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WIDECAST Sea Turtle Recovery Action Plan for Barbados

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CARIBBEAN ENVIRONMENT PROGRAMME

WIDECAST
Wider Caribbean Sea Turtle Conservation Network

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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 Vulnerable 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 of turtles 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 dam-aged 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 second 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 Re-sources 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 CEP.

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[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 the international WIDECAST project has come from Monitor International, The Chelonia Institute, the UNEP Caribbean Environment Programme, and the U. S. National Marine Fisheries Service.

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ABSTRACT

Barbados is the most easterly island in the Lesser Antilles. Four species of sea turtle are recorded from the waters of Barbados: the hawksbill (Eretmochelys imbricata), leatherback (Dermochelys coriacea), green turtle (Chelonia mydas), and, rarely, the loggerhead (Caretta caretta). The primary nesting species is the hawksbill; leatherbacks nest only occasionally. Hawksbills nest in all months except February and March, but there is a marked peak in nesting between June and August. Leatherbacks are seasonal visitors, arriving to nest between April and June. Sea turtle nesting activity has been monitored over the past five years. The data suggest that not many more than 50 hawksbills and fewer than two leatherbacks nest each year. Juvenile green turtles are commonly seen feeding in nearshore sea grass and algal beds, particularly off the east coast. In contrast, hawksbills feed on coral reef-associated sponges. Subadult and adult loggerheads are sometimes captured in deep water; foraging has not been observed. Estimates of population size for non-nesting sea turtles (green turtles, hawksbills, loggerheads) around Barbados are not available. It is generally acknowledged by fishermen that sea turtles are less common today than in previous years. The primary stresses on sea turtles in Barbados are exploitation, nesting habitat deterioration, and, to a lesser extent, foraging habitat deterioration.

Hawksbill turtles are taken during nesting or in nets at sea for meat, eggs and shell. The shell is either fashioned into products sold locally or it is exported to Japan. Since Barbados is not yet a member of CITES, importation and exportation of shell is permitted with the appropriate documentation, although new policy requires that the Chief Fisheries Officer give his per-mission for export. Discussions on Barbados' accession to CITES are in progress. In addition to the harvest of hawksbills, juvenile green turtles are caught in nets set a few hundred yards from shore on the east coast, and adult greens and loggerheads are speared opportunistically by pelagic fishermen whilst they wait for gill nets to fill. The meat (rarely the shell) from green turtles and loggerheads is used; leatherbacks are not killed, only the eggs are taken. National legislation prohibits at all times the take of sea turtles or their eggs on the beach or within 100 yd (90 m) of shore, and the capture of turtles weighing less than 30 lbs (13.6 kg). The penalties are inadequate, however, and do not serve as an effective deterrent. Enforcement of legislation is problematic because of the lack of seriousness with which the offense is viewed, the difficulty of proving that a turtle was taken illegally, and because of manpower constraints within the enforcement agencies. Very few people depend on turtle exploitation for a living and redrafted legislation banning the harvest of all sizes and species of sea turtles, as well as the use of entangling nets, is presently being considered by Cabinet. If a national ban on harvest comes into effect, there will be even greater reason to accede to CITES in order to control the importation of shell.

Hawksbills prefer to nest on the west and south coasts of Barbados, often in beach vegetation. These same beaches have been altered, primarily by development for tourism. Buildings and walls constructed close to the high water mark, and the positioning of gabions and boulders on beaches to protect beach-front properties has reduced the amount of beach suitable for nesting. The loss of stabilizing vegetation which has accompanied extensive beach-front development is also implicated in beach loss. Ornamental and security lights deter females from

emerging to lay eggs and cause hatchling disorientation and mortality. In 1990, hatchlings from 83% of monitored nests were disoriented by lighting. Heavy pedestrian use of beaches leads to compaction of the sand over nests, increasing mortality among eggs and hatchlings. The patchy spatial distribution of hawksbill nesting makes it difficult to identify and protect specific nesting areas. However, an estimated 15 different hawksbills nested on 1.5 km of the southwestern coast between 1989 and 1991, suggesting that this is an area within which any future development should be carefully managed. On other beaches, measures can be taken to reduce the impacts of development on turtle nesting; e.g., lighting problems can be minimized by keeping lights low to the ground, shielding them from shining directly onto the beach, and using low sodium vapor lamps in preference to full-spectrum white lights. Fortunately, the few leatherback nests recorded each year are made on the largely undeveloped high energy east and southeast coasts. Nesting habitat for leatherbacks appears unstressed at the present time.

