas and Hunting Cays, and campers entirely cover Hunting and Limes Cays at certain times during the sea turtle nesting season. To protect this area in the future, active enforcement of the laws against poaching and protection of important nesting areas from adverse development will be necessary. To accomplish this, we recommend that enforcement personnel be stationed in the area full-time. Establishing a Marine Reserve in the Sapodilla Cays would provide the necessary protection personnel for turtles and other resources, and still allow tourists and residents to use the cays. It is essential that a plan be devised that allows for the controlled use of the cays by visitors on a long-term, sustainable basis. Revenue from tourists required to pay a fee to enter the Reserve would provide sufficient funds to make the protection self-sustaining.

The Manatee Bar nesting site, which is within the boundaries of the Manatee Special Development Area (MSDA), supports ca. 50% of all known hawksbill nesting in Belize. The nesting zone extends 7.25 miles (11.6 km), mostly south of the Bar River. Protection of this unique nesting site is essential. The government has already demonstrated its commitment to this objective by rejecting a recent proposal for a subdivision to be located on the beach north of Manatee Bar. However, all of the beach north and south of the bar is privately owned and it is expected that pressure to develop the area will continue (Smith, 1991). WIDECAST supports the recommendation of the Manatee Advisory Team in Belize that "the Government of Belize acquire the Hawksbill Turtle Conservation Zone (7.25 mi by 0.25 mi) for management and public use, monitoring of nests, and permitting of concessions leased to the private sector for small scale eco-tourism development utilizing the given zone and use recommendations." Alternatives include a joint government-private or wholly private initiative to include conservative setbacks and other development restrictions. A Gales Point village-based eco-tourism venture featuring the Manatee Bar hawksbills is planned. A manual for "sea turtle eco-tourism" is currently being prepared by WIDECAST and will be very useful for the Gales Point project.

Since nesting beaches in many parts of Belize are privately owned, one alternative to a government-owned reserve is the formation of a "voluntary sanctuary" for sea turtles by the landowners themselves. By voluntarily agreeing to restrict their building on nesting beaches, minimize the use of lights and vehicles, and prevent others from disturbing turtles and their nests, enlightened owners are making a very positive contribution to the conservation of sea turtles in Belize. The Belize Audubon Society has agreed to help Ambergris Cay landowners establish a Voluntary Sea Turtle Sanctuary along the lines of the Baboon Sanctuary. [N.B. At present, a government-sponsored management plan for the cay includes provisions for strict zoning of the sea turtle nesting area with no construction between Robles and Rocky points.] Whether protected area status is formal or informal (voluntary), regulatory guidelines should be clearly understood by all parties, the enforcement of such guidelines should be clear and consistent, and information about the area should be made available to visitors.

Turtles may also benefit from management plans and protected areas designed for other species. Because coral reefs and sea grass beds are vitally important to commercial fisheries (e.g., lobster, conch, grouper), the protection of turtle foraging areas might logically be tied to fisheries management schemes. The National Fisheries Development Plan recommended that

fish, lobster and conch habitats be protected. These recommendations were never enacted, but the ongoing planning process to develop a management strategy for the coastal zone of Belize will include measures to protect critical habitats. Any effort to safeguard coral reefs and sea grass beds to enhance the production of commercial fishes and invertebrates will naturally benefit sea turtles as well. An Action Plan should be completed in late 1994.

4.121 Involve local coastal zone authorities

The Coastal Zone Management (CZM) Unit evaluates most coastal development projects and thus has an opportunity to recommend that measures be adopted which ensure the protection of turtle nesting and foraging sites. The ongoing CZM Project recognizes that public participation in the planning and implementation process is essential for the long-term success of integrated coastal zone management initiatives. Therefore, the input of community-level organizations such as village councils and tourism associations is actively encouraged. The participation of the northern Ambergris Cay landowners association in the voluntary turtle sanctuary is a good example of community involvement. The World Conservation Union, World Wildlife Fund, and the Wildlife Conservation Society (New York Zoological Society) are presently supporting the CZM Project in Belize. The Project, including institutional and legislative recommendations and the need for strong government and public commitment, is fully described elsewhere (Price and Heinanen, 1992; Young et al., 1992). A comprehensive CZM Action Plan is scheduled to be completed in 1994.

4.122 Develop regulatory guidelines

It is a recommendation of this Recovery Action Plan that when areas are defined as especially critical to remaining sea turtle stocks, regulatory guidelines should seek to establish a framework within which appropriate land use and development (commercial, recreational, residential) can occur. Development proximal to important nesting beaches should carry the requirement that beachfront lighting be designed in such a way as to prevent the disorientation of hatchlings or nesting adults, the construction of buildings seaward of the line of permanent vegetation should be prohibited, and natural beach vegetation should be preserved. Recreational equipment, such as lounge chairs, sail boats and surfboards, should not be allowed to remain on the beach after sunset because it may obstruct nesting or hatching turtles. The construction of solid jetties and sea walls, and coastal activities such as sand mining and dredging should be regulated in such a way as not to result in the erosion of nesting habitat. Indiscriminate anchoring and the disposal of waste at sea should be forbidden.

At the present time, any hotel requesting a development concession on a beach is required to agree to lighting, building, and use restrictions to minimize possible impact on nesting turtles. For example, Statutory Instrument No. 32 of 1990 (an Order made by the Minister of Economic Development) stipulates as a condition of development that the Blue Marlin Resort, Ltd., must, among other things, (1) satisfy the Minister of the Environment that all necessary measures are taken to control any pollution to the environment that may result from the operation of the company, (2) comply with the Fisheries regulations concerning the protection of nesting turtles and their eggs and shall not construct any building or seawall less than 60 ft from the high tide mark; nor use any bright lighting on the beach, and (3) confine pets

during the nesting season and shall generally inform employees and guests of the need to protect turtles. It is a recommendation of this Recovery Action Plan that the government of Belize make enforcement of such restrictions a priority.

We recommend that the following specific guidelines be implemented nation-wide. The recommendations, adapted from Orme (1989) and Eckert (1989b), are further expanded in the section(s) referenced in each category.

1) *Sand mining*: No mining of beach sand should be permitted under any circumstances, and the offshore mining of sediments should be closely monitored for negative effects on down-current coastlines (section 4.131). The persistent removal of beach sand disrupts stabilizing vegetation and exacerbates erosion. The resulting pits not only invite injury to both humans and livestock, but they accumulate water and serve as breeding areas for mosquitoes and other unwanted insects. The ongoing dredging of offshore deposits can result in a deficit of material necessary to maintain adjacent and down-current beaches.

2) *Artificial lighting*: Sea turtles, especially hatchlings, are profoundly influenced by light. Hatchlings depend largely on a visual response to natural seaward light to guide them to the ocean. In zones of coastal development, sources of artificial light distract hatchlings so that they turn away from the sea and crawl landward. It is essential that artificial light sources be positioned so that the source of light is not directly visible from the beach and does not directly illuminate areas of the beach; if lighting must be seen from the beach, it should emit wavelengths (560-620 nm) which are least attractive to sea turtles. Low pressure sodium lights should be used to the maximum extent possible. Low intensity, ground-level lighting is encouraged. Nighttime and security lighting should be mounted not more than 5 m above the ground and should not directly illuminate areas seaward of the primary dune or line of permanent vegetation. No lighting, regardless of wavelength, should be placed between turtle nests and the sea.

Natural or artificial structures rising above the ground should be used to prevent lighting from directly illuminating the beach/dune system and to buffer noise and conceal human activity from the beach. Improving dune height in areas of low dune profile, planting native or ornamental vegetation, or using hedges and/or privacy fences is encouraged. Barriers between 76-85 cm high are generally sufficient to block visual cues from artificial lights (Ehrenfeld, 1968; Mrosovsky, 1970). Ferris (1986) showed that a low fence of black polyester material stretched between three posts and positioned between the nest and a lighthouse resulted in the hatchlings orienting correctly to the sea. Balcony lights should be shielded from the beach, decorative lighting (especially spotlights or floodlights) within line-of-sight of the beach should be prohibited, and safety/security lights should be limited to the minimum number required to achieve their functional roles (section 4.132).

3) *Beach stabilisation structures*: Hard engineering options to beach protection, including impermeable breakwaters, jetties, groynes and seawalls positioned on the beach or in the nearshore zone, should be considered only as a last resort. There are already cases of beaches lost, rather than secured, as a result of armouring in Belize. Sandy beaches are naturally dynamic. The physical characteristics of the coastline should be taken into account prior to coastal construction so that adequate setbacks, rather than expensive and potentially counterpro-

ductive armouring, can be used to provide for the long-term conservation of the beach resource (section 4.133).

4) *Design setbacks*: If development of land adjoining a sandy beach is planned, setback limits should be defined that reflect the damage likely to be caused to the beach and backshore environment during a major storm, and that take into consideration beach and backshore characteristics. Setbacks should provide for vegetated areas including lawns and dunes between hotels, homes and similar structures, and the beach proper. Setbacks of 30-40 m and 80-120 m from the line of permanent vegetation are reasonable guidelines for upland coast development and lowland beach coast development, respectively (section 4.133). Setbacks not only help to protect coastal properties from storm damage, but also reduce overcrowding of the shorezone, lessen the likelihood that local residents will be excluded from the beach, and enhance the probability that artificial lighting will not shine directly on the beach.

5) *Access*: The use of motorized vehicles should be prohibited on beaches at all times and parking lots and roadways (including any paved or unpaved areas where vehicles will operate) should be positioned so that headlights do not cast light onto the beach at night. Driving on the beach creates unsightly ruts, exacerbates erosion, and lowers sea turtle hatch success by compacting nests (section 4.134). Tyre ruts also present a significant hazard to hatchlings crossing the beach. Where vehicles are needed to transport heavy fishing or recreational equipment, multiple access points should be provided and vehicles parked landward of the line of permanent vegetation. Pedestrian access to beaches should be confined to specific locations and strictly regulated so as to minimize destruction of the beach, including backshore vegetation, by trampling. Whenever possible, access should be provided by the construction of elevated walkways built over the primary dunes and positioned to direct foot traffic.

6) *Waste disposal*: No dumping should be permitted within the nearshore, beach, dune, or wetland environment of the shorezone. Such dumping as has already occurred should be subject to immediate cleanup. The fouling of beaches runs counter to the economic interests of residents and landowners, especially hoteliers. The waste is insulting aesthetically, both while on the beach and after washing into the sea. Sunbathing, beach walking, snorkeling, and fishing should not have to been done amid discarded household and construction waste. Further, glass and metal injure turtles and larger objects on the beach can prevent females from finding a nest site and hatchlings from escaping the nest. Visitors should be required to pick up and take with them any garbage or other waste brought to or generated at the beach. Trash cans and regular pickup should be provided at all beaches. To the extent that beach cleanup is necessary, it should be done using hand tools (section 4.134).

7) *Vegetation cover and fires*«: All attempts should be made to preserve vegetation above the mean high tide mark. Creeping vegetation, such as beach bean or seaside bean (Canavalia maritima), seaside purselane (Sesuvium portulacastrum), and beach morning glory or goat's foot (Ipomoea pescaprae), stabilises the beach and offers protection against destructive erosion by wind and waves. Larger supralittoral vegetation, such as West Indian sea lavender (Mallotonia gnaphalodes), sea grape (Coccoloba uvifera), manchineel (Hippomane mancinella), and acacia (Acacia sp.), provides nesting habitat for the hawksbill sea turtle and offers natural shielding for the beach from the artificial lighting of shoreline development (section 4.132). Fires, either for

recreation or charcoal production, should be prohibited on beaches. Fires are a hazard to the surrounding dry forest, create unsightly scars, may scorch sea turtle eggs and hatchlings beneath the surface of the sand, and can disorient hatchlings. Cooking fires should be restricted to designated grill facilities.

8) *Marine pollution*: The dumping of solid or chemical wastes into the sea should be prohibited under all circumstances. In addition to degrading the environment for residents and visitors alike, sea turtles often ingest tar, plastic, rope, and other substances (e.g., Mrosovsky, 1981; Balazs, 1985; Lutz and Alfaro-Schulman, 1991), presumably mistaking these for food, and become weakened or die. It is commonplace for sea turtles to confuse plastic bags with jellyfish and eat them. Polluted effluent, including sewage, from land-based sources should be centrally treated and any noxious chemicals removed before discharging it to the sea. One environmental cost of accommodating increasing boat traffic in Belize is the dumping not only of garbage at sea, but of raw sewage. The latter practice adds nutrients to the water which results in eutrophication and algae overgrowth in shallow coastal areas. See sections 4.143 to 4.146.

9) *Anchoring and dredging*: Anchor damage is a leading cause of destruction to sea grass and coral reefs in the Wider Caribbean. Yachts, mini-cruise ships, and vessels of all sizes should be required to either anchor in designated sand bottom areas or tie in at approved moorings. At this time there are few cost-effective systems for mooring larger vessels, such as cruise ships. Ships longer than 200 ft should be required to dock at port facilities or anchor in specially designated areas. Dredging results in dramatic disruption of the seabed and often heavy siltation of downstream coral and sea grass. Whenever possible, dredging sites should be chosen or timed to cause the least amount of downstream silt and sedimentation (section 4.147).

10) *Physical destruction of coral and sea grass*: Neither living coral reefs nor algal ridges should be dynamited or dragged with chains in order to provide boat access. Anchoring should not occur in reef or sea grass areas (see above, and section 4.147). In the absence of the sheltering influence of offshore reefs, shorelines are often severely altered, resulting in great economic and environmental losses. The practices of using chemicals or dynamite (sections 4.141, 4.142) for the purpose of stunning fish for harvest are prohibited at all times and under all circumstances and should remain so. The destruction of coral reefs resulting from these practices can be irreversible in our lifetime.

4.123 Provide for enforcement of guidelines

Institutional and governmental support for enforcement cannot be over-emphasized. Within marine reserves, the core zone is a no-fishing area. The no-fishing regulation is strictly enforced in Hol Chan where there is day-to-day management and regular patrols. In contrast, no fishing is permitted within the entire protected area at Half Moon Cay Natural Monument (HMCNM), Lighthouse Reef, and the National Park at Laughing Bird Cay, but since no authority is presently based in these reserves enforcement has been relatively ineffective. Illegal fishing within the boundaries of the HMCNM is common. In order to effect compliance with rules and regulations concerning the protection of habitat, visible and consistent law enforcement is necessary.

It is a recommendation of this Recovery Action Plan that a team of Conservation Officers, Wardens, or other law enforcement personnel be responsible for monitoring compliance in protected areas. With regard to conditions imposed on beach-front construction projects, such as setbacks and lighting restrictions, a registered architect, professional engineer, or other authority designated by the Government should conduct a site inspection, including a night survey with all the beachfront lights turned on. The purpose of this inspection would be to verify that beach illumination is minimized and is in accordance with regulations designed to protect nesting, and especially hatching, sea turtles. With regard to enhancing environmental enforcement in general, including protected species, pollution, and game and mining laws, the creation of a Division of Environmental Enforcement is suggested (section 4.24).

4.124 Develop educational materials

Public education, like law enforcement, is crucial to the long-term success of any legal protection of endangered species. Several agencies and organizations participate in environmental education in Belize. The Belize Audubon Society (BAS), Belize Zoo, Belize Center for Environmental Studies, Programme for Belize, Ministry of Agriculture and Fisheries, Ministry of the Environment, and the U. S. Peace Corps are all becoming increasingly involved in environmental education and embrace public awareness as a primary goal. Both HMCNM and Hol Chan have brochures containing information for the visitor, including guidelines and regulations. At HMCNM, the BAS has several interpretative signs along the beach and the path leading to the observation tower in the bird rookery. BAS is also working toward opening a Visitor Center on the Cay. WIDECAST is available to assist in developing or locating educational materials on sea turtles that are applicable and relevant to existing and planned reserves in Belize.

In order for area management planning to be effective, residents, visitors, developers and concessionaires must be aware of regulations in place to safeguard the environment. It is a recommendation of this Recovery Action Plan that materials be readily available to the public and include clear descriptions of what types of activities are permitted and what types of activities are not permitted in the management area. Permanent wooden sign boards at beach entrances are one way to educate users. For example, a sign board may explain that beach fires and littering are not permitted, pets must be leashed, and vehicles must be parked in designated areas. If the nesting beach area is closed to the public at night, this should be clearly indicated. Finally, a phone number to report violations should be provided. Other options include the distribution of informative pamphlets and repeated information provided by the media. The non-government conservation community can be very helpful in promoting a grassroots understanding and appreciation of protected areas.

4.13 Prevent or mitigate degradation of nesting beaches

4.131 Sand mining

The chronic removal of sand from nesting beaches accelerates erosion and degrades or destroys beach vegetation either by removal or by salt water inundation. In severe cases, saline ponds are formed in unsightly pits left by mining operations. It is a recommendation of this Recovery Action Plan that sand mining be prohibited on or near nesting beaches, as it can cause

erosion and beach loss even on down-current beaches by "starving" them of sand. At the present time sand mining is legal in Belize, but a permit is required from the Officer of Geology and Petroleum. Beach sand mining is relatively uncommon; more common is the removal of sediments from river mouths, such as the Sibun River delta a few kilometers south of Belize City. Studies are needed to evaluate erosion of down-current shorelines, such as at Manatee Bar, an important hawksbill nesting site, as a result of offshore mining. Aerial photographs taken over the course of the last several decades clearly illustrate that beaches in the Dangriga area south of Manatee Bar have severely eroded. Offshore mining was implicated, and mining at the mouth of the North Stann Creek River and the river "bar" has been banned for this reason. The Office of Geology and Petroleum has requested that a coastal engineer conduct a study of the dynamics of the shore line with regard to past and present mining activities and make recommendations. It is a recommendation of this Recovery Action Plan that the Office of Geology and Petroleum be fully informed of important nesting beaches so that this information can be taken into account prior to permitting mining activity.

4.132 Lights

Sea turtle hatchlings orient to the sea using the brightness of the open ocean horizon as their primary cue (e.g., Mrosovsky, 1972, 1978). When artificial lights, such as commercial, residential, security or recreational lights, shine on the nesting beach, hatchlings often orient landward toward these lights instead of toward the ocean horizon. The result is often that the hatchlings are crushed by passing vehicles, eaten by dogs and other domestic pets, or die from exposure in the morning sun. Nesting females are also sometimes disoriented landward by artificial lighting. Blair Witherington, examining the problem of artificial lighting on the beaches in Florida (US) and Tortuguero (Costa Rica), found that the presence of mercury vapor lights all but eliminated nesting on affected beaches; nesting of green turtles and loggerheads on beaches so lit was 1/10 and 1/20 that observed on darkened beaches (Witherington, 1992). With this in mind, some beachfront owners in Florida have switched to low pressure sodium (LPS) vapor lighting, which shines primarily in the 590 nm range and has little effect on nesting females. Unfortunately, LPS lights do not appear to constitute a complete answer to this difficult problem because they mildly attract green turtle hatchlings (though to a much lesser extent than do mercury vapor lights; B. Witherington, Florida Dept. Natural Resources, pers. comm.).

An absence of lighting is the best guarantee that hatchlings will safely find the sea. Where this is not an option, Witherington (1990) proposes several "next-best" solutions, including (a) time restrictions (lights extinguished during evening hours when hatching is most likely to occur; e.g., 1900-2300 hrs), (b) area restrictions (restrict beach lighting to areas of the beach where little or no nesting occurs; the effectiveness of this is diminished, however, since sources of light several km away can disrupt hatchling orientation), (c) motion sensitive lighting (sensor activated lighting comes on only when a moving object, such as a person, approaches the light; this might be effective in low traffic areas), (d) shielding and lowering light sources (low intensity lighting at low elevations can be both attractive and adequate for most purposes; the glow can be shielded from the beach by ornamental flowering hedges or other barriers), (e) alternative light sources (LPS lighting is known to be less attractive to hatchlings than full-spectrum white light).

It is important that developers and residents alike understand that sea turtles are very sensitive to light during their reproductive period and as newly emerged hatchlings. It is a recommendation of this Recovery Action Plan that lights (even LPS lights) always be shielded from shining directly on the beach. A common and effective method for accomplishing this is to leave or to plant a vegetation buffer between the sea and shoreline developments. As an alternative, shields can be built into the lighting fixture. Coastal developments in many parts of Florida are required to turn lights out during specified evening hours during the hatchling season so as to reduce the effects of disorientation. In 1990 the Belize Audubon Society suggested to the Ministry of Economics that, as a matter of course for all coastal development concessions, a clause be inserted requiring that artificial lighting not shine directly on a beach at night. Recent applications to build beachfront resorts have been granted with the condition that there be no "bright lighting on the beach" (section 4.13).

In the U. S. Virgin Islands, an overview of the problems posed by beachfront lighting and potential solutions (Raymond, 1984) is issued to all developers seeking permits for projects which may have an effect on sea turtle orientation due to lighting. Most developers now include this information in their environmental impact assessments and are designing appropriate lighting systems (Ralf Boulon, USVI Division of Fish and Wildlife, pers. comm.). In Barbados, Dr. Julia Horrocks (University of the West Indies; WIDECAST Team Member) has sent out a letter to all hotels and restaurants built near the beach asking two things, (1) that security personnel report incidents of sea turtle nesting on the beach, and (2) that lights shining on the beach be redirected or shaded during the breeding season. If the latter is impossible, she suggested that staff examine the grounds each morning and "rescue" hatchlings that mistakenly crawled away from the sea (Horrocks, 1992). We encourage such communication in Belize.

4.133 Beach stabilization structures

Most beaches are naturally dynamic. In order to protect commercial investments such as beachfront hotels, beach stabilization typically involves the use of breakwaters, jetties, impermeable groynes and/or seawalls. These structures are expensive and rarely effective in the long-term. Furthermore, because they interfere with the natural longshore transport of sediment, the armouring of one beach segment can result in the "starvation" and eventual loss of other beach segments down-current. In addition, the armouring of beaches limits access to nesting turtles, such as has already occurred at English Cay, Tobacco Cay, South Water Cay, Carrie Bow Cay, and San Pedro where the best approaches to the nesting habitat are blocked. It is noteworthy that landowners from Ambergris Cay have been involved in establishing a Voluntary Sanctuary where conservation guidelines include agreeing not to build breakwaters or seawalls. It is a recommendation of this Recovery Action Plan that hard engineering options to beach protection, such as breakwaters and groynes, be regarded only as a last resort and that solid structures be disallowed in favour of permeable structures.

The better solution to beach maintenance is an enforced construction setback adequate to reduce or eliminate the risk of losing coastal buildings to routine erosion or violent storms. Setback limits should be defined that reflect the damage likely to be caused to the beach and backshore environment during a major storm, and that take into consideration beach and backshore characteristics. Setbacks should provide for vegetated areas, including lawns and

dunes between hotels, homes and similar structures, and the beach proper. Setbacks of 30-40 m and 80-100 m from the line of permanent vegetation are reasonable guidelines for upland coast development and lowland beach coast development, respectively. Setbacks not only help to protect coastal properties from storm damage, but also reduce overcrowding of the shorezone, lessen the likelihood that local residents will be excluded from the beach, and enhance the probability that artificial lighting will not shine directly on the beach.

Because of the undeveloped nature of most of its coastline, Belize still has the potential to utilize coastal development control as a low cost solution to coastal erosion. It is a recommendation of this Recovery Action Plan that the necessary regulations be passed into law, that the high water mark be clearly defined, and that conservative setback regulations apply to all lowland coasts below the 10 ft (3 m) contour.

4.134 Beach cleaning equipment and vehicular use of beaches

Waste disposal has become a major concern, especially on the cays, due to increasing resident and tourist populations. Most beaches are littered to some extent by recreational users, garbage (e.g., household waste, automobile tyres) thrown into ghauts and washed to the coast, ocean-borne debris and oil, and/or by sea grasses that regularly wash ashore in some areas. It is a recommendation of this Recovery Action Plan that beach cleaning, when necessary, be accomplished using hand tools such as shallow rakes and not heavy machinery or devices that deeply incise the sand. The uppermost eggs in a loggerhead or green turtle nest commonly incubate 15 cm (6 inches) or more beneath the surface of the beach. In contrast, hawksbills construct shallow nests in which eggs are protected by less than 10 cm (4 inches) of overlying sand. Damage to incubating eggs (or hatchlings awaiting an evening emergence) is easily caused by compaction or puncture from mechanized beach cleaning techniques. If raking seaweeds by tractor or other heavy machinery is inevitable, it should be confined to beach zones below the mean high tide line in order to avoid the compaction of sand above incubating eggs. Repeated compaction will kill developing embryos and tyre ruts can trap hatchlings crawling across the beach to the sea. The Belize Audubon Society regularly sponsors beach clean-up campaigns on Half Moon Cay (see also section 4.144).

Beach driving is not a common practice in Belize. Nevertheless, it is a recommendation of this Recovery Action Plan that driving cars and trucks on sandy beaches should be prohibited. Vehicles crush eggs and can kill developing or newly hatched turtles. In addition, tyre ruts are unsightly and create hazards for hatchlings trying to reach the sea. Hatchlings fall into the ruts, which generally run parallel to the sea, and because they cannot get out they die in the morning sun or become an easy meal for a predator. If it becomes necessary, signs should be erected on heavily-used beaches alerting potential drivers to the dangers vehicles pose on nesting beaches. Fliers should also be distributed to car rental agencies. The last alternative may be to prevent access by blocking the terminus of beach access roads.

4.135 Beach rebuilding projects

Beaches are sometimes rebuilt, or replenished, with sand from adjacent areas when erosion of beach areas, particularly those fronting resorts, becomes economically threatening. It

is a recommendation of this Recovery Action Plan that rebuilding, when unavoidable in sea turtle nesting areas, require that replacement sand be similar to the original material in organic content and grain size (thereby maintaining the suitability of the beach for the incubation of sea turtle eggs) and that rebuilding activities do not take place during the primary breeding season. If beaches are rebuilt during the sea turtle nesting season (1 May-31 November), heavy equipment and activity can deter nesting and crush eggs. In addition, the new overburden can suffocate incubating eggs and prevent hatchlings from successfully digging out of the nest. The disadvantages of renourishment are clearly seen on Cay Chapel where rebuilding resulted in a hard compacted sand beach unusable to sea turtles for nesting. Small-scale rebuilding has occurred elsewhere, such as in San Pedro.

It is worth noting that there is an imbalance in the system somewhere when sand is lost from an otherwise predictable beach habitat and is not replaced by natural accretion processes. The underlying cause can be as direct as an up-current solid jetty or pier that is literally "starving" the down-current beaches by interrupting the constant longshore transport of sand and sediments. Or the impetus may be more subtle, as occurs with the removal of beach vegetation or when nearshore pollution retards the productivity of calcareous (coralline) algae and other sand sources. The linkages between development and the persistence of sandy beaches are complex, and should be considered with great care before construction proximal to sandy beaches is permitted. If dunes are leveled, vegetation removed and/or jetties constructed, the likelihood of committing the owners to repetitive and increasingly expensive rebuilding is heightened and sometimes guaranteed.

The clearing of vegetation is a particular problem in Belize. When beach development begins, be it private or commercial, it usually starts by clearing away all the vegetation except for a few coconut trees. In addition to increasing the vulnerability of the cleared site to wind and water erosion (and often incurring the loss of economically important sandy beach habitat), it is important to remember that hawksbills often seek out vegetation for nesting (see section 2.4). Thus, it is vital to leave beach vegetation intact where hawksbills may nest. It is a recommendation of this Recovery Action Plan that clearing within 100 feet (30 m) of the mean high tide line be minimal and developers be required to protect native bushes and other low lying vegetation, such as sea grape (Coccoloba sp.). Removal of beach vegetation has already led to erosion of the shoreline both in San Pedro and at Cay Caulker. To protect property, expensive defenses including seawalls and groynes have been erected. In the Belize City area, the removal of coastal mangroves has also resulted in the erosion of exposed coasts.

4.14 Prevent or mitigate degradation of marine habitat

4.141 Dynamiting reefs

Dynamiting reefs removes coral substrate and is illegal. The Fisheries (Amendment) Regulations, 1991, reads, "11. Any person who uses poison of any description or any explosive with intent to stupefy, poison, take, or kill fish shall be guilty of an offence and liable on summary conviction to a fine not exceeding five hundred dollars or to imprisonment for a period not exceeding six months." The law enforcement agency responsible for enforcing the statute is the Compliance Unit of the Fisheries Department and the BDF Maritime Wing. Reports of viola-

tions should be made to the Fisheries Department. Reef-blasting is periodically carried out by the British, on request by the Government of Belize, to create access for fishing boats near Buttonwood Cay [N.B. coral, dominantly Acropora palmata, grows quickly in this area and occasionally creates problems for the seasonal snapper fishery]. In addition, there was a recent incident of blasting of a reef near Hatchet Cay to open a navigation channel. Finally, there have been unverified reports of illegal blasting by a marine archaeological group. The dynamiting of coral reefs can result in extensive and permanent damage to fish nursery areas, sea turtle feeding areas, and important tourist sites. The use of explosives can also result in death to endangered sea turtles, as was recently the case in Barbados (Julia Horrocks, pers. comm.).

4.142 Chemical fishing

Chlorine and a wide variety of other chemicals are extremely toxic to corals. Chemical-assisted fishing is illegal in Belize under the Fisheries (Amendment) Regulations of 1991 (see section 4.141, above). The law enforcement agency responsible for enforcing the statute is the Compliance Unit of the Fisheries Department and the BDF Maritime Wing. The extent to which chemicals are used to stun and capture small fishes in Belize is not known. Despite the claim of Perkins (1983) that "poisons" are used in fishing, the practice is not believed to be widespread. Because healthy coral reef ecosystems are crucially important to sustainable fisheries and tourism (both economically important industries in Belize), as well as to sea turtles, it is important that fishermen engaging in chemical-assisted fishing be apprehended and prosecuted to the fullest extent of the law.

4.143 Industrial discharges

Industrial discharges can contaminate marine organisms used as food by turtles, as well as fish and shellfish consumed by man. While industrial discharges have not been identified as a significant threat to sea turtles in Belize (largely because of the relative lack of polluting industries), wastes dumped into the Belize River have occasionally resulted in fish kills. As the industrial base of the country expands, the discharge or runoff of industrial waste into rivers, aquifers and coastal areas is likely to increase. Hartshorn et al. (1984) concluded that "Belize's primary contamination problem is water pollution" and recommended that steps be taken to, among other things: (1) render harmless all sugar processing effluents and industrial wastes, especially toxic chemicals like cyanide, (2) prevent chemical effects and sedimentation of rivers and coastal waters that will eventually kill the coral reefs, (3) enforce strong legislation to prevent contamination of ground water aquifers and rivers, and (4) improve urban and industrial waste disposal systems. It is a recommendation of this Recovery Action Plan that industrial discharges be monitored carefully and that legal standards be introduced and enforced. The Environmental Protection Act (No. 22 of 1992) provides the necessary regulatory framework. Residents should be encouraged to report pollution to the Ministry of Environment.

4.144 At-sea dumping of garbage

The dumping of waste at sea is recognized as a growing problem in the Caribbean. Death to marine organisms as a result of ingestion or entanglement is widespread (e.g., O'Hara et al., 1986; Laist, 1987; CEE, 1987). Several years ago, Mrosovsky (1981) summarized data showing

that 44% of adult non-breeding leatherbacks had plastic in their stomachs. In Belize, as is true throughout the Caribbean Sea, dumping violations by the boating community are difficult to monitor and require a concentrated effort at public education, coupled with stiff penalties for offenders. A recent problem has been the disposal at sea of plastic bags by the banana industry. These bags have been observed wrapped around corals and entangled on the prop roots of mangroves. Balazs (1985) summarized worldwide records of ingestion of oceanic debris by sea turtles and listed a wide variety of items consumed, including banana bags ingested by green turtles off Costa Rica.

Garbage is a serious and growing problem in some areas, such as the Sapodilla Cays and Goff's Cay. Manatee Bar, an important hawksbill nesting site, is heavily littered with ocean-borne debris. Regulations enacted in 1980 made it unlawful to discharge or dump ballast, sewage, garbage, liquids, etc. in Belize territorial waters, but enforcement is hindered by a lack of resources (Hartshorn et al., 1984). The Environmental Protection Act (No. 22 of 1992) also restricts dumping at sea. It is a recommendation of this Recovery Action Plan that relevant legislation be fully enforced, and that a public awareness campaign be launched to encourage boaters to properly dispose of waste at shore-based facilities. Announcements should be prepared for radio and newspaper. The campaign should be sponsored jointly by the Government, the non-government conservation community, and the national media. In 1992, Belize, through the Ministry of Tourism and Environment, participated in the international beach-cleanup campaign organized by the Center for Marine Conservation (Washington D.C.).

4.145 Oil exploration, production, refining, transport

Belize has no facility to dispose of or to recycle used oil. Such a facility should be provided as a matter of urgency. Used oil is presently disposed of in any convenient way, including spilt in coastal areas. The accumulation of tar balls and small mats of tar is an increasing problem in some areas, such as Placencia and Ambergris Cay (and other islands near to Belize City, the principal port). These may be the product of ballast-dumping and tanker washing by ships outside Belizean waters (Hartshorn et al., 1984). Given the potential hazardous effects of oil contaminants on sea grasses and coral reefs, bilge pumping and other point sources of oil should be closely regulated. The proximity of Belize to offshore oil discoveries in Mexican waters has spurred exploration for oil in Belizean waters. To date, there have been no discoveries and all 40 exploratory wells were capped successfully before abandonment (see Perkins, 1983, for details).

When we consider both the potential for shipwreck on the reef and the fact that two oil tankers carrying a total of about 55,000 barrels of fuel visit Belize each month, the possibility of oil spills is very real. In 1990, a minor spill occurred from an oil barge near San Pedro, and in 1988, a barge sank on its way to Belize from Honduras (Young et al., 1992). It is a recommendation of this Recovery Action Plan that an Oil Spill Contingency Plan be developed and implemented, and that Government proceed with the acquisition of emergency equipment and personnel training. An "ecosystem vulnerability index" to determine which ecosystems and re-sources are most sensitive to oil pollution should be compiled (Price and Heinanen, 1992). The vast expense of cleaning up oil spills could probably be met only through international co-operative agreements and sharing of costs, such as are encouraged by the Protocol to the Carta-

gena Convention concerning Oil Spills. We urge Government to accede to the Cartagena Convention as soon as possible (see section 4.32). Article 3 of the Oil Spill Protocol states:

> a. The contracting Parties shall, within their capabilities, cooperate in taking all necessary measures, both preventive and remedial, for the protection of the marine and coastal environment of the Wider Caribbean Region, particularly the coastal areas of the islands of the region, from oil spill incidents.
>
> b. The contracting parties shall, within their capabilities, establish and maintain, or ensure the establishment and maintenance of, the means of responding to oil spill incidents and shall endeavor to reduce the risk thereof. Such means shall include the enactment, as necessary, or relevant legislation, the preparation of contingency plans, the identification and development of the capability to respond to an oil spill incident and the designation of an authority responsible for the implementation of this protocol.

In the context of this Recovery Action Plan it is important to note that sea turtles are potentially very vulnerable to oil spills. Behavioral studies suggest that sea turtles have a limited ability to avoid oil slicks. Physiological experiments indicate that the respiration, skin, some aspects of blood chemistry and composition, and salt gland function of 15-18 month old loggerheads are seriously affected by crude oil (Vargo et al., 1986). In both experimental and stranded oil-fouled turtles, Vargo et al. (1986) observed oil clinging to the nares and eyes and in the upper portion of the esophagus; oil was also found in the feces. Chemical analysis of the internal organs of the stranded turtles provided clear evidence that crude oil from tanker discharge had been ingested. Since hawksbills are of particular concern in Belize, it is noteworthy that hawksbills (predominantly juveniles) accounted for only 2.2% (34/1551) of the total sea turtle strandings in Florida between 1980-1984, yet comprised 28.0% of petroleum-related strandings. Oil and tar fouling was both external and internal. Carr (1987b) reported juvenile hawksbills (to 20 cm) "stranded [in Florida] with tar smeared sargassum"; some had ingested tar.

4.146 Agricultural runoff and sewage

In 1982 only about 15% of the arable land was under cultivation or used for grazing cattle, and agriculture was identified as the highest priority for development in Belize (Perkins, 1983). The potential effects of siltation due to clearing additional land and of contamination of rivers and nearshore waters by pesticides and fertilizers should be assessed. Local fish kills have already been reported in Belize rivers due to the runoff of agricultural chemicals. The CZM Project has initiated a reef assessment programme to monitor the effects of agro-chemical runoff on corals. It is a recommendation of this Recovery Action Plan that discharge of untreated sewage be monitored, as well. The greatest effect of agro-chemicals and sewage on sea turtles is likely to be the effect of these chemicals on important habitats, such as coral reefs, because the barrier reef ecosystem is inextricably linked to mainland activities via the numerous rivers that transport inland runoff to the sea. Siltation from soil erosion due to deforestation and chemical contamination of waters from the application of herbicides, pesticides, and fertilizers have caused coral deaths by suffocation and toxic pollution in other parts of the world (Perkins, 1983).