In addition to the deterioration of nesting habitat, feeding grounds have also been affected. Hawksbills, ranging in size from small juveniles to adults, are known to forage on reef-associated sponges on the fringing and bank coral reefs around Barbados. Juvenile green turtles forage within sea grass and algal beds. Coral reefs and sea grass meadows are important to the survival of sea turtles in Barbados, yet coral cover and diversity on west and south coast fringing reefs has deteriorated over the past 30 years. Likewise, sea grass beds have diminished in size. Both types of habitats are impacted by land-based sources of pollution; e.g., sewage, household chemicals, agrochemicals, and sediment. Careless fishing practices, indiscriminate anchoring, and illegal fishing practices such as dynamiting, further contribute to the degradation of these habitats. One area of the west coast has been designated as a marine reserve, where fishing and boat use are restricted and where turtle harvest is illegal. Efforts to identify sources of pollution and implement measures to protect nearshore habitats along the entire west and south coasts are ongoing as part of a national coastal conservation project. Important sea turtle foraging habitats will benefit from these measures.

A project for improving the institutional effectiveness of coastal zone management in Barbados has recently been conducted. Enforcement of legislation pertaining to the coastal zone is one of the areas under review, and all aspects of coastal zone law enforcement may ultimately become the responsibility of one agency specifically trained in environmental legislation and its enforcement. Increasing environmental awareness among the public through educational materials and activities will assist enforcement agencies. The WIDECAST Sea Turtle Recovery Action Plan for Barbados strongly supports ongoing efforts at improving sea turtle conservation legislation, enhancing the effectiveness of law enforcement and coastal zone management, and allocating financial and personnel resources more efficiently by consolidating coastal zone responsibilities. The Plan also supports ongoing field research and public awareness campaigns and proposes several activities to enhance and expand sea turtle conservation in Barbados. In concert with national efforts, and recognizing that sea turtles are highly migratory (meaning that Barbados may share its sea turtles, particularly its hawksbills, with neighbouring islands), a tagging programme that includes at least St. Lucia, St. Vincent and the Grenadines, Grenada, and Barbados is suggested. The full recovery of shared populations will require regional cooperation. The Government of Barbados is encouraged to support multinational efforts aimed at the conservation and recovery of depleted marine species, such as sea turtles, by ratifying the Cartagena Convention Protocol concerning Specially Protected Areas and Wildlife (SPAW Protocol).

RESUMEN

La isla de Barbados es la más oriental de las Antillas Menores. En sus aguas, se encuentran cuatro especies de tortuga: la carey (Eretmochelys imbricata), la barriguda (Dermochelys coriacea), la tortuga verde (Chelonia mydas), y muy infrecuentemente, la tortuga de mar (Caretta caretta). La especie que más anida es la carey; la tortuga barriguda sólo anida de vez en cuando. La tortuga carey anida todos los meses con la excepción de febrero y marzo pero el anidamiento llega al tope entre junio y agosto. La barriguda es visitante estacional. Viene a anidar entre abril y junio. El anidamiento de la tortuga marina ha sido vigilado durante los últimos cinco años. Según los datos, poco más de 50 tortugas carey y menos de dos barrigudas anidan cada año. A menudo se ven tortugas verdes jóvenes alimentándose de la yerba marina cerca del litoral y lechos de algas, sobre todo afuera de la costa oriental. En contraste, las carey se alimentan de esponjas asociadas con los arrecifes coralinos. Las tortugas de mar maduras y quasimaduras son capturadas de vez en cuando en las aguas profundas; no se ha notado forraje. No hay cálculos del tamaño de la población de tortugas marinas alrededor de Barbados que no anidan (la tortuga verde, la barriguda, la tortuga de mar). Los pescadores por lo general reconocen que las tortugas marinas son menos frecuentes hoy que anteriormente. Las presiones primarias que experimentan las tortugas marinas en Barbados son la explotación, el deterioro del habitat donde anidan y a menor grado el deterioro del habitat de forraje.