4.147 Others (anchoring, dredging, land reclamation)

Indiscriminate anchoring is a serious environmental problem throughout the Caribbean. The destruction of coral can sometimes be irreparable in our lifetime, and with the loss of our reefs will come the loss of all vertebrate and invertebrate species that depend on the reefs. Furthermore, channels and holes in the reef structure left by repetitive anchoring can alter current and tidal patterns and promote the erosion of bottom sediments. The devastation of our coral reefs will eventually (and sooner rather than later) destroy not only the marine-based tourism economy, but local fisheries and many shoreline investments which are now protected by extensive reef formation offshore. Mooring buoys have been installed in the Hol Chan Marine Reserve and at Lighthouse Reef. The CZM Project plans to expand the system to all popular dive sites. It is a recommendation of this Recovery Action Plan that a national system of moorings be established. Inexpensive and effective mooring technologies (e.g., Halas, 1985) make such a recommendation attainable.

Dredging and land reclamation activities affecting the coastline and inshore waters can severely degrade sea turtle foraging and refuge areas. All such activities should be conducted in such a way as to minimize damage to benthic communities resulting from turbidity. Turbidity (suspended sediment) degrades and smothers, sometimes fatally, surrounding coral reefs and sea grass beds. Dredging operations have been a problem in the Belize City area, around Ambergris Cay, and around some of the other cays. Permits are required for dredging by the Inspector of Mines, Office of Petroleum and Geology. At the time of their writing, Hartshorn et al. (1984) found "no evidence that environmental considerations are examined prior to port maintenance (e.g., dredging) or development activities." Today the situation has improved, as evidenced by the fact that site assessments are routinely performed by the Office of Geology and Petroleum in collaboration with the Fisheries Department.

4.2 Manage and Protect all Life Stages

4.21 Review existing local laws and regulations

Sea turtles are currently protected by the Fisheries Regulations of 1977, but the Fisheries (Amendment) Regulations of 1993 will substantially strengthen existing law. Under the 1977 Regulations, it is illegal to "export or attempt to export any turtle or any articles made from any part of a turtle otherwise than under a license granted by the Minister", to take turtles "found on the shores of Belize and adjacent cays thereof", to "set or attempt to set within 100 yards of the shores of Belize or of the adjacent cays thereof any net or seine or other instrument whatsoever for the purpose or with the intent of taking turtles", to take or possess "any turtle eggs", to take or possess any turtle from 1 June to 31 August, and to take, buy, sell or possess loggerheads less than 30 lb, or greens or hawksbills less than 50 lb. A commercial fisherman's license at the cost of B$ 2.00 is necessary in order to take turtles (a fisherman must indicate at the time of licensing that he wishes his license to include sea turtles). There is a maximum fine of B$ 500.00 for persons convicted of violating the Fisheries Regulations.

The Fisheries (Amendment) Regulations of 1993 will read as follows:

10. (1) No person shall fish, sell, purchase or have in his possession any turtle, other than turtles of the species Dermatemys mawii (commonly known as hickatee), during the period from the 1st April to the 31st October, inclusive, in any year.
(2) No person shall take any turtle found on land.
(3) No person shall interfere with any turtle nest.

11. No person shall disturb, damage, take, sell, purchase or have in his possession any turtle eggs.

12. No person shall set or attempt to set within one hundred yards of the shores of Belize or of the adjacent cayes thereof any net or seine, or other instrument whatsoever for the purpose or with the intent of taking turtles.

12.(A) No person shall fish, sell, purchase or have in his possession any turtle of the following description:
(1) Chelonia mydas, commonly known as green turtle, greater than 60 cm (24 in) curved carapace length;
(2) Caretta caretta, commonly known as loggerhead turtle, greater than 60 cm (24 in) curved carapace length.

12.(B) [specifies restrictions pertaining to D. mawii]

12.(C) No person shall import, bring into Belize in transit or export any turtle without a valid permit issued by the Minister.

12.(D) (1) No person shall buy, sell, or have in his possession any articles made of turtle shell;
(2) Any person who on the date of entry into force of these Regulations has in his possession any articles made of turtle shell (a) may detain such articles for personal use; (b) shall not sell such articles later than 31st July, 1993.

13. No person shall at any time fish, sell, purchase or have in his possession any turtle of the species Eretmochelys imbricata, commonly known as hawksbill turtle.

Editor's note: Four species of sea turtle (loggerhead, green, hawksbill, leatherback) were briefly protected under the Wildlife Protection Act of 1981 but were removed from the schedule in January 1982 on the grounds that the designation contradicted existing Fisheries legislation.

4.22 Evaluate the effectiveness of law enforcement

Conservation law enforcement could be much improved, but this will require greater will and expanded resources on the part of the Government. It will also require a greater commit-

ment on the part of the citizenry to obey conservation legislation. Both the Fisheries legislation and the Wildlife Protection Act grant the Minister powers to appoint enforcement personnel. In the first case, Fishery Officers are appointed to "carry into effect the provisions of the Fisheries Act and Regulations made thereunder". To date, these include all members of the Maritime Wing of the Belize Defence Force, the Manager and Biologist for Hol Chan Marine Reserve, and Fisheries Department personnel. In addition, any member of the Management Committee of a fishing co-operative can be so appointed. In the case of wildlife regulations, a Game Warden and game rangers are given powers of search, seizure and arrest to enforce the Wildlife Protection Act.

Enforcement is crucial to the long-term success of any legal protection of endangered species. In recognition of this fact, increased enforcement capabilities were recommended in the National Fisheries Development Plan (1983-1988). With funding from the U. S. Agency for International Development, the Fisheries Department has recently established a Compliance Unit which has five new patrol boats. Two law enforcement officers have been hired for each boat, in addition to an administrative officer and a mechanic. The Unit greatly enhances the Department's surveillance and enforcement capabilities. Arrests, convictions, and confiscations are on the rise and regular marine patrols are having a palpable effect on illegal fishing. One patrol boat is based in Punta Gorda; the other four are based in Belize City.

4.23 Propose new regulations where needed

4.231 Eggs

The taking or possession of eggs is prohibited at all times (section 4.21). Thus there is no need for a new law, but rather for more effective enforcement of the existing law. Egg poaching is widespread, particularly in the southern Sapodilla Cays (Smith, 1990b) (see also section 3.3). The annual nationwide theft of eggs has been estimated at 10,000 (Miller, 1984), but the actual volume is not known. The protection of eggs is important to the recovery of sea turtle populations nesting in Belize. Adult females are believed to return to their natal beaches to deposit their eggs. It is self-evident that if too few eggs are allowed to hatch, there will be no future generations of sea turtles. Natural mortality is high and less than one percent of the eggs laid will reach adulthood. Therefore, many thousands of eggs are needed to sustain a population. Eggs should be carefully protected to ensure that as many as possible hatch successfully.

4.232 Immature turtles

Earlier drafts of this Recovery Action Plan urged the Government to revise the Fisheries Regulations of 1977 because they sanctioned the continued take of large juveniles and breeding-age adults during a nine-month open season (1 September-31 May). Traditional fisheries regulations which protect small juvenile size classes reflect a conventional wisdom that it is unwise to harvest an animal before it has had a chance to breed. This argument is appropriate for fishes and crustaceans with relatively short life spans. Most species of sea turtle, however, require upwards of two decades to reach sexual maturity in the Western Atlantic and Caribbean (Frazer and Ehrhart, 1985; Frazer and Ladner, 1986). In some parts of the world, green turtles may not breed until they reach nearly a half century in age (Balazs, 1982).

It is imperative that sea turtle conservation regulations reflect the biological realities of long-lived species; that is, that regulations protect large juveniles rather than small juveniles. We are pleased that the Ministry heeded our recommendations (see also Appendix I) and that the Fisheries (Amendment) Regulations of 1993 will fully protect green and loggerhead sea turtles larger than 60 cm shell length. These individuals have reached approximately ten years of age and it can be shown mathematically that they are dramatically more "valuable" to the future reproductive potential of the population than are the younger turtles (cf. Frazer, 1989). Natural rates of mortality are high for eggs and small turtles, which are constantly replenished from productivity on the beaches. In contrast, larger juveniles represent many years of selective survival and their loss, especially in populations already declining, can be catastrophic.

This is not to say, however, that the continued harvest of any immature sea turtle is warranted in Belize since it has been established that sea turtle populations are declining and it is well known that no one depends on sea turtle-derived income for a major portion of their livelihood. It is the view of this Recovery Action Plan that any harvest in declining populations is counter-productive to the goal of population recovery and so while we applaud the advances made in the 1993 Regulations, we view the Regulations as a short-term compromise between a full moratorium on the one hand and the continued take of large juveniles and breeding-age adults on the other. We urge Government to enact an unconditional moratorium on all species of sea turtle, as has already been done on behalf of the hawksbill (section 4.21). In the interim, a detailed study of income derived from fishing turtles should be undertaken and credible alternatives for turtle fishermen should be formulated by the Fisheries Department (section 4.26).

4.233 Nesting females

The Fisheries Regulations prohibit the taking of nesting females on the beach at all times (section 4.21). Determined enforcement is needed in this regard.

4.234 Unprotected species

Although rare in Belizean waters, endangered leatherback and Kemp's ridley sea turtles are occasionally reported (section II). Neither species is mentioned under the current fisheries law. Both are internationally recognized to be endangered species and should be fully protected.

4.24 Augment existing law enforcement efforts

Recognizing that environmental law is becoming increasingly important and increasingly technical in Belize, as is the case throughout the Caribbean region, it is a recommendation of this Recovery Action Plan that the Division of Environmental Enforcement be established. Officers should be trained in environmental law and enforcement procedures and be responsible for regulations concerning mining and minerals, pollution, protected species, fisheries and marine resources, boater safety, game and hunting, coastal zone permits and compliance, etc. A national workshop should be convened to better inform all branches of law enforcement of conservation regulations and the urgent need to consistently enforce domestic and international laws protecting turtles, lobsters, conchs, etc. A Manual of existing environmental legislation should be developed for public distribution.

Enforcement of Fisheries Regulations is particularly difficult on the offshore cays. Almost every confirmed nesting site is inhabited by fishermen and coconut pickers, particularly just before and after lobster season opens on 15 July, and those few not inhabited are usually close to inhabited areas and regularly visited (Smith, 1990b). Where enforcement is hampered by remote conditions or limited personnel, citizens should be encouraged to share in the responsibility by reporting violations. Citizens should also become more involved in lobbying for more effective law enforcement programmes. It is a recommendation of this Recovery Action Plan that citizens become familiar with laws protecting wildlife so that they can report violations. With the support of the local community, enforcement resources are more efficiently utilized. And as more people become involved in reporting violations, it will become increasingly difficult for wrongdoers to ignore wildlife laws. The Department of Fisheries sponsors an Environmental Hotline to enable citizens to report illegal activities, injured wildlife, etc.

In order to enhance compliance with the 1993 Fisheries Regulations, which allow the take of young loggerhead and green turtles during a five-month open season but protect hawksbills at all times, trammel nets should either be banned (as has recently been done in St. Lucia) or set so that they float to the surface, allowing captured sea turtles to breathe. Fishermen should be required to check nets frequently to minimize the prospects of accidentally drowning protected species and size classes.

4.25 Make fines commensurate with product value

The existing maximum fine (B$ 500) for violation of the Fisheries Regulations is commensurate with the legal, local value of the product. However, it is a recommendation of this Recovery Action Plan that a maximum monetary penalty of B$ 5,000 be adopted to convey the message that violations against the Fisheries Regulations are viewed as a serious offence. As the closed season lengthens and ultimately culminates in year-around protection for endangered sea turtles, potential black marketeers are not likely to be deterred by a B$ 500 fine.

4.26 Investigate alternative livelihoods for turtle fishermen

No one depends on income derived from sea turtles to provide a majority portion of their living, but the monies earned are important in some cases and consideration should be given to the fishermen still fishing primarily turtles in Belize. Fewer than ten men are involved, most are 50 years of age or older, and they also fish for fish, lobster, and/or conch. The government has been requested by the Belize Audubon Society, Programme For Belize, and Belize Center for Environmental Studies to limit permits to fish turtles to only those fishermen who have traditionally fished turtles, thus gradually allowing turtle fishing to disappear. To date there has been no response to this request. "Traditional" turtle fishermen are defined to be those men who have fished specifically for turtles in the past, as indicated on their fishing license.

It is a recommendation of this Recovery Action Plan that the Department of Fisheries consider purchasing turtle nets and/or offering training and other support toward increasing income derived from reef fish. The deployment of Fish Attracting Devices (FADs) and the designation of additional Marine Reserves could also increase fish recruitment. Before reasonable alternatives can be formulated, the extent to which fishermen will be affected by a

moratorium on the capture of turtles should be determined. Surveys have already been conducted by Fisheries personnel on the market side of the equation. In the summer of 1991, hotels, restaurants, retail stores, and selected citizens were asked to describe any concerns or reservations they had regarding removing sea turtle meat and products (e.g., shell jewelry) from the marketplace. An overwhelming 97% responded that eliminating sea turtles from their menu or product lines would not adversely affect their businesses.

To the extent possible, bearing in mind that formal records have not been kept, a Sea Turtle Fishery Frame Survey should determine: (1) number of men active in the turtle fishery, (2) number of turtles caught per year, (3) species and size classes caught, (4) capture methods, (5) capture/landing sites, (6) catch per unit effort, (7) gear in possession, (8) gear used and frequency of use, (9) cost of gear, (10) market price for turtle meat and products, (11) income and proportion of total income derived from turtles. Historical trends in catch per unit effort are also important. Do hunters travel further today than they did 20 years ago to obtain turtles? Set their nets (or wait on the nesting beach) for longer periods of time? With Frame Survey data in hand, tenable scenarios for enhancing alternative sources of income can be developed and implemented. The Frame Survey will also provide an opportunity for Fisheries personnel to talk with fishermen about the endangered status of sea turtles, stress the importance of a Caribbean-wide moratorium on these migratory species, and solicit comments on a national moratorium.

The following points should be emphasized when talking to fishermen:

1. Sea turtles are long-lived, reaching sexual maturity in 20-35 years.
2. Mortality is high in young juvenile stages, but extremely low for fully armoured large juveniles and adults.
3. Adult females average five clutches of eggs per year and nest every 2-5 years; under natural conditions females live for many years and lay thousands of eggs in order that populations remain stable.
4. Unfortunately, large turtles have historically been targeted because they provide the most meat; Fisheries laws usually protect only small turtles.
5. Egg-bearing adult females are taken in disproportionate numbers because they are easily obtained from the nesting beach.
6. Harvesting large turtles, especially gravid females, is the surest way to invite population collapse (this has been observed at rookeries throughout the world and is easily shown mathematically).
7. Sea turtle populations *cannot sustain* the persistent harvest of large juvenile and adult animals.
8. Nesting populations have been greatly reduced or exterminated all over the Caribbean, including in Belize, because adults are not survi-ving long enough to produce the next generation (the widespread harvest of eggs only exacerbates this problem).
9. The fact that nesting populations have been decimated but juvenile turtles are still seen is not surprising -- the stocks are unrelated.
10. Juveniles travel widely during the many years prior to maturity – local juveniles are not residents, they are a shared regional resource.

11. Nesting females, which return to Belize at regular intervals to lay their eggs on beaches where they were born many years ago, leave Belize at the end of the nesting season and return to resident feeding areas which are most likely located in distant countries.
12. All nations must work together if this shared resource is to survive.

4.27 Determine incidental catch and promote the use of TEDs

Despite a relatively small shrimping industry, several hundred sea turtles may be captured annually incidental to this fishery. Carr et al. (1982) reported that "in July 1978, shrimp trawling was just beginning in Belize, and reports of turtle deaths in trawls were already coming in." Gillett (1987) reported to the Second Western Atlantic Turtle Symposium that the fleet had expanded from seven to 11 boats and that "conservative estimates" placed the 1986/87 season's incidental catch from seven vessels at 700 turtles, mostly hawksbills and green turtles. Turtles are not the only bycatch concern. A recent study estimated that finfish bycatch exceeds by more than five times the annual finfish export. As the majority of the bycatch consists of juvenile fishes which are simply discarded at sea, "the consequent reduction in the spawning stock may produce a significant impact" (RDA International, 1991). The same can be said for sea turtles; that is, the persistent drowning of turtles in trawls may result in fewer turtles surviving to reproductive age. The U. S. National Academy of Sciences has concluded that shrimp trawling results in more sea turtle deaths in U. S. waters than all other human activities combined and is an important factor in the continuing decline of nesting populations of loggerhead turtles (National Research Council, 1990). Shrimp vessels operating in U. S. waters are now required to use turtle excluder devices (TEDs) in their trawls during all times of the year (Crouse, 1993).

In response to a 1989 law (Appendix II) passed in the United States to "ban the importation of shrimp or products from shrimp...[unless] (a) the government of the harvesting nation has provided documentary evidence of the adoption of a regulatory program governing the incidental taking of sea turtles in the course of such harvesting that is comparable to that of the United States, (b) the average rate of that incidental taking by the vessels of the harvesting nation is comparable to the average rate of incidental taking of sea turtles by United States vessels in the course of such harvesting, or (c) the particular fishing environment of the harvesting nation does not pose a threat of the incidental taking of sea turtles in the course of such harvesting", the Government of Belize submitted a report to the U. S. Department of State outlining a three-year program for the conservation of sea turtles by its shrimping industry. In this report, government officials acknowledged the problem of incidental catch and endorsed the idea that TEDs be required when fishing in Belizean waters.

A short-term study undertaken by RDA International for the Government of Belize "to identify qualitative and quantitative attributes of the bycatch in shrimp trawls" reported six turtles (four loggerheads, two green turtles) caught in 188 drags in the Inner Channel. Three were caught in five days in September 1990 and three were caught during two weeks in January-February 1991. Extrapolation suggested that a total of 87 turtles would have been captured during the 1990/91 shrimp season (RDA International, 1991). Based on interviews with shrimp fishermen, the authors of this Recovery Action Plan learned that shrimp trawlers catch greater numbers of turtles when trawling near the coast and there are certain areas where

turtles can be expected to be caught by the trawlers. Also, beach residents in Placencia have reported seeing trawlers fishing just off the beach where hawksbills regularly nest. We believe that the annual fleet catch is likely to be greater than 87 turtles and that it includes gravid females which are fully protected by law. It is a recommendation of this Recovery Action Plan that any national conservation programme for the recovery of depleted sea turtle stocks necessarily include the mandatory use of TEDs at all times by trawlers operating in Belizean waters.

The Government recently reaffirmed its intention to make the use of TEDs compulsory on all shrimp trawlers and promised to take "appropriate measures to reduce incidental mortality, including the use of TEDs by all shrimp vessels operating at times and in areas where there is a threat of taking sea turtles" (Ministry of Foreign Affairs, in litt. to the U. S. Department of State, 1991). In addition to improvements in sea turtle conservation legislation and the preparation of management plans for important sea turtle habitat, the Government has stated that "TEDs will be deployed on all commercial shrimp trawl vessels operating in the waters of Belize by May 1, 1994. Further, in order to achieve this goal, the Government of Belize will begin during 1992 with testing and evaluation of TEDs and will have TEDs in use on a significant number of commercial shrimp vessels by May 1, 1993" (Government of Belize, 1992). Representatives of both Government and the fishing industry in Belize participated in a TED Workshop conducted by the U. S. National Marine Fisheries Service in Panama in February 1991 (William Gibbons-Fly, U. S. State Department, pers. comm.). Since the trawlers operating in Belizean waters are foreign (Honduran) vessels and a permit is needed to trawl and land shrimp in Belize, the use of TEDs could logically be required as a prerequisite for such a permit.

In addition to the incidental catch of sea turtles by shrimpers, other fishing industries in Belize also catch turtles. For example, the use of gill nets to catch finfish and sharks seems to be on the increase and gill nets are well known to catch and drown sea turtles in Belize (Will Eiley, fisherman, pers. comm.). Gill nets have been observed set in waters adjoining Manatee Bar, the most important hawksbill nesting beach in Belize, during the nesting season. With an estimated 20-25 hawksbills nesting on this beach each year, the loss of even one drowned turtle could have adverse effects on the population (Smith, 1991). Longline vessels unintentionally hook sea turtles. The capture of sea turtles by longlines has been documented in the northeast Caribbean (e.g., Tobias, 1991; Eckert et al., 1992; Fuller et al., 1992), the southeastern U. S. (Witzell, 1984), and the Gulf of Mexico (Hildebrand, 1987). It is not known how long the turtles survive after being released with a large hook embedded in their mouth or throat. A small longline industry targeting sharks outside the barrier reef has recently begun and is reportedly hooking leatherback turtles. It is a recommendation of this Recovery Action Plan that all incidents of sea turtle capture be reported to the Fisheries Department, allowing the extent of incidental catch to be determined and mitigating measures taken.

4.28 Supplement reduced populations using management techniques

There are several management techniques that are likely to benefit sea turtles in Belize. For example, beach predator control (removal/relocation) and/or individual nest protection using wire mesh or netting should be implemented when field studies indicate that such measures are necessary. Near complete depredation of eggs laid at the Manatee Bar nesting area by raccoons prompted a successful pilot programme to protect nests in 1992 using netting (Smith, 1993). Sea

turtle conservationists have learned a great deal in recent years from participating in WIDECAST and attending annual symposia on the Biology and Conservation of Sea Turtles in the USA. The information gained and contacts made, as well as materials such as the "WATS Manual" (Pritchard et al., 1983) that are available to conservationists in Belize, will help us evaluate threats and design appropriate responses. Management techniques such as "head-starting" and other captive rearing schemes have yet to demonstrate conservation benefit to wild populations and are beyond the capabilities and facilities presently available in Belize. These options are not considered a priority. We are confident that much can be accomplished by the vigilant protection of wild turtles and the long-term conservation of terrestrial and marine habitat. Monitoring programmes, discussed below, are essential in order to detect new threats as they emerge and to evaluate the success of ongoing management programmes.

4.29 Monitor stocks

4.291 Nests

It is very important to monitor trends in sea turtle productivity. The easiest way to do this is to count nests on the beach. The sooner this is initiated the better, because it will take many years to identify statistically significant population trends using nest numbers. Under normal circumstances the numbers of females breeding in any given year fluctuate widely, presumably because of physiological differences amongst females and variations in ambient conditions, such as food availability. Therefore, long-term databases are needed to accurately document population dynamics. In Belize we must start with the reality that sea turtle nesting has declined (older turtle fishermen interviewed in Belize reported larger numbers of turtles nesting on beaches when they were children than at present; Smith, 1989, 1990b) and now we must do what we can to protect remaining nests from egg poaching, feral and exotic predators, man-induced beach erosion, and habitat degradation. Only in this way, and coupled with the conservation of other life stages, can we ensure the continued survival of the sea turtle in Belize.

Nest counts should be initiated on a priority basis on nesting beaches known to be important to sea turtles (e.g., Ambergris Cay, Manatee bar) and in areas thought to be important and known to have high levels of poaching (e.g., Sapodilla Cays). Surveys should occur on a regular basis so that "trends" do not emerge simply as a result of the fact that beaches received more coverage during certain days of the week, or certain months of the year. Crawls should be smoothed over after being counted so that they are not counted twice; this also protects the nest somewhat against poaching. Beaches should be surveyed for hawksbill nesting at dawn, ideally daily (the crawl is faint and easily obscured) but at least three times a week. All data should be coordinated by a designated government or non-government entity. Annual surveys are ongoing at Manatee Bar.

We have had good success with our nest monitoring programme to date. For instance, as described by Smith (1990c) in the Belize Audubon Society (BAS) Newsletter, by 1988 high levels of visitation to nesting areas on the northern coast of Ambergris Cay had resulted in >30% of the nests there being disturbed. In response, the BAS, with help from the Fisheries Department and the Hol Chan Marine Reserve (and financial support from Programme for Belize, landowners Jo and Wayne Castleberry, and the North Ambergris Cay Property Owners

Association) organized beach patrols by volunteers to protect the nests laid in 1989 and 1990. Volunteers stayed 15 miles north of San Pedro for intervals of one week and patrolled the beach daily throughout the nesting season. As a result, only a few nests were disturbed and the people responsible left future nests alone, after seeing volunteers patrolling and learning about their work to protect the sea turtles. Thousands of hatchling turtles have thus been protected and poaching has been nearly eliminated.

4.292 Hatchlings

When possible, nests should be monitored for hatching in order to assess hatchling mortality due to disorientation (from artificial light sources shining on the beach, see section 4.132), depredation, and other sources (harassment from people, entanglement in beach debris, etc.). Monitored nests should be exhumed post-hatching by trained personnel and hatch success and embryo mortality should be determined. This will not be possible at every site, but a representative sample is useful in quantifying hatchling production. At present, nests are monitored at Manatee Bar. Once hatchlings leave the beaches of Belize their whereabouts are unknown. During recent interviews, two fishermen reported having seen "young turtles in drift lines of ocean weeds in the Bay of Honduras" and a few fishermen had also observed "very young turtles near mangroves at Turneffe, San Pedro and Hunting Cay" (Smith, 1989). Monitoring hatch-lings at sea is not feasible at this time.

4.293 Immature and adult turtles

The monitoring of sea turtle populations in the water is no easy task and requires systematic surveys of known foraging grounds. If such surveys are undertaken in conjunction with a tagging programme, it is possible to evaluate not only trends in abundance at the feeding ground, but also foraging behavior and the movements of individuals (since a tagged turtle may be recaptured elsewhere). Nonetheless, it is not imperative to tag individuals. Valuable data can be obtained by repeated surveillance of foraging areas with documentation of the number of turtles seen. Fisheries statistics would be useful in evaluating historical trends in sea turtle abundance, with the caveat that the take of small juveniles is not reported because it constitutes an illegal catch. Market surveys may also yield helpful information and should be initiated.

The use of laparoscopy and other sophisticated techniques can also shed light on the status of populations by assisting in the determination of breeding state, breeding history, recruitment rate, and a variety of other vital statistics. These kinds of studies have been ongoing in the Great Barrier Reef ecosystem of eastern Australia for many years and have yielded valuable information regarding the status of sea turtle populations there (Colin Limpus, Queensland National Parks, pers. comm.). It would be most useful to employ telemetry to ascertain the foraging grounds of the Manatee Bar hawksbill population, and then proceed to study the population at both the nesting and feeding ground. This would allow a much more accurate determination of the status of this population.

4.3 Encourage and Support International Cooperation

4.31 CITES

The 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) was established to protect certain endangered species from over-exploitation by means of a system of import/export permits. The Convention regulates international commerce in animals and plants whether dead or alive, and any recognizable parts or derivatives thereof. Appendix I lists endangered species (including all species of sea turtle), trade in which is tightly controlled; Appendix II lists species that may become endangered unless trade is regulated; Appendix III lists species that any Party wishes to regulate and requires international cooperation to control trade; Appendix IV contains model permits. Permits are required for species listed in appendices I and II stating that export/import will not be detrimental to the survival of the species. CITES is one of the most widely supported wildlife treaties of all time. With the recent accession of Barbados, the Convention has 118 Parties (USFWS, 1992).

Belize is a Party to CITES, having registered a Declaration of Succession on 21 September 1981 (Bräutigam, 1987; UNEP, 1989). In addition, the export of turtle products is illegal under Belizean law, except with a special permit from the Minister of Agriculture and Fisheries. Enforcement of CITES is problematic because Customs Officers are not trained to recognize endangered species or products derived therefrom, and regular checks do not occur. It is a recommendation of this Recovery Action Plan that training be provided for Customs officials with regard to the details of implementing CITES. Such training should include identification of animal and plant parts and products, the proper issuance of documents, permit fraud, shipping container standards, the transport of live animals, methods of search and seizure, etc. The need for such training should be communicated to John Gavitt, Enforcement Officer, CITES Secretariat, 6 rue du Maupas, Case postale 78, 1000 Lausanne 9, Switzerland.

Large volumes of raw hawksbill shell (tortoiseshell, or "bekko") have been exported during the last two decades. Of the approximately 5,200 hawksbills estimated to have been taken from the waters of Belize for export to Japan from 1970-1986, more than 4,000 were exported after 1981 (Milliken and Tokunaga, 1987). Current export statistics are not available, but reliable reports indicate that the trade continues illegally. The cumulative effect of the international market on Caribbean sea turtles, especially hawksbills, should not be underestimated. Because Japan entered a "reservation" on some sea turtle species when it joined CITES, Japanese imports of tortoiseshell from 1970-1989 totalled 713,850 kg, representing >670,000 turtles; more than half of these imports originated in the Caribbean and Latin America (Milliken and Tokunaga, 1987, updated by Greenpeace to 1989). In addition, from 1970-1987 Japan imported 675,247 kg of stuffed hawksbills (Greenpeace, 1989). Milliken and Tokunaga (1987) estimated that in order to maintain these levels of importation, the annual slaughter of at least 28,000 hawksbills was required. Between 1970 and June 1989, Japan imported 368,318 kg of bekko from the Wider Caribbean . . . the equivalent of more than a quarter million turtles (Canin, 1989).

Because all nations of western Europe, as well as North, Central and South America, belong to CITES, it is illegal for tourists returning home to these countries to bring sea turtle items with them. Furthermore, it is technically illegal for Belizean merchants to knowingly sell sea turtle items to tourists without issuing them a CITES export permit. By selling and purchasing tortoiseshell, merchants and tourists unwittingly (and illegally) contribute to the further decline of sea turtles in the Caribbean region.

4.32 Regional treaties

In 1940, the Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere was negotiated under the auspices of the Pan American Union. Twelve of the parties to the Western Hemisphere Convention are in the wider Caribbean region. However, the Convention contains no mechanism for reaching decisions binding upon the parties, but leaves each party to implement the treaty's provisions as it find "appropriate". The Bonn Convention for the Conservation of Migratory Wild Animals, if ratified by enough nations in the wider Caribbean, could be an effective tool in the conservation of migratory species, such as sea turtles. It was developed to deal with all threats to migratory species, including habitat destruction and taking for domestic consumption. Unfortunately, only France, the Netherlands and the United Kingdom, among nations with claims in the Caribbean Sea, have signed this Convention.

A relatively recent regional environmental Convention that shows great promise is the United Nations Environment Programme's (UNEP) Regional Seas Convention in the Caribbean, known as the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (or, the "Cartagena Convention"). The Convention is coupled with an Action Plan, known as the Action Plan for the Caribbean Environment Programme (APCEP). The First Intergovernmental Meeting on APCEP was convened by UNEP in cooperation with the Economic Commission for Latin America (ECLA) in Montego Bay, Jamaica, 6-8 April 1981. The representatives of Governments from 22 States in the region (Belize was not represented) adopted APCEP at this meeting and established the Caribbean Trust Fund to support common costs and activities associated with the implementation of the Action Plan.

In March, 1983, a Conference of Plenipotentiaries met in Cartagena, Colombia to negotiate the "Cartagena Convention". Representatives from 16 States participated (again, Belize was not represented). The Conference adopted both the Convention and a Protocol concerning cooperation in combating oil spills in the region. The Convention describes the responsibilities of Contracting Parties to "prevent, reduce and control" pollution from a variety of sources (i.e., pollution from ships, from at-sea dumping of waste, from land-based sources, from sea-bed activities, and from airborne sources). Article 10 is of special interest in that it addresses the responsibilities of Contracting Parties to "individually or jointly, take all appropriate measures to protect and preserve rare or fragile ecosystems, as well as the habitat of depleted, threatened or endangered species, in the Convention area." The Cartagena Convention entered into force on 11 October 1986.

In January 1990, a Protocol Concerning Specially Protected Areas and Wildlife (SPAW) to the Cartagena Convention was adopted by a Conference of Plenipotentiaries, providing a mechanism whereby species of wild fauna and flora could be protected on a regional scale. The landmark Protocol grants explicit protection to species listed in three categories, or annexes. Annex I includes species of flora exempt from all forms of destruction or disturbance. Annex II ensures total protection and recovery to listed species of fauna, with minor exceptions. Specifically, Annex II listing prohibits (a) the taking, possession or killing (including, to the extent possible, the incidental taking, possession or killing) or commercial trade in such species, their eggs, parts or products, and (b) to the extent possible, the disturbance of such species, particularly during periods of breeding, incubation, estivation or migration, as well as other

periods of biological stress. Annex III denotes species in need of "protection and recovery", but subject to a regulated harvest.

On 11 June 1991, Plenipotentiaries again met in Kingston, Jamaica, to formally adopt the Annexes. The Conference voted unanimously to include all six species of sea turtle inhabiting the Wider Caribbean (i.e., Caretta caretta, Chelonia mydas, Eretmochelys imbricata, Dermochelys coriacea, Lepidochelys kempi, and L. olivacea in Annex II (UNEP, 1991; Eckert, 1991). The unanimous vote on this issue is a clear statement on the part of Caribbean governments that the protection of regionally depleted species, including sea turtles, is a priority. While Belize has been a regular financial contributor to the Caribbean Environment Programme Trust Fund, as of 31 July 1992 Belize had not yet ratified the Cartagena Convention (UNEP, 1992). It is a recommendation of this Recovery Action Plan that the Cartagena Convention and its Protocols be ratified by Belize as soon as possible.

4.33 Subregional sea turtle management

It is clear that while some sea turtle stocks may be resident in the waters of Belize, many of the sea turtles observed at sea and especially on the nesting beaches are migrants. Based on tag return data, Belize shares its sea turtles not only with adjacent Mexico and Guatemala, but also with the United States, the Bahamas, Costa Rica, and Venezuela. During recent interviews, tags were solicited from turtle fishermen. Of six tags obtained, five were taken from green turtles tagged in Costa Rica and one from a hawksbill apparently tagged in Guatemala (the tag bore a Guatemalan address). The men reported they had recently captured a second hawksbill apparently tagged in Guatemala, as well as a green turtle tagged in Mexico (Smith, 1990b). Sternberg (1981), in a global summary of sea turtle nesting beaches, reports loggerhead, hawksbill, leatherback, and green turtles nesting in Belize and Guatemala from Cabo de Tres Puntas to the Rio Montagua, and contiguous with Mexico to the north and Honduras to the south.

Both Guatemalan and Honduran fishermen regularly enter Belizean waters to fish. Similarly, some Belizean fishermen collect eggs on Manabique beach in Guatemala. One man interviewed reported that he knew the Manabique area well and "despite patrols many eggs were taken because so much money could be made"; three or four men could return with as many as 1200 eggs (Smith, 1990b). It is clear that bilateral or subregional (e.g., Central America and Mexico) agreements on the subject of sea turtle conservation, including the problems of egg collection and the incidental catch of turtles in commercial fisheries, would be highly desirable. Furthermore, mutual adherence to international agreements such as the Cartagena Convention and SPAW Protocol (section 4.32) could serve as a basis for multilateral protection.

In recent years, mitochondrial DNA (mtDNA) sequence analysis has proven useful for resolving sea turtle population structure, and thus elucidating the extent to which the sea turtle resource is shared among nations. Dr. Brian Bowen (Project Director, Genetic Analysis Core, Univ. Florida) has recently obtained, through harmless techniques, valuable samples of genetic material from Belizean sea turtles. We look forward to the results of this important research and to obtaining data that will assist us in our efforts to conserve our sea turtles.

4.4 Develop Public Education

4.41 Residents

There is a recognized need to inform residents, particularly children, of the need to manage sea turtles in terms of local cultural values. Further, as there is some interest in having environmental education programmes in the public schools in Belize, curricula focused on the marine environment, sustainable fisheries, and endangered species should be actively encouraged. WIDECAST has agreed to assist with the development of sea turtle conservation materials (e.g., slide shows, posters, brochures). In addition to classroom efforts, adult education is a high priority. Wildlife laws should be known to all and residents should be encouraged to report violations. People should be encouraged not to purchase sea turtle meat or products out of season and to consider the linkages between sea turtle survival and beach litter, indiscriminate anchoring, beachfront lighting, etc. This information should be communicated in a variety of media and venues, including newspapers, conservation periodicals, and public seminars. Belize Information Service's *Belize Today* recently featured proposed changes in sea turtle legislation (Matola, 1992).

Public service announcements on waste disposal, mooring, beach etiquette (no fires or heavy machinery on the beach, pull lounge chairs off the beach at night, etc.), and the effects of artificial beachfront light on sea turtles would be very useful. Presently, the Belize Audubon Society and the Belize Zoo have weekly radio programmes which educate the public on environmental concerns in Belize, at times including sea turtles. The Belize Audubon Society also has a specific programme for sea turtles that has produced brochures, posters, slide shows and colouring books. The Hol Chan Marine Reserve office has bulletins and pamphlets that are provided to the public free of charge.