Las tortugas carey son capturadas durante el anidamiento o pescadas del mar con redes por la carne, los huevos o el caparazón el cual o se elabora para la fabricación de productos que se venden localmente o se exporta al Japón. Dado que Barbados aún no es miembro de CITES, se le permite la importación y exportación del caparazón con el único requisito de que tenga la documentación apropiada, aunque la nueva política requiere que el Oficial encargado de la Pesca otorgue permiso para la exportación. Las discusiones con respecto a la adhesión de Barbados a CITES están encaminadas. Aparte de la cosecha de las tortugas carey, las tortugas verdes jóvenes están atrapadas en redes colocadas unas cientas de yardas costa afuera del litoral oriental y las tortugas verdes y las tortugas de mar adultas son pescadas con arpón por pescadores pelágicos oportunistas mientras esperan que se llenen las redes rastreras verticales. La carne (rara vez el caparazón) de las tortugas verdes y las tortugas barriguda son utilizadas; las tortugas de mar no son matadas, sólo se les quita los huevos. La legislación nacional prohibe de modo perenne la capturación de las tortugas marinas o sus huevos de la playa o dentro de un límite de 100 yardas (90 m) de litoral y la capturación de tortugas que pesan menos de 30 libras (13.6 Kilos). Sin embargo, las multas son inadecuadas y no sirven de freno afectivo. La ejecución de la legislación es problemática a causa de la falta de seriedad con que ven el delito, la dificultad de probar que una tortuga fue capturada de forma ilegal y las limitaciones de recursos humanos dentro de las agencias que ejecutan la legislación. Hay pocas personas que ganan la vida de la explotación de tortugas y el Gabinete está en el proceso de estudiar la legislación remodelada que prohibe la cosecha de todo tamaño y especie de tortuga marina asicomo el uso de redes rastreras verticales. Al aprobarse una ley nacional prohibiendo la cosecha, habrá aún más razón para integrarse a CITES para poder controlar la importación de caparazones.

La tortuga carey prefiere anidar en las costas occidentales y meridionales de Barbados, a menudo entre la vegetación de la playa. Estas mismas playas han sufrido cambios, primordial-

mente debidos al desarrollo turístico. La construcción de edificios y paredes próximos a la linea de la marca alta y la colocación de garriones y piedras grandes sobre las playas para proteger las propiedades con playa han reducido la extensión de playa que se presta idóneamente para el anidamiento. La pérdida de playa también incluye la pérdida de vegetación mínima de sustentación que ha acompañado el desarrollo extensivo de propiedades con playa. Las luces decorativas y de seguridad sirven de freno a las hembras que no salen a poner huevos y también conduce a la desorientación y la mortalidad de las recién nacidas. En 1990, las recién nacidas del 83% de nidos observados fueron desorientadas por las luces. El constante paseo de personas resulta en la compactación de la arena sobre los nidos, y el aumento de la mortalidad de huevos y recién nacidas. La configuración irregular del anidamiento de la tortuga carey dificulta la identificación y protección de áreas específicas de anidamiento. Sin embargo, alrededor de 15 tortugas carey anidaron sobre una extensión de 1.5 km de la costa sudoccidental entre 1989 y 1991, lo cual indica que ésta es una área donde habrá que vigilar todo tipo de desarrollo futuro. En las otras playas, se pueden introducir medidas para reducir el impacto del desarrollo sobre el anidamiento de la tortuga, por ejemplo, el problema de las luces se puede minimizar al mantenerlas bajas, juntas al suelo sin iluminar las playas directamente y utilizando lámparas de vapor de bajo volúmen de sodio. Afortunadamente, los pocos nidos de tortugas barrigudas que se registran cada año se encuentran en las costas por mayor parte no desarrolladas y altas en energía del lado oriental y sudeste de la isla. Por el momento, el habitat donde anidan de las tortugas barrigudas parece no ser presionado.