4.42 Fishermen

The Fisheries Extension Programme is active in informing fishermen about all aspects of marine resource management, fishing technology, legislation, etc. Most full-time fishermen are organized into cooperatives; part-time, independent operators are more difficult to reach. In addition to ensuring fishermen are knowledgeable about sea turtle biology and conservation, it is important that Extension personnel provide up-to-date information on technologies designed to prevent or minimize the incidental catch of sea turtles in commercial or artisanal fisheries. Leaders in the fishing community should be alerted to training opportunities, such as the U. S. National Marine Fisheries Service-sponsored regional workshop to demonstrate the use of the TED ("turtle excluder device", or "trawling efficiency device") in Panama in 1991 (see section 4.27). Fishermen should be involved in efforts to revise legislation to more fully protect endangered sea turtles, and be encouraged to promote and to participate in self-policing with regard to conservation legislation.

4.43 Tourists

There has been an attempt to educate tourists not to take archaeological artifacts from the country by placing posters in the airport. Similar warning posters or other educational materials

should be directed toward tourists concerning trade in sea turtle products. The Belize Audubon Society, Programme For Belize, and the Belize Center for Environmental Studies have petitioned the government to ban the sale of hawksbill jewelry nationwide (Appendix I). The proposal has been favourably received. In addition to alerting visitors to the fact that it is illegal to transport sea turtle products across international borders, it is essential to develop a campaign to educate tourists about endangered species in general and the laws that protect them. Hoteliers provide a continuous source of information to tourists and should be enlisted to enlighten visitors about sea turtles. This effort would be enhanced if beachfront hotel owners actively protected sea turtles encountered on or adjoining their property. An owner at South Water Cay has already expressed an interest in becoming involved in such an activity.

4.44 Non-consumptive use of sea turtles to generate revenue

All beachfront and marine-based tourism should take into account the survival needs of endangered sea turtles in order to promote the survival of these native species. Viewing sea turtles by tourists whilst diving or fishing adds interest to these trips and makes them more enjoyable. This contributes to the economy of Belize in the long-term, as it results in more business for local guides through recommendations and returns. On nesting beaches, guided tours can provide revenue without being consumptive. It is noteworthy that in the last five years, tourism in Belize, especially so-called "eco-tourism", has grown faster than any other sector and is now the number one industry in the country. In 1990, tourism accounted for more than B$ 100 million and attracted over 200,000 foreigners. The coastal zone accounted for the majority of this figure. With its close proximity to the reef and the Hol Chan Marine Reserve, Ambergris Cay is the most popular destination. A large number of the smaller cays are also developing tourist operations (Young et al., 1992). Extreme care should be taken when planning eco-tourism programmes with the often timid hawksbill turtle; the advice of WIDECAST should be sought in this regard.

Some interest has been expressed, both by native Belizeans and by expatriate citizens of the USA who operate tourist hotels in Belize, to maintain sea turtles in captivity for public viewing. If allowed, such keeping of turtles must be carefully regulated to ensure that it is a part of an overall conservation strategy. Facilities used to showcase sea turtles for tourist enjoyment should provide information on why sea turtles are endangered. Only small juveniles (which are more economical to feed, require less space, and are not likely to be nearing breeding age) should be used. A limit of 2-3 turtles should be imposed on each viewing facility. The number of facilities should also be limited and guidelines should be established for the care and maintenance of the turtles. Presently, there is one bar on Ambergris Cay which keeps turtles under crowded conditions and regularly elicits complaints from tourists. Inadequate facilities should be upgraded or disallowed.

4.5 Increase Information Exchange

4.51 Marine Turtle Newsletter

The Marine Turtle Newsletter (MTN) is published in both English and Spanish and is distributed quarterly, free of charge, to readers in more than 100 countries. The MTN provides a

means for decision-makers to remain informed about current sea turtle research, as well as sea turtle conservation and management activities around the world. Each issue provides a current list of sea turtle literature available in technical journals. Government officials and biologists are encouraged to subscribe and need only make the Editors aware of their interest. The Fisheries Administrator, the Belize Audubon Society, and several WIDECAST-Belize members presently receive the MTN. Others, especially local libraries, fisheries groups, and conservation organizations, are encouraged to subscribe. To receive the MTN, please write to: Editors, Marine Turtle Newsletter, Hubbs-Sea World Research Institute, 1700 South Shores Road, San Diego, California 92109 USA.

4.52 Western Atlantic Turtle Symposium (WATS)

In 1983, Mr. G. W. Miller (Fisheries Unit Lab, Belize City) represented Belize at the First Western Atlantic Turtle Symposium (WATS I) convened in San José, Costa Rica. In 1987, Mr. Vincent Gillett, Fisheries Administrator, represented Belize at WATS II in Mayagüez, Puerto Rico. The WATS database has proven useful both in stimulating national survey efforts and in educating governments to the grave situation faced by sea turtles in the Wider Caribbean. Belize is encouraged to continue its participation in this fine regional programme.

4.53 WIDECAST

The Wider Caribbean Sea Turtle Conservation Network (WIDECAST) consists of a regional Recovery Team of sea turtle experts which works closely with local Country Coordinators, who in turn enlist the support and participation of citizens in and out of government who have an interest in sea turtle conservation. The primary project outputs are Sea Turtle Recovery Action Plans (STRAPs) for each of 39 government regions, including Belize, in the Wider Caribbean. Each STRAP is tailored specifically to local circumstances and provides the following information:

1. The local status and distribution of nesting and feeding sea turtles.
2. The major causes of mortality to sea turtles.
3. The effectiveness of existing national and international laws protecting sea turtles.
4. The present and historical role of sea turtles in local culture and economy.
5. Local, national, and multi-lateral implementing measures for scientifically sound sea turtle conservation.

The short-term objectives of WIDECAST are to provide Wider Caribbean governments with updated information on the status of sea turtles in the region, to provide specific recommendations for the management and recovery of endangered, threatened, and vulnerable sea turtle stocks, and to assist Wider Caribbean governments in the discharge of their obligations under the Protocol Concerning Specially Protected Areas and Wildlife (SPAW) in the Wider Caribbean Region (see section 4.32). The longer-term objectives are to promote a regional capability to implement scientifically sound sea turtle conservation programmes by developing and supporting a technical understanding of sea turtle biology and management among local individuals and organizations. These objectives are accomplished by:

1. Implementing WIDECAST through resident Country Coordinators.
2. Utilizing local network participants to collect information and draft, under the supervision of regional sea turtle experts, locally appropriate sea turtle management recommendations.
3. Providing or assisting in the development of educational materials (slides, brochures, posters, pamphlets).
4. Sponsoring or supporting local or subregional workshops on sea turtle biology and management.
5. Assisting governments and non-government groups with the implementation of effective management and conservation programmes for turtles.

Beyond supporting the local and national efforts of governments and non-governmental organizations, WIDECAST works to integrate these efforts into a collective regional response to a common problem, the disappearance of sea turtles. WIDECAST is supported by the Caribbean Trust Fund of the UNEP Caribbean Environment Programme, as well as by a wide variety of government and non-government agencies and groups. Non-governmental organizations, government agencies, and local biologists are encouraged to support the WIDECAST effort in Belize and should be made aware of WIDECAST materials as they become available. Belize Audubon Society (BAS) is the Lead Organization in Belize for the international WIDECAST project. Janet Gibson, a member of the BAS Board of Directors (P. O. Box 282, Belize City) and Greg Smith (General Delivery, San Pedro, Ambergris Cay) serve as the WIDECAST Country Coordinators.

4.54 IUCN/SSC Marine Turtle Specialist Group

The Marine Turtle Specialist Group (Dr. Karen Bjorndal, Chair) is responsible for tracking the status of sea turtle populations around the world for the World Resources Union (IUCN) Species Survival Commission (SSC). The Group is presently drafting an outline for a global Marine Turtle Action Plan. The Group is a valuable source of information about sea turtles and technical advice on conservation projects. For further information, contact Dr. Karen Bjorndal, Archie Carr Center for Sea Turtle Research, University of Florida, Gainesville, Florida 32611.

4.55 Workshops on sea turtle research and management

Government agencies and conservation groups are encouraged to sponsor technical workshops. Individuals who have expressed an interest in becoming involved in protecting nests and/ or turtles (research, conservation, eco-tourism) should be asked to assist or participate. Workshops on species identification, standardizing data collection, capture-recapture techniques, genetic material sampling, habitat utilization studies, and nesting beach management are needed. The WATS Manual (Pritchard et al., 1983) is a valuable technical resource and WIDECAST personnel are available upon request to lead workshops, or to train people interested in leading workshops. Training can also be obtained outside of Belize. Earl Young (Belize Fisheries Department) participated in the Caribbean Conservation Corporation's "International Short Course in Marine Turtle Conservation" at Tortuguero, Costa Rica, in 1991. This was an excellent experience and brought additional knowledge to sea turtle conservation initiatives in Belize.

4.56 Exchange of information among local groups

There is general consensus that a mechanism for greater exchange of information is needed, but this has yet to be organized. The Belize Fisheries Department and the Belize Audubon Society are specifically involved with sea turtles on a regular basis through beach patrols at Manatee Bar. Programme For Belize, the Belize Center For Environmental Studies, the Belize Audubon Society, and Belize Zoo have been active in lobbying the government to change the fisheries laws to give greater protection to sea turtles in Belize (Appendix I). The Smithsonian Institution scientists at Carrie Bow Cay will be contacted to assess their interest in becoming involved in sea turtle work. Interest in sea turtles, as well as in other components of Belize's natural history, should be actively promoted in youth and conservation groups. This WIDECAST Sea Turtle Recovery Action Plan will significantly advance the exchange of information about sea turtles and their conservation.

Not only are there a growing number of local groups interested in the conservation of natural resources such as sea turtles, but a recently compiled literature search revealed over 800 citations describing the geology and ecology of Belize (Boles, 1988a). More than half of these were published within the last decade. Research and conservation interest are growing steadily and many projects are underway to investigate ecological systems, conserve endangered wildlife and habitats, develop resource management practices, upgrade environmental health conditions, and provide environmental education. These activities are supported by both private and government organizations, national and international (Boles, 1988b).

4.6 Implement Belize Sea Turtle Conservation Programme

4.61 Rationale

At least a century of virtually uncontrolled commercial and subsistence harvest of sea turtles has left local stocks depleted. Residents can cite several beaches where sea turtles once nested but either no longer do so or arrive in noticeably smaller numbers each year. Fisheries data indicate that the average size of turtles landed fell 60% between 1982 and 1986. Until recently, thousands of pounds each of loggerhead, green turtle, and hawksbill were consumed annually in Belize. We estimate that 500-800 turtles (all species combined) are still landed each year. Historical and contemporary harvests have concentrated on large juveniles and migrating, mating and nesting adults. Because sea turtles are long-lived, requiring two decades or more to reach sexual maturity, and hatchling and young juvenile mortality is very high under natural circumstances, few sea turtles survive to reproductive age. By targeting the larger size classes (older turtles), we have unwittingly contributed in a very tangible way to the endangered status of our sea turtles.

As stated in the Introduction, our objectives in writing this Recovery Action Plan were to compile existing data on the status and distribution of sea turtles in Belize, assess the role of sea turtles in the culture and economy, discuss contemporary factors threatening sea turtles and their habitats, review existing national and international conservation legislation, and provide resource and habitat management recommendations. Based on the information herein assembled, it is clear that much needs to be done to promote the recovery of sea turtles. We must do more than

publish this Action Plan, we must do our part to ensure that sea turtles, which are highly migratory, are protected both within our borders and throughout the Caribbean region. The most pressing needs in our country are for the protection of both turtles (all life stages) and habitat (nesting beaches, coral reefs, sea grass). Studies designed to assess habitat usage, determine stock origins, and evaluate the extent to which stocks are shared internationally are also needed. Field surveys to identify critical habitat are essential so that informed decisions regarding protected areas can be made.

Time is short for the turtles of Belize. Therefore, we have designed our Sea Turtle Conservation Programme to give priority to training personnel, encouraging public participation in the programme, collecting vital data, and drafting holistic and long-term habitat management plans. We have detailed several accomplishments which we hope to realize in the next 3 years and we have included a budget for this work, but the true test of our conservation efforts will be to maintain the field work and the vigilance for many years so that hatchlings emerging from the sands of Belize in 1993 will return to healthy nesting habitat well into the twenty-first century.

4.62 Goals and objectives

The overarching goal of the Belize Sea Turtle Conservation Programme is to prevent further decline of sea turtle nesting and foraging populations under national jurisdiction, and ultimately to increase the numbers of gravid females arriving to nest each year. In furtherance of this goal, the following objectives will be pursued:

1. lobby for a moratorium on the catch of sea turtles and their eggs, passage of comprehensive coastal zone management legislation, and improved law enforcement capability,

2. determine nest density and nest success at important rookery sites,

3. determine the distribution and abundance of turtles at sea,

4. identify critical habitat and develop holistic management plans for same,

5. improve hatch success,

6. increase understanding of residency patterns and movements of sea turtles,

7. quantify legal and illegal exploitation of sea turtles, and

8. promote public awareness of endangered sea turtles and community support of conservation measures.

4.63 Activities

To fulfill programme objectives, the following activities will be undertaken:

1. administrative and field personnel will be hired by Belize Audubon Society (BAS) to oversee a national sea turtle conservation programme,

2. BAS will collaborate with other national NGOs to encourage substantive improvements in fisheries legislation *viz* sea turtles and enforcement of same (e.g., letter writing, media campaigning, meetings with Fisheries officials, building a citizen network to report violations),

3. daily ground surveys will be undertaken of three important nesting areas (Ambergris Cay, Manatee Bar, selected cays in the Sapodilla group); four beach patrollers will be hired and full advantage taken of volunteer assistance; training will be provided by BAS and Fisheries personnel; additional areas (e.g., Placentia, the atolls) will be included in the survey as resources permit,

4. tagging will be initiated at selected beaches (at least Ambergris Cay and Manatee Bar) for at least two consecutive years to determine the number of females nesting, clutch frequency, site fidelity and nest success; training will be provided by BAS and Fisheries personnel; additional target areas will be included as resources permit,

5. preliminary (short-term) surveys will be conducted of areas under-represented in surveys to date, such as Placentia and many of the southern cays, during peak nesting season,

6. data sheets will be developed and distributed to fishermen, divers and others willing and able to contribute sightings data to the programme; data will be collected for at least three consecutive years so that preliminary determinations of habitat important to foraging and resting sea turtles can be made; sightings data will be encouraged from scientists participating in habitat monitoring efforts,

7. holistic management plans will be developed for at least three important nesting and three important feeding areas, based on the scientific recommendations presented in this Recovery Action Plan; critical habitat will be proposed for protected status,

8. sea turtle project personnel will attend at least one international scientific meeting and/or training workshop each year and at least one technical workshop will be convened each year for the purpose of training project staff and volunteers to identify sea turtle species (including crawls, eggs, and hatchlings), survey habitat, and collect data,

9. hatch success will be improved at three important nesting areas during at least three consecutive years; methods may include predator exclusion (e.g., fencing nests), predator removal (e.g., trapping and relocation),

patrolling nesting beaches to discourage predators and poachers, and moving eggs from areas of high risk (erosion, predators) to areas of lower risk (e.g., high ground, hatcheries),

10. tagging and biotelemetry will be used to increase our understanding of residency patterns and movements of sea turtles,

11. market and industry surveys will be undertaken to determine the legal and illegal exploitation of sea turtles,

12. Town Meetings will be hosted in important fishing communities to discuss sea turtle status and conservation in Belize, explore alternatives for turtle fishermen (and artisans as necessary), and propose the purchase of turtle nets by the Fisheries Department, and

13. a full-colour sea turtle conservation brochure and poster will be produced and distributed nationally, a slide show will be developed for use in the schools, and monthly articles will be written for local newspapers and conservation periodicals.

4.64 Results and outputs

The following important outputs, including material products, capacity building, and community participation in conservation activities, are expected to result from initiation of a national sea turtle conservation programme:

1. a Project Coordinator and field staff will be hired and trained by BAS,

2. an annual report (Status of Sea Turtles in Belize) will be produced, including annual levels of nesting and hatch success, contemporary threats to sea turtles and their habitats, and updated research and surveys results,

3. a Manual will be developed describing how to identify sea turtles, conduct habitat surveys, protect nesting areas, complete sightings forms, etc.,

4. comprehensive legislation will be enacted for the protection of sea turtles and the habitats upon which they depend,

5. important nesting and feeding areas will be identified and management plans produced; critical habitat will be proposed for public or private sanctuary status,

6. a network of volunteers will be identified to collect data on nesting, hatching, nest fate, and observations of turtles at sea,

7. the capacity of local conservationists, NGOs, fishermen, and policy-makers to participate in conservation decisions will be enhanced, and

8. public understanding of and participation in sea turtle and habitat conservation will increase.

4.65 Budget

Category		***Year 1***	***Year 2***	***Year 3***
Personnel				
Project Coordinator (full-time)	**US$**	8000	8800	9680
Environmental Educator (half-time)		3500	3850	4235
Field Biologist (half-time)		4000	4400	4840
Beach Patrollers (part-time) 1/		7200	7200	7200
Taggers (part-time) 2/		--	12000	12000
Subtotal		22700	36250	37955
Equipment				
24-ft fiberglas skiff with two 40hp outboard motors	**US$**	10000	--	--
1 survey/patrol vehicle		10000	--	--
office furnishings		1000	--	--
slide projector		--	625	--
camera and accessories		--	750	--
tags and applicators		--	1000	1000
radio equipment		5000	--	--
camping gear		1500	--	--
Subtotal		27500	2375	1000
Operating costs				
vehicle - fuel, maintenance	**US$**	5000	6000	7000
boat - fuel, maintenance		5000	6000	7000
educational materials		3000	4000	4000
travel and subsistence		5000	5500	6000
meetings		500	500	500
film and developing		500	500	500
office supplies		2000	2500	3000
field supplies		1000	2000	2500

Budget, *continued*

Category		***Year 1***	***Year 2***	***Year 3***
purchasing turtle-nets from fishermen		2500	--	--
administrative overhead 3/		11205	9844	10418
Subtotal		35705	36844	40918
Training				
staff attendance at regional and intl. meetings; technical training	**US$**	3500	4000	4000
seminars and workshops for fishermen, tour guides, hoteliers, divers, etc.		2000	2000	2000
Subtotal		5500	6000	6000
TOTAL	**US$**	91405	81469	85873

1/ 4 beach patrollers (2 at Ambergris Cay, 2 at Manatee Bar) @ US$ 1800/6 mo
2/ 4 taggers (2 at Ambergris Cay, 2 at Manatee Bar) @ US$ 3000/3 mo
3/ Belize Audubon Society administrative overhead @ 15% of total

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TABLE 1. Selected reproductive data from a sample of 17 loggerhead sea turtle nests laid on Ambergris Cay, Belize, in 1990. The nesting beach was surveyed between 1 April and 31 August 1990 (data from Smith, 1990a). In 1988, 68 crawls believed to be nests were reported on the cay (Smith and Azueta, 1989); in 1989, 59 nests were observed, 40 of them loggerheads (Smith, 1989); in 1990, 106 crawls were observed, 95 of them loggerheads and 33 confirmed nests (Smith, 1990a).

Date Laid	**Clutch Size**	**Days to Emergence**	**Escaped Unaided**	**Percent Emerged**
??	137	??	80	60%
19 May	118	50	86	73%
31 May	89	55	67	78%
05 June	123	52	65	53%
10 June	69	54?	41	60%
15 June	111	50	80	72%
21 June	99	53	89	90%
22 June	77	53	68	88%
22 June	101	53	94	93%
23 June	93	52	9	9%
27 June	135	56	110	81%
03 July	103	49	93	90%
03 July	77	53	56	73%
05 July	119	53	71	60%
06 July	93	59	39	42%
09 July	113	57	103	91%
14 July	71	53	57	90%

TABLE 2. Reported nesting areas for sea turtles -- loggerhead (L), green (G), hawksbill (H) -- in Belize. Data from Miller (1984) and Gillett (1987) were presented to the Western Atlantic Turtle Symposium and consist of estimated numbers of nests per year. Carr et al. (1982) and Moll (1985) recorded nests observed during brief visits to the country. The data, especially the estimated number of nests/year, are considered preliminary. There is also the caveat that considerable confusion exists with regard to differentiating between loggerhead and green turtle crawls on the beach. With the exception of Ambergris Cay (see Table 1), no season-long surveys of these nesting beaches have been undertaken. Locations are divided into three categories -- cays, atolls, and mainland -- and are arranged in approximately geographical order, north to south (see Figures 2a,b).

Location	Species	Nests	Source/Comments
<u>Cays</u>			
Reef Point	??	??	3 crawl, 2 July 1982 aerial survey for WATS I; Miller, 1984
Ambergris Cay	G	6/yr	Miller, 1984
	G	3/yr	Gillett, 1987
	G	8	Smith, 1989; Apr-Sept 1989 survey
	G	7-11	Smith, 1990b; Apr-Aug 1990 survey
	H	5/yr	Gillett, 1987
	H	1	Smith, 1989; Apr-Sept 1989 survey
		10/yr	Miller, 1984
	L	2/yr	Gillett, 1987
	L	2	Moll, 1985; Jun-Jul 1983 survey
	L	50	Smith, 1989; Apr-Sept 1989 survey
	L	95 crawls min.33 nests	Smith, 1990b; Apr-Aug 1990 survey
			Comments: "traditional nesting site" (Perkins,1983); now developed for tourism; logger-head most common nester
Cay Caulker	L or G	??	"June-July"; Miller, 1984
Cay Chapel	??	rare	One turtle seen on the beach in July or August, 1981; Perkins, 1983
	L or G	??	"June, July, August"; Miller, 1984
	L or G	rare	One turtle seen on the beach in 1986 (J. Beveridge, pers. comm.)
Sergeant Cays	??	??	"traditional nesting site, may still be used"; Perkins, 1983; Smith, 1989

Table 2, *continued.*

Location	Species	Nests	Source/Comments
Tobacco Cay	??	few	"reputed turtle nesting"; Perkins, 1983
	H	1	Smith, 1989; 3-24 Sept 1989 survey
Goff's Cay	E	??	"June, July, August"; Miller, 1984
	??	??	"traditional nesting site, may still be used"; Perkins, 1983; Smith, 1989
	H or L	1	poached (egg shells found); Smith, 1990b
Twin Cays	??	??	beach quality poor, interviewee reported nesting; Smith, 1990b
South Water Cay	??	few	no details provided; Perkins, 1983
	L	1	Moll, 1985; Jun-Jul 1983 survey
	L	2-3	Smith, 1989; 3-24 Sept 1989 survey
	L	2	2 L nests confirmed in June; Smith, 1990b
	H	4 crawls	number of nests unknown; Smith, 1989; 3-24 Sept 1989 survey
	H	1	1 H nest confirmed late June; Smith, 1990b
Carrie Bow	L	1	Moll, 1985; Jun-Jul 1983 survey
	??	??	habitat appears marginal; past nesting reported by Smithsonian research staff; Smith, 1989
Long Coco Cay	H	25 crawls	many unsuccessful nests due to hard sand and (Gladden area) roots, 1 nest found hatched; Smith 1989
Rendezvous Cay (Gladden area)	H or L	??	"one crawl, very old"; Smith, 1990b
Silk Cays	H, G	few	no details provided; Perkins, 1983
(=Queen Cays)	H, G	??	no details provided; Miller, 1984
	H	1-3 nests	1-3 nests reported, but none observed; Smith, 1989; 3-24 Sept 1989 survey
	H	1 crawl	"possible nest on southern cay"; Smith, 1990b
South Silk Cay	G	1	Moll, 1985; Jun-Jul 1983 survey
Laughing Bird Cay	H	??	poaching reported; Smith, 1989

Table 2, *continued.*

Location	Species	Nests	Source/Comments
Round Cay	H	3	3 nests reported, but none observed; Smith, 1989; 3-24 Sept 1989 survey
	H?	5	"9 body pits, 5 nests reported by local fisherman who also reported H seen nesting [during the] day"; Smith, 1990b
Pompion Cay (=Pumpkin Cay)	L	3/yr	Miller, 1984
	H	7/yr	*ibid*.
	H	1	Moll, 1985; Jun-Jul 1983 survey
	H	4-7	Smith, 1989; 3-24 Sept 1989 survey
	H	3	"fewest H nests [in 1990] on Pompion in 9 years"; Smith, 1990b
	G	1	Moll, 1985; Jun-Jul 1983 survey
	H, L	few	"nesting occurs every year"; Perkins, 1983 Comments: turtles/eggs taken; Perkins, 1983
Ranguana Cay	L	1	Moll, 1985; Jun-Jul 1983 survey
	L	3/yr	Miller, 1984
	H	4/yr	*ibid*.
	H	1	Moll, 1985; Jun-Jul 1983 survey
	H	7-10	Smith, 1989; 3-24 Sept 1989 survey
	H	15 bodypits	two confirmed nests, one hatched/one poached; Smith, 1990b
	G	2/yr	Gillett, 1987
	L, H	??	"moderate numbers" reported during July 1978 visit; Carr et al., 1982 Comments: turtles/eggs taken (Perkins, 1983)
North Spot	H	??	no details provided; Smith, 1989 Comments: "unusable, uninhabited"; Smith, 1990b
Red Rock Sandbore	H?	12 body pits	"2 probable H nests found in July"; digging, camping, poaching; Smith, 1990b
Tom Owens Cay	H	??	no details provided; Smith, 1989
	H	3	"3 H nests reported in July, all poached"; Smith, 1990b
Middle Snake Cay	H	4	"probable nests", 1 maybe poached; Smith, 1990b

Table 2, *continued*.

Location	Species	Nests	Source/Comments
West Snake Cay (=Lagoon Cay)	H	4+	"6 H crawls, 2 of which appear poached"; 17 Sept 1990 visit; Smith, 1990b
Northeast Cay (Sapodilla Group)	G	1	Moll, 1985; Jun-Jul 1983 survey
	H	2+	15 false nests, 2 likely nests; Smith, 1989; 3-24 Sept 1989 survey
	H?	??	no crawls in July, 2 crawls in Sept (1 probable H nest); Smith, 1990b
Frank's Cay (Sapodilla Group)	H, L	very few	no details provided; Perkins, 1983
	H, L	??	"June, July, August"; Miller, 1984
	H	34 crawls	Smith, 1989; 3-24 Sept 1989 survey
	H	1	probable nest laid 12 Sept 1990; Smith, 1990b
Nicolas Cay (Sapodilla Group)	H, L	??	"moderate numbers"; Carr et al. 1982; July '78
	H, L	few	no details provided; Perkins, 1983
	H, L	??	"June, July, August"; Miller, 1984
	H	2	Moll, 1985; Jun-Jul 1983 survey
	H	2/yr	Gillett, 1987
	H	10	most nests disturbed; Smith, 1989; 3-24 Sept 1989 survey
	H	5?	1 nest confirmed late June, 1 nest poached mid-July, 3 crawls August; Smith, 1990b
	L	4/yr	Gillett, 1987
	G	8/yr	*ibid*.
			Comments: nesting occurs each year, eggs and adults are taken
Hunting Cay (Sapodilla Group)	H, L	??	"June, July, August"; Miller, 1984
	H, L	few	Perkins, 1983
	H	2	Moll, 1985; Jun-Jul 1983 survey
	H	14	Smith, 1989; 3-24 Sept 1989 survey; nests reported by lighthouse keeper, all poached
	H	7 crawls	1 confirmed/1 probable nest; Smith, 1990b
	G	1/yr	Gillett, 1987
Ragged Cay (Sapodilla Group)	??	1	9 body pits, only 1 nest (appeared poached); Smith, 1990b

Table 2, *continued.*

Location	Species	Nests	Source/Comments
Lime Cay (Sapodilla Group)	L	3/yr	Miller, 1984
	H	4/yr	*ibid.*
	H	1	Moll, 1985; Jun-Jul 1983 survey
	H	??	10 nests reported by lighthouse keeper in 1989; Smith, 1989
	H, L	few	"one to three turtles nest at a time; likely that turtles and eggs are taken"; Perkins, 1983
	H	4+	Smith, 1990b
Atolls			
Turneffe Islands:			
Three Corner Cay	??	??	1 crawl, 2 July 1982 aerial survey for WATS I; Miller, 1984
Grassy Cay	??	??	1 crawl, 2 July 1982 aerial survey for WATS I; Miller, 1984
Cockroach Cay	??	??	marginal habitat, but nesting reported by fishermen; Smith, 1989
Cockroach Bogue	??	??	good habitat, nesting reported by fishermen; Smith, 1989
Blackbird	??	??	Comments: "traditional nesting site, doubtful if any nest there now"; Perkins, 1983
Calabash Cay	??	??	inhabited cay, good nesting habitat, nesting reported by fishermen; Smith, 1989
	H	few	3 H crawls, 3 possible nests; Smith, 1990b
Lighthouse Reef:			
Sandbore Cay	??	??	1 crawl, 2 July 1982 aerial survey for WATS I; Miller, 1984
	L	15-18 crawls	reported by lighthouse keeper (6 L crawls observed); Smith, 1990b

Table 2, *continued.*

Location	Species	Nests	Source/Comments
Half Moon Cay	G, L	12/yr (combined)	"June, July"; Miller, 1984
	G	??	10 nests reported by lighthouse keeper in 1989; Smith, 1989
	G	8	"possible nests"; Smith, 1990b
	L	??	Carr et al., 1982; July 1978 visit
	L	4-12	Smith, 1990b
Northern Cay	L	1	Moll, 1985; Jun-Jul 1983 survey
Long Cay	L	1	Moll, 1985; Jun-Jul 1983 survey
	L	7/yr	Miller, 1984
	H	4/yr	*ibid.*
	G	??	Smith, 1989 Comments: foraging reported in surrounding waters
Glover's Reef:			
Glover's Reef (general)	L	3/yr	Miller, 1984
	H	5/yr	*ibid.*
	G	2/yr	*ibid.*
Northeast Cay	??	??	1 crawl, 2 July 1982 aerial survey for WATS I; Miller, 1984
	L	??	"definite nesting area"; Smith, 1989
	L	5	"1 probable nest, 4 possible nests", 1990 nesting did not start until after 20 Sept; Smith, 1990b
Long Cay	L	??	no details provided; Smith, 1989
	L, G	few	2 G crawls (1 probable nest); L hatchling found dead in nest; Smith, 1990b
Middle Cay	L	??	no details provided; Smith, 1989
	H?	few	2 H? crawls (1 possible nest); Smith, 1990b
Southwest Cay	H	1	Moll, 1985; Jun-Jul 1983 survey
	H	1	"probable nest"; Smith, 1990b

Table 2, *continued.*

Location	Species	Nests	Source/Comments
Mainland			
Mullins River to Manatee River	H	100+	"160 H nests destroyed by raccoons, 9 probable H nests; many nests appeared old, possible laid in 1989; Smith, 1990b
just north of South Stann Creek	H	5	interviewee reported 5 nests eroded away in 1990; Smith, 1990b [N.B. reported as green, but believe they were hawksbill]
Placencia	L	3/yr	Miller, 1984
	H	1/yr	*ibid.*
	H	1/yr	Gillett, 1987
	H	15 crawls	Smith, 1989; 3-24 Sept 1989 survey
	G	1/yr	Gillett, 1987
			Comments: "Traditional nesting area, turtles no longer nest in the Rum Point/Maya Beach areas" (Perkins, 1983); nesting on the peninsula is extremely rare now; attempted poaching common
Jonathan Point (mainland Placencia)	H	1	laid early August, destroyed by raccoons; Smith, 1990b
Rum Point (mainland Placencia)	H	1	"probable nest", laid early May; Smith, 1990b
Placencia (lower peninsula)	L	2	Moll, 1985; Jun-Jul 1983 survey
	G	2	*ibid.*
Palmero Point	??	??	1 crawl, 2 July 1982 aerial survey for WATS I; Miller, 1984
Punta Negra	L, G, H	1-2/yr ea	Gillett, 1987
	L, G, H	??	definite nesting; 3 nests reported in village near church; 1 L seen on beach; total number of nests unknown; Smith, 1989
	H	few	"3 H crawls, all appeared disturbed in July, no new crawls in Sept."; Smith, 1990b

Table 2, *continued.*

Location	Species	Nests	Source/Comments
Punta Ycacos	H	12 crawls (incl. 8 nests)	Smith, 1990b; 2 nests hatched (Sept.), 3 poached, 1 taken by raccoons

TABLE 3. Existing and proposed Reserves in Belize that include known or potentially important sea turtle habitat.

Category	Area
Marine and coastal protected areas	Hol Chan Marine Reserve Half Moon Cay Natural Monument Laughing Bird Cay National Park Paynes Creek Wildlife Sanctuary Sarstoon Temash Wildlife Sanctuary
Proposed protected areas	Sapodilla Cays Cay Caulker Glover's Reef Marine Reserve Bacalar Chico Mexico Rocks North Turneffe Islands Blue Hole, Lighthouse Reef South Water Cay area Port Honduras area
Coastal Special Development Areas	Manatee SDA Monkey River SDA Placencia SDA (proposed)

TABLE 4. Landing sites for sea turtles in 1982, with estimated number and weight (kg) landed, as reported to the 1983 Western Atlantic Turtle Symposium. All turtles were reported captured by nets, with the exception that turtles landed for the Belize City Market were "infrequently taken incidentally when diving". L = loggerhead; G = green turtle; H = hawksbill. The last column estimates average weight (kg) per turtle calculated from data provided by Miller (1984).

Port/Site	Species	Months	Number / Wt	Avg kg
Belize City Market	L, G, H	Sept-Nov, Feb-May *	200 / 40,460	202.3
Newtown Barraks	"	"	50 / 8,800	176.0
Corozal Town	"	"	75 / 15,675	209.0
Dangriga	"	"	90 / 15,840	176.0
Punta Gorda	"	"	250 / 46,750	187.0
San Pedro	H **	"	180 / 14,300	79.4
Cay Caulker	"	"	70 / 7,700	110.0
Sarteneja	"	"	90 / 14,300	158.9
TOTAL			1005 / 163,825	163.0

TABLE 5. Landing sites for sea turtles in 1986, with estimated number and weight (kg) landed, as reported to the 1987 Western Atlantic Turtle Symposium. All turtles were reported captured by nets, with the exception that turtles landed for the Belize City Market were "infrequently taken incidentally when diving". L = loggerhead; G = green turtle; H = hawksbill. The last column estimates average weight (kg) per turtle calculated from data provided by Gillett (1987).

Port/Site	Species	Months	Number / Wt	Avg kg
Belize City Market	L, G, H	Sept-Nov, Feb-May *	280 / 11,454	40.9
Newtown Barraks	"	"	28 / 1,654	59.0
Corozal Town	"	"	[not given]	
Dangriga	"	"	90 / 6,545	72.7
Punta Gorda	"	"	250 / 18,181	72.7
San Pedro	H **	"	200 / 15,888	79.4
Cay Caulker	"	"	15 / 1,073	71.5
Placencia	"	"	116 / 10,545	90.9
TOTAL			979 / 65,340	66.7

* Occasionally turtles are landed in December or January; turtle season is closed from 1 June to 31 August.