Aparte del deterioro del habitat de anidamiento, los terrenos de forraje también han sido afectados. La carey, jóven y adulta se alimentan de esponjas de los arrecifes coralinos que se encuentran en las bordes y las orillas de la isla. Las jóvenes tortugas verdes forrajean entre la yerba marina y los lechos de algas. Los arrecifes coralinos y los prados de yerba marina son importantes para la sobrevivencia de las tortugas marinas de Barbados a pesar de que la cobertura coralina y la diversidad de los arrecifes costeros al oeste y al sur de la isla se han deteriorado durante los últimos 30 años. Asimismo, los lechos de yerba marina se han achicado. Ambos tipos de habitat son afectados por fuentes terrestres de contaminación, por ejemplo, el alcantarillado, los productos químicos domésticos, las agroquímicas y la sedimentación. Las prácticas irresponsables pesqueras, el anclaje indiscriminado y actividades ilícitas pesqueras, por ejemplo, el uso de dinamita, contribuyen aún más a la degradación de estos habitats. Una área de la costa occidental ha sido designada como reserva marina, donde la pesca y el uso de barcos están controlados y donde la cosecha de tortugas es ilegal. Los esfuerzos para identificar las fuentes de contaminación y aplicar medidas para proteger los habitats litorales a lo largo de las costas occidentales y meridionales son continuos y forman parte de un proyecto nacional de conservación costera. Los habitats importantes de forraje de tortugas marinas se beneficiarán de estas medidas.

Recientemente, se ha llevado a cabo un proyecto para la mejora de la eficacia institucional en cuanto al manejo de la zona costera de Barbados. La aplicación de legislación relativa a la zona costera es una de las áreas bajo revisión y todos los aspectos de la aplicación de legislación relativa a la zona costera en última instancia devendrá la responsabilidad de una agencia específicamente adiestrada en la legislación ambiental y su aplicación. Mayor concientización ambiental entre el público por medio de materiales y actividades educacionales ayudará las agencias en la tarea de aplicación. El Plan de Acción de WIDECAST para la recup-

eración de las Tortugas Marinas de Barbados apoya rotundamente los esfuerzos encaminados a la mejora de la legislación relativa a la conservación de la tortuga marina, la de la eficacia de la aplicación de la ley y el manejo de la zona costera asicomo la distribución más efectiva de los recursos financieros y de personal por medio de la consolidación de las responsabilidades por la zona costera. El Plan también apoya la investigación encaminada en el campo y las campañas de concientización del público y propone varias actividades para mejorar y expandir la conservación de la tortuga marina en Barbados. Junto con los esfuerzos nacionales y en reconocimiento del hecho de que las tortugas marinas son altamente migratorias (que significa que Barbados pueda compartir sus tortugas marinas, en particular la carey con las islas vecinas), un programa compartido que incluya por lo menos a Santa Lucia, San Vicente y las Grenadinas, Granada y Barbados ha sido recomendado. La recuperación de las poblaciones compartidas requerirá la cooperación regional o por lo menos subregional. Al Gobierno de Barbados se le anima apoyar los esfuerzos multinacionales dirigidos a la conservación y recuperación de las especies marinas decimadas tales como la tortuga marina, por medio de la ratificación del Protocolo relativo al Convenio de Cartagena del PNUMA tocante las Areas y Fauna y Flora Silvestres Especialmente Protegidas en la Región del Gran Caribe.