** "There is a fairly heavy trade in juveniles to satisfy tourist demand" (Gillett, 1987).

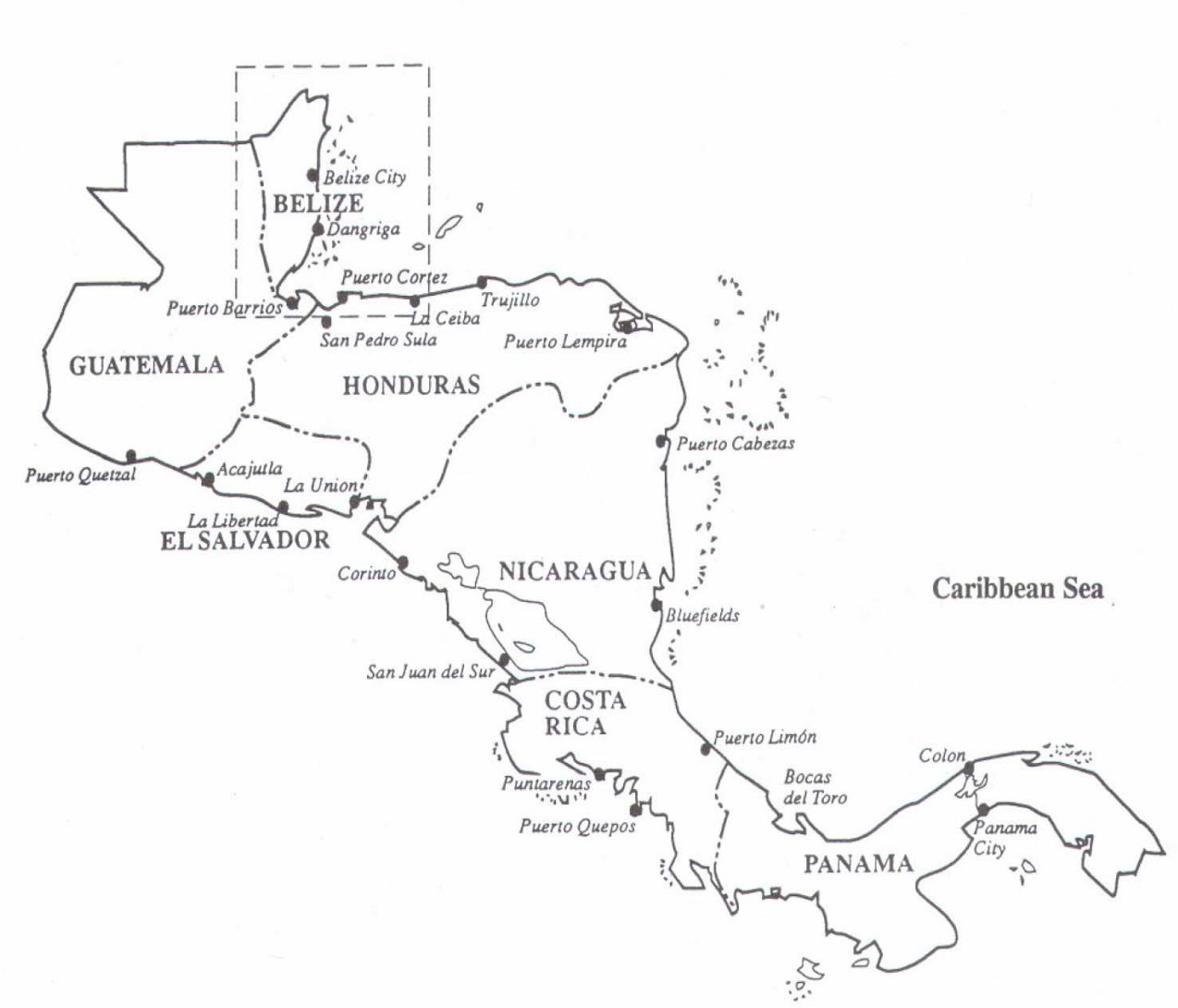


Figure 1. Location of Belize, once British Honduras, on the Caribbean coast of Central America (source: Young et al., 1992).

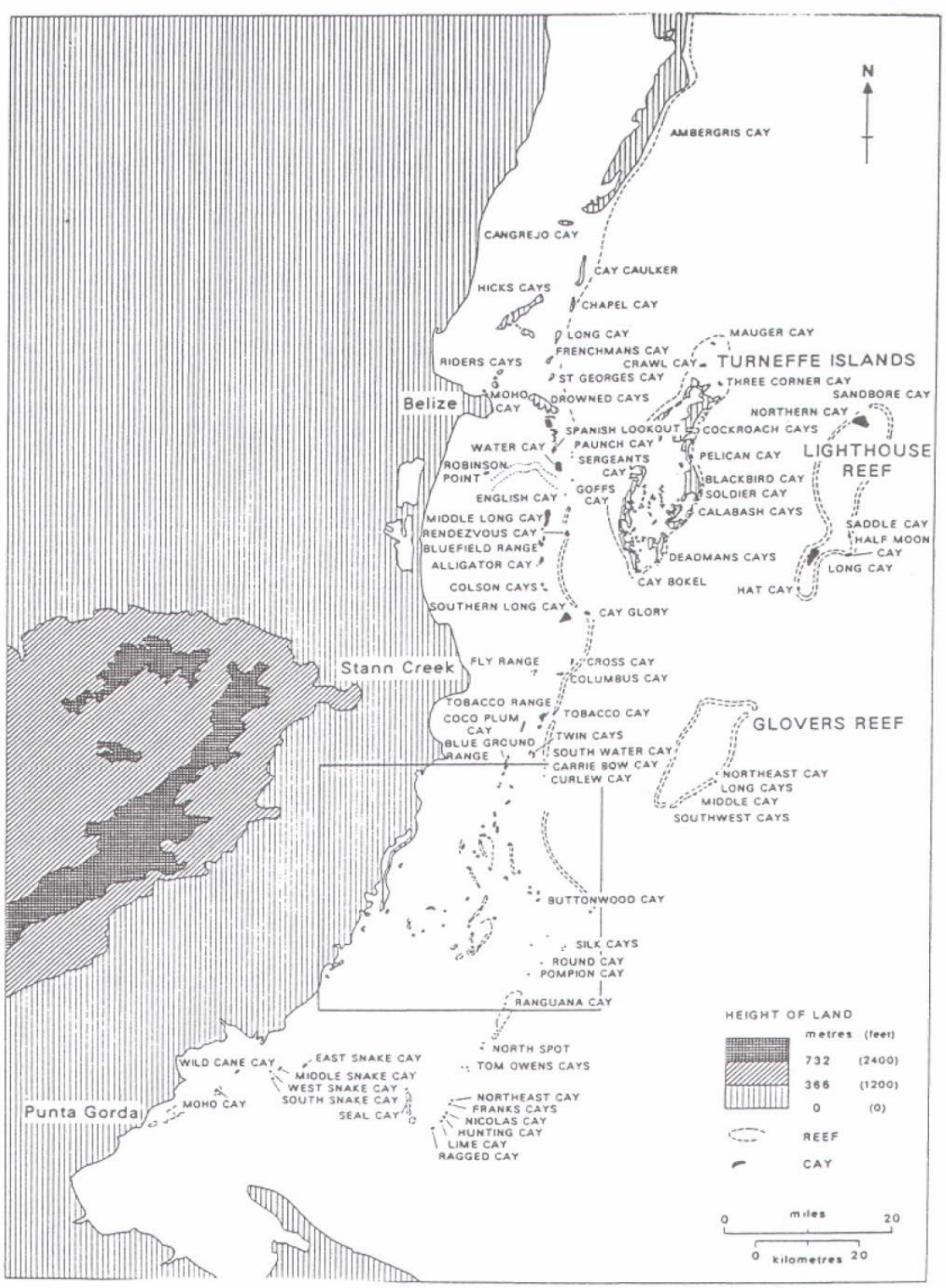


Figure 2a. Location of the Belize barrier reef and offshore cays (source: Stoddart et al., 1982).

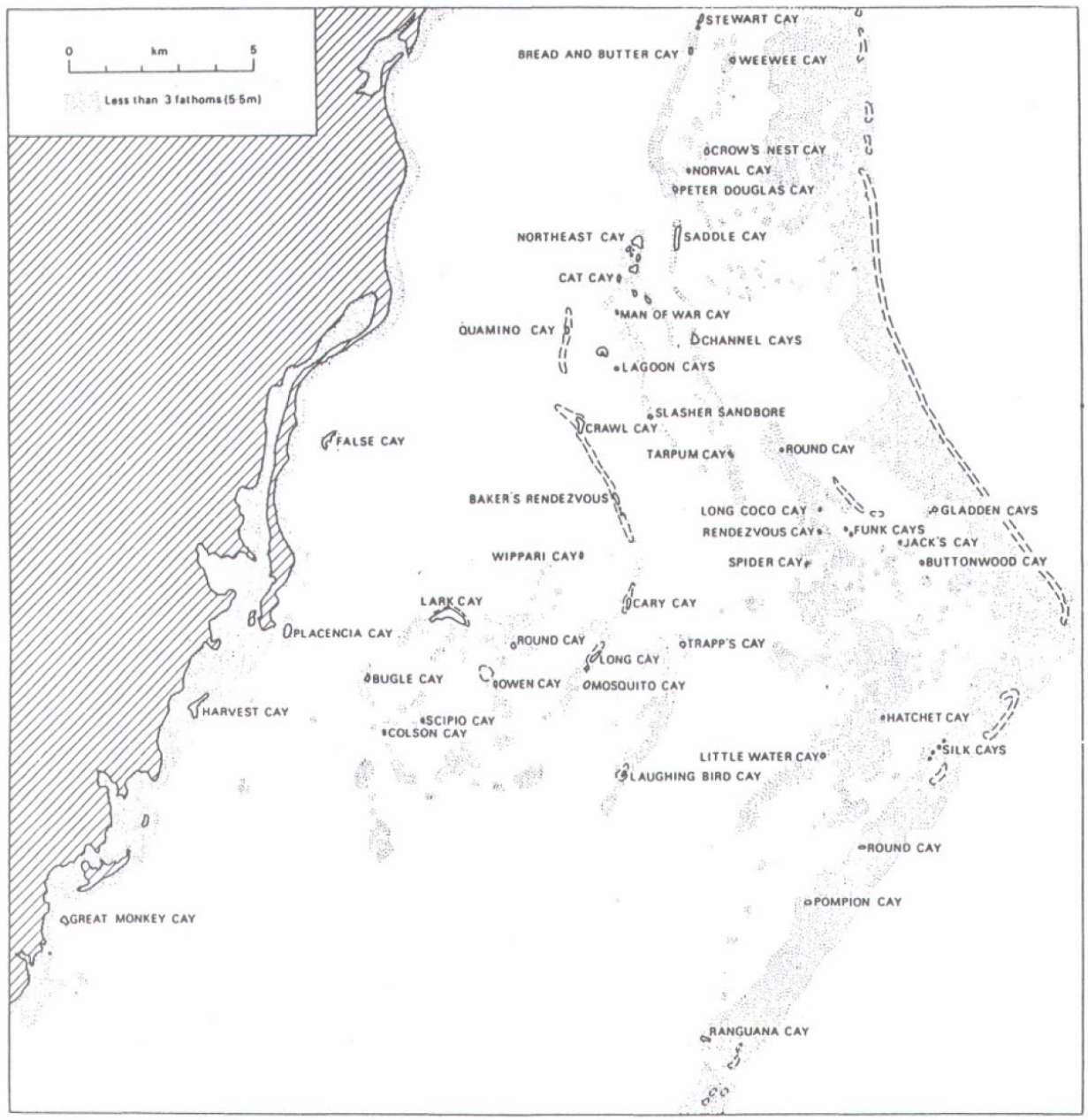


Figure 2b. Detail of the reefs and cays of the central barrier reef lagoon (source: Stoddart et al., 1982).

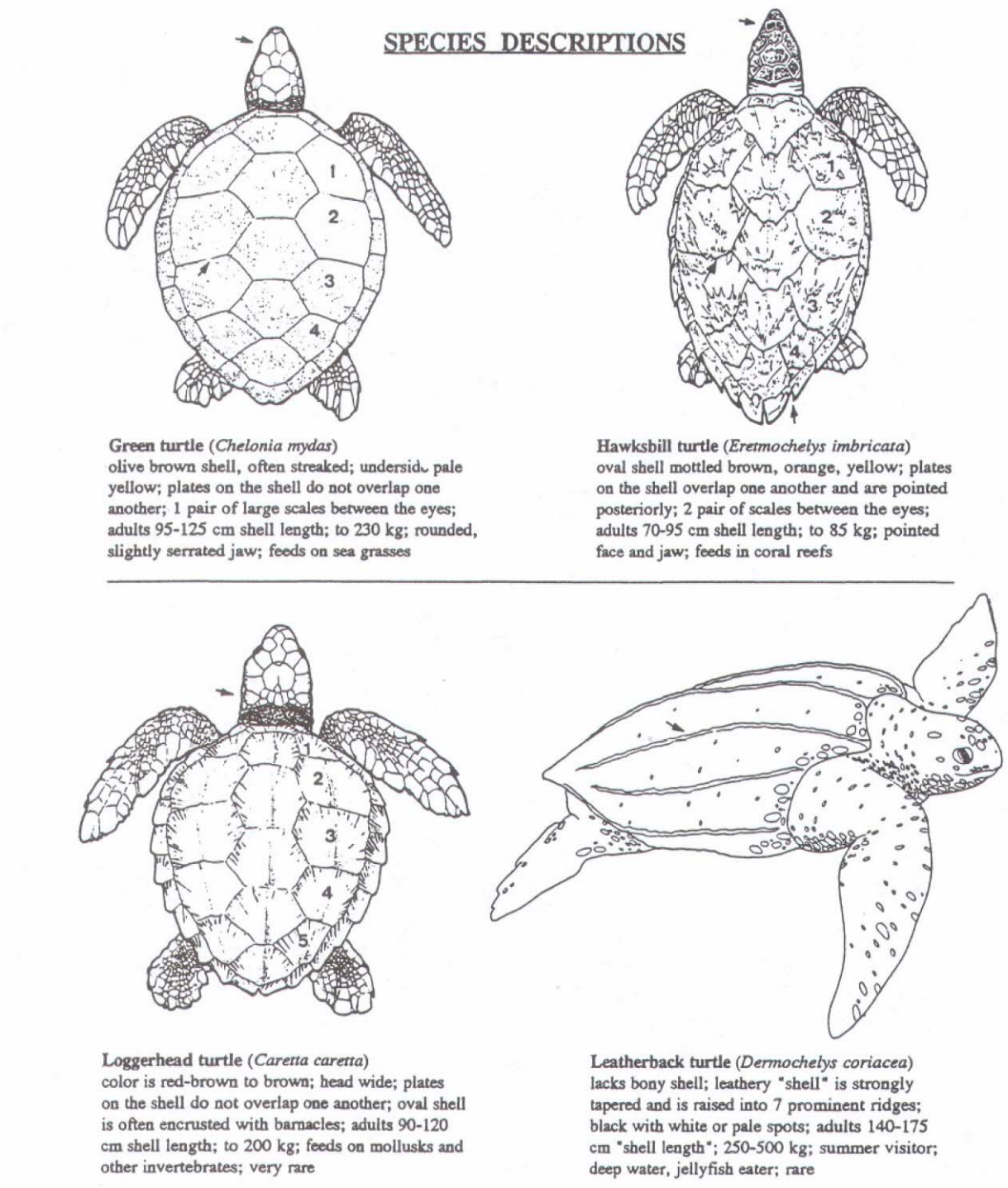


Figure 3. An identification guide to sea turtles in Belize. With rare exceptions, leatherbacks are observed only seaward of the barrier reef.

APPENDIX I

BELIZE AUDUBON SOCIETY

29 Regent Street
Post Office Box 1001
Belize City, BELIZE

TELEPHONE (02)-77369

From: Belize Audubon Society, Programme for Belize, Belize Centre for Environmental Studies

To: Minister of Agriculture and Fisheries, Minister of Natural Resources, Minister of Tourism and Environment, Minister of Trade and Commerce

The NGO's listed above are seriously concerned about the decline in Belize's population of hawksbill sea turtles. In 1925, "The Handbook of British Honduras", described the number of sea turtles around Belize's cays as "inexhaustible". Today, worldwide depletion of hawksbills has led to their inclusion in Appendix I of the Convention on International Trade in Endangered Species (CITES) which was enacted to prevent the extinction of species. Belize and more than 100 other countries have agreed to protect the hawksbill by prohibiting exports of hawksbill shell or any products made from them.

During an 1989 survey of sea turtle nesting sites in Belize, it was learned from fishermen that hawksbill shells are being bought in Belize, stockpiled and then illegally exported to Japan. It was also learned that Belize is being used as a transshipment port for hawksbill shell coming from our region.

Another cause for fewer hawksbill reported to the 1989 survey team by older experienced fishermen was the catching of large numbers of small hawksbill by lobster divers.

As tourism continues to increase, so do the numbers of shops selling hawksbill jewelry to tourists. It is prohibited to export this jewelry out of Belize by the tourists, but this is overlooked by the shop that sells it knowing that tourists intend to take it out of the country.

For all these reasons, we are requesting that the Government of Belize prohibit the commercial sale of hawksbill and their shell, the stockpiling of hawksbill shell, and the transshipment of hawksbill shell through Belize. As the major buyer of the shell is Japan, we request that the Government of Belize, through diplomatic channels, work along with Japanese officials to curtail this illegal trade.

All three species of turtles occurring in Belize are threatened. Recent studies show that mating starts in March, with nesting commencing in May and continuing through to November.

The current turtle management regulations are in need of revision in view of more up-to-date management principles for turtle populations. The following recommendations are suggested for amendments to the existing regulations:

(1) As marine turtles are long-lived species, gaining maturity at more than 30 years, a maximum size limit of 25 inch shell length should be introduced.

(2) Complete protection should be given to the hawksbill, as this species is not taken for meat, only the shell.

(3) The turtle closed season should be extended to include the months of May through October, inclusive.

(4) No new licenses for turtle fishing should be granted, thus ensuring the gradual phasing out of the catches.

(5) Shrimp trawlers operating in Belizean waters should be required to install Turtle Exclusion Devices (TEDS) to prevent the incidental capture and drowning of sea turtles.

_____

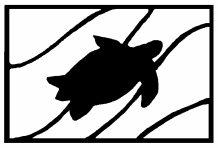
Janet Gibson
President
Belize Audubon Society

_____

Joy Grant
Executive Director
Programme for Belize

_____

Lou Nicolait
Director
Belize Centre for Environmental Studies



WIDER
CARIBBEAN
SEA TURTLE
CONSERVATION NETWORK

To: Honorable Minister Espat, Minister of Agriculture and Fisheries, Belize
Honorable Minister Godfrey, Minister of Tourism and Environment, Belize

From: Wider Caribbean Sea Turtle Recovery Team (WIDECAST)

Subject: Fisheries Regulations and Sea Turtle Conservation in Belize

EXECUTIVE SUMMARY OF COMMENTS AND RECOMMENDATIONS

At the request of Greg Smith, WIDECAST Country Coordinator in Belize, the Wider Caribbean Sea Turtle Recovery Team (WIDECAST Team) has drafted the attached letter in support of increased protection for sea turtles in Belize. The WIDECAST Project is comprised of an international team of sea turtle experts, as well as Country Coordinators and a network of participants in more than 20 Wider Caribbean countries. WIDECAST is supported by the governments of the region via the UNEP Caribbean Environment Programme (based in Kingston, Jamaica) and our mandate is to assist Wider Caribbean nations in their efforts to conserve remaining sea turtle stocks. This is accomplished largely by the production of nation-specific Sea Turtle Recovery Action Plans, orchestrated in each case by an in-country coordinator with the support of the WIDECAST regional recovery team and a network of experts.

WIDECAST stresses two points when it comes to sea turtle management: (*i*) sea turtles can only be effectively conserved in a regional context and (*ii*) until such time that sea turtles can be fully protected by law, it is imperative that adults and large juveniles be exempt from harvest. WIDECAST encourages all nations to implement a moratorium on the harvest of sea turtles and their eggs. Nonetheless we recognize that, for any number of socio-economic reasons, this will not happen overnight. In the interim, we urge governments to recognize that there are steps which can be taken in order to ease the strain on remaining populations. In the case of Belize, it is most essential that maximum, as opposed to minimum, size limits be established (see attached letter for background). Belize is an important country for sea turtles in the Wider Caribbean, and shares its turtle stocks with several adjacent countries which are also struggling to conserve these populations.

We respectfully encourage the Government of Belize to consider implementing legislation as described in (1) or (2) below. Nonetheless, even number (3) represents an improvement over current laws allowing continued harvest of hawksbills and adult turtles. We refer you to the attached letter for details, and appreciate your kind attention.

(1) Full protection for all species and their eggs at all times

(2) Full protection to hawksbill; closed season (all species) 1 April-30 November, inclusive; open season limited to green and loggerhead turtles LESS THAN 60 cm (24 in) curved shell length; full protection to eggs

(3) Full protection to hawksbill; green and loggerhead turtles LESS THAN 60 cm (24 in) catchable 1 April-30 November, inclusive; green and loggerhead turtles all size classes catchable 1 December-31 March; full protection to eggs

WIDER CARIBBEAN SEA TURTLE CONSERVATION NETWORK

To: Honorable Minister Espat, Minister of Agriculture and Fisheries, Belize
Honorable Minister Godfrey, Minister of Tourism and Environment, Belize

From: Wider Caribbean Sea Turtle Recovery Team (WIDECAST)

Subject: Fisheries Regulations and Sea Turtle Conservation in Belize

Date: 16 April 1991

It is clear, based on several studies, including data recently collected by Greg Smith, Co-Country Coordinator (with Janet Gibson, Belize Audubon Society) for WIDECAST in Belize, that Belize is a very important country for sea turtles in the Wider Caribbean region. Green turtles and Loggerheads, as well as the critically endangered and regionally depleted Hawksbill turtle, are represented among Belize's fauna. Nonetheless, man-induced threats to the continued survival of sea turtles in Belize are many. These include the harvest of adults and large juveniles, increasing development in important nesting areas, and the degradation of coral reefs and seagrass beds.

The WIDECAST Sea Turtle Recovery Action Plan for Belize, presently in draft form, discusses these threats, as well as the past and present distribution and abundance of sea turtles in Belize, their economic role, and options for the recovery of their populations. WIDECAST, an acronym for the Wider Caribbean Sea Turtle Recovery Team and Conservation Network, is a regional project sponsored by the UNEP Caribbean Environment Programme. The 10-member Team is comprised of sea turtle experts from throughout the region; in addition, there are WIDECAST Country Coordinators in more than two dozen Caribbean nations and government regions.

The WIDECAST Team is proud that Belize is an active participant in the WIDECAST project. The WIDECAST Sea Turtle Recovery Action Plan for Belize is well developed, and will surely provide a model for other countries striving to balance the protection of sea turtles with the needs and desires of residents and visitors. In an increasing number of cases, Caribbean countries are opting to achieve this balance by implementing an indefinite moratorium on the take of sea turtles, fully protecting one or several species until such time that their numbers show signs of recovery. Typically this decision is based on the reality that few if any individuals rely on sea turtle products to make a living (in Belize there are perhaps 20-30 turtle fishermen), the notion that sea turtles are valuable to a nation as part of the natural and cultural heritage of its people, and the desire to cooperate with adjacent countries that have already established local moratoria.

In view of the precarious status of sea turtle species throughout much of the Caribbean, and recognizing the support that sea turtle conservation has within the Government of Belize, *the WIDECAST Team encourages the Government to consider conferring a greater degree of protection to sea turtles under its jurisdiction*. We fully support the call by conservation groups within Belize for a ban on the harvest of Hawksbill turtles; indeed we support the full protection of all sea turtle species. If a moratorium on the take of Green and Loggerhead turtles is impossible at the present time, however, we urge Belize to prohibit at the very least the taking of adult and near adult ("subadult") animals.

The WIDECAST project stresses two points when it comes to sea turtle management -- (*i*) sea turtles can only be effectively conserved in a regional context and (*ii*) until such time that sea turtles can be fully protected by law, it is essential as an interim step that adults and subadults be exempt from harvest. The purpose of this letter is to high-light the importance of sea turtle conservation in Belize in a regional context, and to recommend the protection of mature sea turtles by implementing a maximum (as opposed to a minimum) size limit and extending the closed season to include mating and nesting seasons when adults are most vulnerable (i.e., 1 April to 30 November).

The idea that all Caribbean nations must work together cooperatively in the protection and management of sea turtle stocks emerges logically from the fact that sea turtles are highly migratory, as evidenced by tag returns throughout the region. In the case of Belize, fishermen have captured Green, Loggerhead, and Hawksbill turtles tagged in Costa Rica, Guatemala, Mexico, and the Bahamas. Juvenile sea turtles travel widely after leaving their natal beaches. Then, as adults, they establish travel routes between feeding and nesting grounds which may be separated by thousands of kilometers and a dozen national borders or more. Adult Green turtles tagged while nesting in Costa Rica, for example, have been subsequently recovered as far away as Mexico, Cuba, and the Lesser Antilles . . . as well as in Belize. Less is known of Hawksbill movement, but tag returns document post-nesting movements by adults of several thousand km. [A recent tag return documented that a 40 kg juvenile Hawksbill, tagged on a feeding ground in Brazil in January 1990, was killed in Dakar, Senegal, six months later!] There is no question that sea turtle resources are shared between Mexico, Belize, Guatemala, Honduras, Nicaragua, Costa Rica, and probably Cuba. Further, sea turtles from even more distant countries probably enter Belize's waters at times.

Hundreds of Green turtles, mostly adults and subadults, are killed annually in Belize. Fishermen know well the seasons of the year when the "big turtles" migrate south along the coast to breeding grounds such as Tortuguero, Costa Rica. While Costa Rica struggles to find the resources to expand Tortuguero National Park in order to further protect the Green turtles arriving to nest there, many of these same turtles, mostly adult females laden with eggs, are killed in Belize en route! The importance of international cooperation in this regard cannot be overemphasized. Belize is also important habitat for Loggerhead turtles in the region. Belize and Mexico (specifically the Yucatan peninsula) jointly support one of the few breeding colonies of Loggerhead turtles remaining in the Wider Caribbean. These animals are protected by law in Mexico and in the U. S., but are still killed legally in Belize and illegally in Mexico. Further, despite efforts by the U. S. Government, tens of thousands per year are caught and killed unintentionally by shrimping fleets in the Western Atlantic. Outside of Florida, the Quintana Roo nesting colony is the only major Loggerhead breeding colony in the Western Hemisphere; Belize also shares responsibility for this resource, as these same Loggerheads forage and nest in Belize.

After the Kemp's Ridley turtle, most experts consider the Hawksbill to be the most threatened of all the sea turtles. The most recent IUCN/CITES report on the global status of the Hawksbill states that about half of the known nesting populations are known or suspected to be in decline; in particular, "the entire Western Atlantic-Caribbean region is greatly depleted." The single most significant factor endangering Hawksbill populations is international trade in Hawksbill shell, or 'tortoiseshell'. Between 1970 and 1986, the tortoiseshell from >577,000 turtles was imported by Japan. In 1988, Japan imported from the Wider Caribbean alone the shell from nearly *12,000* adult Hawksbills (including turtles from Belize). Belize appears to support at least 30 Hawksbill nesting areas, including a few comparatively large colonies, and as such is an important source of young Hawksbills to the region. For instance, along 8 km of beach near Manatee Bar, 160-196 Hawksbill nests were recorded in 1990 (as of 23 September). The southernmost cays along the barrier reef from the Silk Cays to the Sapadilla Cays also support Hawksbill nesting. Finally, the large numbers of Hawksbills nesting on the Yucatan peninsula probably forage in Belizean waters.

Having established that conservation efforts in Belize are vital to the survival of turtles in Belize, as well as being important in the larger context of the Caribbean region, our second point concerns the fact that adults begin breeding at about 18-35 years of age . . . and some individuals will continue breeding for a quarter century or more. Sea turtle life histories, like those of many long-lived organisms, are characterized by high juvenile mortality, delayed sexual maturity, high fecundity, and extended longevity. Adult survivorship is high under natural circumstances, and repeat breeding compensates for the loss of eggs on the beach and the loss of young juveniles to sharks and other predatory fishes at sea. As explained by Dr. Nat Frazer in his presentation at WATS II [Second Western Atlantic Turtle Symposium, Puerto Rico, 1987], long-term studies of Loggerhead sea turtles have shown that the adult and subadult age classes are the most "valuable" to a population. In the parlance of population ecology this is referred to as reproductive value, or the future reproductive contribution of an individual to a population, based on the probability that the individual will survive to breeding age. Breeding adults, as well as subadults on the verge of their breeding years, represent decades of selective survival. They are produced slowly, expected to live a long time, and are difficult for a population to replace even under the best of circumstances.

A sea turtle population can be envisioned as a pyramid, with large numbers of eggs and hatchlings at the bottom and ever decreasing numbers of older individuals as you move toward the apex. The probability that a sea turtle egg will produce a hatchling which will survive to adulthood has been estimated to be <1/1000. For this reason it is essential that large juveniles attain maturity, and that adults survive to breed again and again. Under natural circumstances this is the case, as few predators can successfully kill a large and heavily armored sea turtle. However, in our over-zealous exploitation of Caribbean sea turtles over the past three centuries we have, not surprisingly, targeted these larger turtles for reasons of economics. With fewer adults breeding, recruitment has been greatly reduced and sea turtle populations are nearly everywhere declining. Predators are still taking their fair share of hatchlings and young juveniles . . . and man is ensuring that a significant proportion of those remaining are destined for the market instead of the nesting beach.

Against this background it is clear that, until such time as a moratorium on sea turtle harvest can be implemented in Belize (as was recently decreed in Mexico), fisheries laws should be established to ease the strain on remaining populations. Specifically (and in addition to current laws prohibiting the harvest of eggs and the export of turtles), we recommend that: *a closed season be declared between 1 April and 30 November, inclusive*, in order to protect the vulnerable mating and nesting adults, and *maximum, as opposed to minimum, size limits be imposed*. Recognizing that Green and Loggerhead turtles >60 cm (>24 inches) in curved shell length are, on average, older than 10 years of age and well on their way to breeding a decade or so hence, we suggest a maximum size limit of 60 cm (24 in). Figure 1 illustrates "reproductive value" and shows that turtles which survive their first decade of life quickly become vastly more important than individuals of younger age classes to the continued survival of the population. Regulations allowing any level of legal take should include a monitoring program to document the harvest, including trends in catch per unit effort.

Belize is blessed by a wealth of natural resources, many of them marine, which support thriving fishing and tourist industries. With these resources still relatively intact, the Government of Belize is in a rare and enviable position to make thoughtful decisions with regard to sustainable management. The WIDECAST Team considers it a privilege to have had the opportunity to share our recommendations with you. We hope that we have been successful in conveying the importance of Belize with respect to the conservation of Wider Caribbean sea turtles, and especially the value of adult and subadult animals. We look forward to hearing that sea turtle legislation in Belize has been amended to reflect these realities, and we thank you sincerely for your time and kind attention.

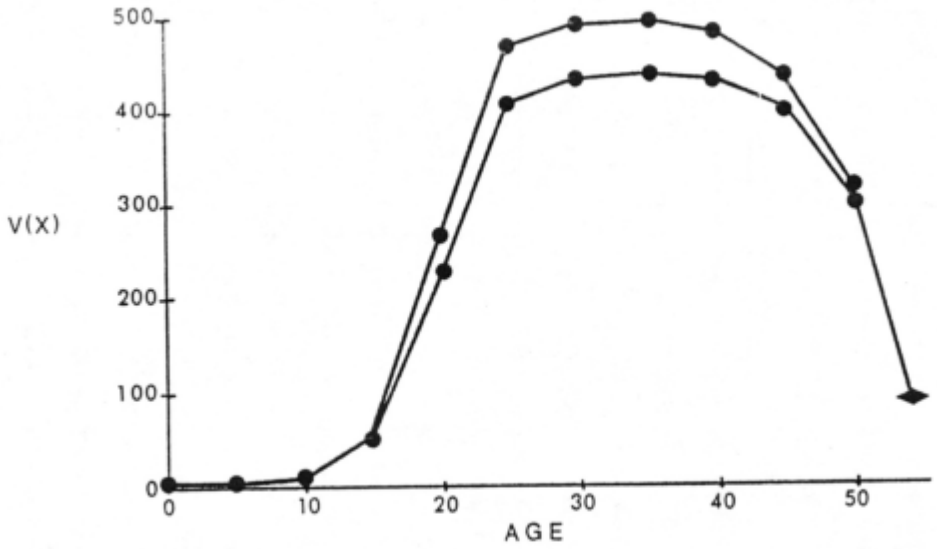


Figure 1. Reproductive value curve, reprinted from Dr. Nat Frazer's keynote address to the Management Options Session of WATS II, 1987. The V(x) or vertical axis from 0 to 500 represents an index of how valuable an individual is based on her future reproductive contribution to the population. The upper and lower curves represent two different scenarios; the lower curve assumes your population is stationary, and the upper that your population is declining. Notice that a turtle's value begins to increase dramatically at about age 15. Loggerhead and green turtle growth curves are similar in structure.

Respectfully,

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Julia Horrocks, Ph.D.
1991 WIDECAST Team Chairperson

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Karen Eckert, Ph.D.
WIDECAST Executive Director

APPENDIX II

U.S. Public Law 101-162 was passed by Congress in November 1989 and reads, in part:

Sec. 609. (a) The Secretary of State, in consultation with the Secretary of Commerce, shall, with respect to those species of sea turtles the conservation of which is the subject of regulations promulgated by the Secretary of Commerce on June 29, 1987 --

(1) initiate negotiations as soon as possible for the development of bilateral or multilateral agreements with other nations for the protection and conservation of such species of sea turtles;

(2) initiate negotiations as soon as possible with all foreign governments which are engaged in, or which have persons or companies engaged in, commercial fishing operations which, as determined by the Secretary of Commerce, may affect adversely such species of sea turtles, for the purpose of entering into bilateral and multilateral treaties with such countries to protect such species of sea turtles;

(3) encourage such other agreements to promote the purposes of this section with other nations for the protection of specific ocean and land regions which are of special significance to the health and stability of such species of sea turtles;

(4) initiate the amendment of any existing international treaty for the protection and conservation of such species of sea turtles to which the United States is a party in order to make such treaty consistent with the purposes and policies of this section; and

(5) provide to the Congress by not later than one year after the date of enactment of this section--

(A) a list of each nation which conducts commercial shrimp fishing operations within the geographic range of distribution of such sea turtles;

(B) a list of each nation which conducts commercial shrimp fishing operations which may affect adversely such species of sea turtles; and

(C) a full report on--

(i) the results of his efforts under this section; and

(ii) the status of measures taken by each nation listed pursuant to paragraph (A) or (B) to protect and conserve such sea turtles.

(b)(1) IN GENERAL.-- The importation of shrimp or products from shrimp which have been harvested with commercial fishing technology which may affect adversely such species of sea turtles shall be prohibited not later than May 1, 1991, except as provided in paragraph (2).

(2) CERTIFICATION PROCEDURE.-- The ban on importation of shrimp or products from shrimp pursuant to paragraph (1) shall not apply if the President shall determine and certify to the Congress not later than May 1, 1991, and annually thereafter that--

(A) the government of the harvesting nation has provided documentary evidence of the adoption of a regulatory program governing the incidental taking of such sea turtles in the course of such harvesting that is comparable to that of the United States; and

(B) the average rate of that incidental taking by the vessels of the harvesting nation is comparable to the average rate of incidental taking of sea turtles by United States vessels in the course of such harvesting; or

(C) the particular fishing environment of the harvesting nation does not pose a threat of the incidental taking of such sea turtles in the course of such harvesting.

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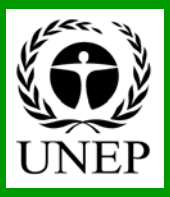

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The series of CEP Technical Reports contains selected information resulting from the various activities performed within the framework of the UNEP Caribbean Environment Programme (CEP). CEP was initiated in 1976 by UNEP with the assistance of ECLAC, at the request of the Governments of the region. A framework for regional projects and activities was first formulated in Montego Bay in 1981, when the Action Plan for the Caribbean Environment Programme was adopted by the First Intergovernmental Meeting.

The major legal instrument of CEP was adopted at the Second Intergovernmental Meeting, convened at Cartagena de Indias, in 1983: the Convention for the Protection and Development of the Marine Environment in the Wider Caribbean Region. The Cartagena Convention provides a framework for the development of specific protocols.

The implementation of CEP is supported by the Caribbean Trust Fund, established by the participating States and Territories. Their active participation is ensured through regular Intergovernmental and Contracting Parties Meetings, a rotating Monitoring Committee formed by representatives from nine States and Territories and through the National Focal Points. The principal focal point in each State or Territory is the ministry or department responsible for external relations or foreign affairs. Additionally, the agency responsible for the management of marine and coastal resources is the focal point for technical purposes.

Currently, the Action Plan of CEP concentrates in six major areas for the management of marine and coastal resources: Overall Co-ordination, Specially Protected Areas and Wildlife (SPAW), Assessment and Control of Marine Pollution (CEPPOL), Integrated Planning and Institutional Development (IPID), Information Systems (CEPNET), and Education, Training and Awareness (ETA).

*

The Protocol Concerning Specially Protected Areas and Wildlife (SPAW) to the Cartagena Convention was adopted in two stages: the text of the Protocol was adopted on 18 January 1990 and the initial Annexes listing relevant marine and coastal species, were adopted on 11 June 1991. The Protocol will enter into force following ratification by nine Contracting Parties.

The Regional Programme for Specially Protected Areas and Wildlife in the Wider Caribbean Region (SPAW) was designed to implement the provisions and requirements of the SPAW Protocol. Its objectives are: (a) to develop specific management plans for economically and ecologically important species; (b) to significantly increase the number of adequately managed protected areas and species in the region; and © to develop a strong regional capability for the co-ordination of information exchange, training and technical assistance in support of national, subregional and regional efforts on management of protected areas and wildlife.