RESUME

L'île située le plus à l'est des petites Antilles est la Barbade. Quatre espèces de tortues de mer ont été observées dans les eaux entourant la Barbade: la tortue a écaille, (Eretmochelys imbricata), la tortue à cuir (Dermochelys coriacea), la tortue verte (Chelonia mydas), et une espèce plus rare, le caouan (Caretta caretta). Ce sont les tortues à écaille qui ont la fécondité la plus élevée. Les tortues à cuir ne niched qu'occasionnellement. Les tortues à écaille nichent pendant toute l'année sauf en février et en mars mais leur période de pointe s'étend du mois de juin jusqu'au mois d'août. Les tortues à cuir sont des visiteurs saisonniers qui arrivent uniquement pour nicher entre avril et juin. Les pratiques de nichage ont été observées pendant les cinq dernières années. Les informations recueillies montrent que pas plus de cinquante tortues a écaille et moins de dux tortues à cuir nichent tous les ans. D'ordinaire, les jeunes tortues vertes se nourissent d'herges marines situées dans les zones côtières et aussi dans lles chmaps d'algues qui se trouvent le plus souvent près de la côte est. Par contre les tortues à écaille se nourissent d'éponges associées aux ris de coraux. Les couans les plus jeunes et les vrais adultes sont souvent pris dans les eaux profondes mais aucune surveillance n'a été effectuée en ce qui concerne leurs habitudes d'alimentation. Les estimations relatives aux populations de tortues de mer, telles que les tortues vertes, les tortues à écaille et le couans, qui ne nichent jamais dans les eaux de la Barbade ne sont pas disponible. Les pêcheurs pensent généralement que les populations de tortues de mer diminuent aujourd'hui par rapport aux années passées. A la Barbade, les pressions que subissent les tortues de mer proviennent de l'exploitation, de la détérioration des habitats de nichage et, dans une moindre mesure, de la diminution des habitats d'alimentation.

On attrappe les tortues à écaille pendant les périodes de nichage ou bien dans la mer à l'aide de filets pour utiliser leur chair, leurs oeufs et leurs écailles. L'écaille ser à fabriquer des artiles vendues sur place ou bien elle est expotée au Japon. Puisque la Barbade ne fait pas encore partie de CITES, l'importation et exportation des écailles accompagnées des documents appropriés sont encore légales bien qu'une décision récente exige un permis d'exportation deliré par le Chief Officier de la Pêche. Des négociations sont en cours en ce qui concerne l'adhésion de la Barbade au CITES. Outre la pêche des tortues à écaille on attrappe les jeunes tortues vertes `a l'aide de filets placés à quelques centaines de yards de la côte orientale; et les tortues vertes adultes et les couans sont capturés par les pêcheurs pélagiques qui se servent de lances pendant qu'ils attendent que leurs filets à ailette se remplissent. Concernant les tortues vertes et les couans, c'est plutôt la chair (et rarement l'écaille) qu'utilise la population. On ne tue pas les tortues à cuir; on utilise uniquement leurs oeufs. La législation antionale interdit définitivement et strictement d'attrapper sur les plages les tortues de mer et leurs oeufs, et les prises ne doivent plus se faire à l'intérieur des 90 mètres (100 yards) de la côte. La législation interdit aussi la prise des tortues qui pèsent moins de 13, 6 kg (30 lbs). Cependant les amendes sont toujours insufficantes et par conséquent n'agissent pas comme une arme préventive efficace. La mise en vigueur de la législation crée des problèmes préventives efficace. La mise en vigueur de la législation crée des problèmes préventives efficace. La mise en vigueur de la législation crée des problèmes du fait que le délit n'est pas pris au sérieux et qu'il est difficile de prover qu'une tortue a été attrappée illégalement, et aussi en raison des contraintes de personnel au sein des organismes de contrôle. Très peu de personnes vivent de l'exploitation des tortues de mer et donc le Cabinet étudie actuellement la révision d'un législation interdisant les prises de tortues

de mer de toute taille et de toute espèce ainsi que l'emploi de filets enchevêtrés. Si l'interiction des prises à l'échelon national était mise en vigueur, il constituerait une raison de plus en faveur d'une adhésion rapide au CITES afin de contrôler l'importation d'écailles.

Les tortues à écaille préfèrent nicher sur les côtes ouest et sud de la Barbade et souvent dans la vegétation du littoral. Ces plages à alimentation ont été altérées et ceci, à la suite surtout du développement du tourisme. Les édifices et les murs qui ont été construits près de la marque des eaux profondes, et les grosses pierres et les gabions qui ont été mis sur les plages pour protéger les résidences ont beaucoup réduit la superficie des zones de nichage. La perte de végétation stabilisatrice qui a accompagné le développement intensif des plages entraîne aussi la diminution de ces superficies. L'éclairage ornamental et celui de sécurité empêchent les femelles de sortir pour pondre leurs oeufs et causent la mort et la désorientation en matière de nichage. En 1990 les nouveux-nés sortis de 83% de nids surveillés étaient désorientés par l'éclairage. Une forte présence de promeneurs entraîne une certaine densitée de sable sur les nids et ceci donne lieu à une mortalité élevée, ce qui accroît la mortalité des oeufs et des nouveaux-nés. Le peu d'espace consacré au nichage des tortues à écaille rend difficiles l'identification et la protection des zones spécifiques de nichage. Cependant entre 1989 et 1991 environ 15 tortues à écaille différentes auraient niché sur un espace de 1,5 km sur la côte sud-ouest et ceci indique que c'est là une zone à l'intérieur de laquelle tout développement sur les champs de nichage des tortues; par exemple, les problèmes d'éclairage peuvent être minimisés, si on installe des lumi-ères basses, c'est à dire, à fleur de terre, pour les empêcher d'éclairer directement les plages, et en se servant de lampes à vapeur et à faible contenu de soude plutôt que de lampes blanches à lumières forte. Heureusement, un petit nombre de nids des tortues à cuir observés chaque année se trouvent sur les côtes isolées de l'est et du sud-est bien eclairées. En fait, il n'y a aucune preuve de pression à l'intérieur des habitats de nichage dont se servent les tortues à cuir.

Outre la détérioration des habitats de nichage, les champs d'alimentation ont aussi été atteints. On sait que les tortues à écaille qui varient en grandeur jusqu'à l'âge adulte se nourissent d'éponges associées aux ris de coraux ou avoisinant les terrasses sous-marines autour de la Barbade. Les tortues vertes se nourissent d'herbes et d'algues marines. A la Barbade les ris de coraux et les champs d'herbes marines jouent un rôle important pour la survie des tortues de mer; et pourtant la superficie et la variété de coraux sur les ris des côtes ouest et sud se sont beaucoup détériorées pendant les trente dernières années. Egalement les champs d'herbes marines se sont rapetisées. Les deux types d'habitats se trouvent fortement atteints par la pollution dont l'origine se trouve à l'intérieur de la Barbade tel que les égouts, les produits chimiques ménagers, les produits agro-chimiques et les sédiments. Par ailleurs, les pratiques de pêche négligentes, le mouillage sans discrimination et les activités de pêche négligentes, le mouillage sans discrimination et les activités de pêche illégales telles que le dynamitage accentuent la dégradation de ces habitats. Une zone de la côte ouest a été désignée comme réserve marine et à l'intérieur de celle-ci, la pêche et l'utilisation des bâteaux sont controlées et la prise des tortues est illégale. On poursuit des initiatives visant à identifier les sources de pollution et à mettre en application les mesures propices à la protection des habitats tout le long des côtes ouest et sud dans le cadre d'un projet national de conservation des zones côtières. Les grands habitats d'alimentation des tortues de mer benificieront de pareilles mesures.

On a récemment entrepris un projet afin d'améliorer l'efficacité institutionelle de la gestion des zone côtières de la Barbade. La mise en vigueur de la législation en matière de zone côtière est un des domaines considérés et il est probable que tous les aspects relatifs à la mise en application de la loi régissant les zones côtières relèvent de la compétence d'une agence spécialisée en matière d'environnement et d'exécution. Une connaissance plus approfondie de la part du public concernant l'environnement grâce à un programme de sensibilisation aidera les agences d'exécution. Le projet appelé "WIDECAST Sea Turtle Recovery Action Plan" pour la Barbade appuie fortement les programmes en cours visant à améliorer la conservation des tortues de mer en augmentant l'efficacité de la loi et celle de la gestion des zones côtières et en consacrant des resources financières et humaines de façon plus éfficace grâce à la consolidation des compétences en ce qui concerne les zones côtières. En outre, le projet apporte son appui aux recherches sur le champ déjà effectuées et aux programmes de sensibilisation et il propose la mise en place de plusieurs programmes de sensibilisation et il propose la mise en place de plusieurs activités ayant pour bût d'améliorer et d'accroître la conservation de la tortue de mer à la Barbade. Parallèlement aux initiatives prises à l'échelon national et en reconnaissant que les tortues de mer sont de grands animaux migratoires (c'est à dire que la Barbade partagerait ses tortues, et surtout ses tortues à écaille avec les îles voisines) on propose de mettre en place un programme continue à la Barbade avec la participation des îles suivantes: Ste. Lucie, St. Vincent, les Grenadines et la Grenade. Un tel programme qui impliquera la participation de populations diverses peut être entrepris dans le cadre de la coopération régionale, ou sous-régionale. On recommande au gouvernement de la Barbade de s'efforcer d'appuyer les initiatives multi-latérales qui visent à conserver et à récupérer les espèces marines en voie de disparition, telles que les tortues de mer et ceci, en ratifiant le Protocole de la Convention de Cartagène conclue par la PNUE et relative aux zones spéciales protegées et à la flore et la faune de la région des Caraïbes.

I. INTRODUCTION

Barbados (59°35'W, 13°10'N) is the most easterly island in the Lesser Antilles (Map 1). Historical evidence suggests that turtles may never have been particularly common around Barbados. Turtle bones, dating back to about 1000 AD, have been found at only one of five Amerindian sites excavated in the country. By contrast, the bones of turtles are commonly found at Amerindian sites of a similar period in Antigua, as well as in St. Vincent and the Grenadines. Ligon (1673), in an account of the society, economy, and natural history of Barbados recorded during a stay between 1647 and 1650, mentions an abundance of green turtles (Chelonia mydas) in the Leeward Islands of the Caribbean. A lover of turtle meat, he was disappointed that green turtles were so few around Barbados, and moreover that those present were neither "fat nor kindly". Perhaps the green turtles he encountered were immature, or perhaps he was misidentifying hawksbills as immature green turtles.

Fresh green turtle meat was widely eaten in the Caribbean, and calipee especially was considered a delicacy in the Leeward Islands, at the time Ligon was writing. Yet the only turtle meat that was available in Barbados was pickled turtle meat imported from the Leeward islands. Ligon (1673) postulated that the lack of green turtles reflected the fact that there were no sandy beaches for turtles to nest on in Barbados. This is somewhat surprising, since one of the primary attractions of Barbados as a present day tourist destination is its white sandy beaches. Nearly two centuries later, Schomburgk (1848) included three species of sea turtle in the vertebrate fauna of Barbados: the hawksbill, green, and loggerhead sea turtles, archaically known as Caretta imbricata, Caretta esculenta, and Caretta cephalo, respectively. He made no mention of the distribution or abundance of these species, nor whether they nested on the island.

Today, hawksbills and an occasional leatherback (Dermochelys coriacea) are the only species of sea turtle known to nest in Barbados. Hawksbills, loggerheads, and green turtles are all harvested (additional detail is provided in section 3.3). Hawksbills are primarily caught with the use of nets set between the outer edges of fringing reefs and the bank reef (1000 m offshore) off the west and south coasts. Juvenile green turtles are caught in similar nets set a few hundred yards from shore on the east coast. Adult greens and loggerheads are speared opportunistically by offshore pelagic fishermen whilst they wait for gill nets to fill. The meat, eggs, and shells of hawksbills are used, as well as (but more rarely) the meat and shells of green turtles, the meat of loggerheads, and the eggs of leatherbacks -- despite the fact that egg harvest is illegal at all times (section 4.21). Turtle shell articles such as jewelry and combs are on sale in numerous tourist-orientated shops. Although present legislation prohibits the possession of any turtle under 30 lbs (13.6 kg), preserved and mounted juvenile hawksbills (generally <30 cm carapace length and thus clearly under the 30 lbs limit) can be bought from a few wayside vendors.

Sea turtles of all species can be legally caught at a distance greater than 100 yd (90 m) offshore, providing that they are over 30 lbs in weight (section 4.21). Fishermen set nets for turtles during the hawksbill's breeding season (May-October), which is said to coincide with the dropping of manchineel tree (Hippomane mancinella) berries. Since fishing practices have developed to reflect the availability of resources, the seasonality of fishing may suggest that there are insufficient numbers of adult turtles around Barbados to make fishing for them profitable outside of the breeding season. Alternatively, adult turtles may be present all year but

may be harder to catch because they are not approaching and departing from nesting beaches, nor are they mating at the water's surface. Thus, during the season when pelagic fish such as flying fish (Hirundichthys affinis) and dolphin fish (Coryphaena hippurus) become abundant, fishermen concentrate on this more profitable fishery rather than on sea turtles.

Very few fishermen, if any, are dependent on the turtle fishery for their primary livelihood. No reliable records of turtle landings at fish markets have ever been kept, again suggesting that the turtle fishery was never considered important. At the present time, the majority of turtles are probably captured illegally whilst laying eggs on the beach. Certainly a high proportion of hawksbills observed nesting by the public is killed annually (15-22%, section 2.4). Consistent with a lack of economic dependence of Barbadians on sea turtles, there is a general lack of superstitions or traditions associated with sea turtles when compared to other islands in the region. This lack of dependence, combined with the high literacy rate in Barbados, may make conservation of sea turtles in Barbados relatively easier than in some other parts of the region.

II. STATUS AND DISTRIBUTION OF SEA TURTLES IN BARBADOS

2.1 Caretta caretta, Loggerhead Sea Turtle

There are no indigenous common names applied to this species and the preferred name is loggerhead. The loggerhead turtle is recognized by its large head, thick, somewhat tapered carapace (=shell), brown and gold or reddish-brown colouration, and characteristically heavy encrustation of invertebrate epifauna (especially barnacles). There are typically five pairs of lateral scutes on the carapace (Figure 1). The large head and strong jaws, for which the species was named, are necessary adaptations to a diet of mollusks and hard-shelled crabs; tunicates, fishes, and plants are also eaten (Dodd, 1988). Adults attain a straight-line carapace length of 120 cm (nuchal notch to posterior tip) and weigh up to 200 kg (Pritchard et al., 1983).

The species has a wide oceanic distribution. In the Atlantic Ocean individuals have been sighted as far north as Newfoundland (Squires, 1954) and northern Europe (Brongersma, 1972) and as far south as Argentina (Frazier, 1984). Nesting grounds are often located in temperate latitudes, with the greatest numbers of nesting females recorded on the Atlantic coast of Florida (USA) and on the shores of Masirah Island, Oman. Nesting is also reported from various islands of the Greater and Lesser Antilles (although firm records are not always available), the Caribbean coasts of Mexico and Central America, and the Atlantic coast of South America from Venezuela to Brazil, as summarized by Dodd (1988).

Loggerheads are not known to nest in Barbados, but juveniles (one weighed 32 kg) and adults or near-adults (one measured 83 cm straight carapace length) are occasionally caught opportunistically offshore by pelagic fishermen. These turtles are usually speared by the fishermen as they wait for their gill nets to fill (see section I). The meat is eaten whenever available. Foraging grounds have not been identified. Neither spatial nor temporal patterns of distribution are known. Population estimates are not available. The species is considerably rarer than either the green turtle or the hawksbill.

2.2 Chelonia mydas, Green Sea Turtle

Local common names for this species include green turtle and green-back. Green turtles are recognized by a single pair of scales on the forehead between the eyes and a round, blunt beak serrated for clipping sea grasses. The carapace is smooth and the plates (=scutes) do not overlap one another (in contrast to the hawksbill turtle, see section 2.4). The carapace is characterized by four pairs of lateral scutes (Figure 1) and is generally free of barnacles. Adults attain weights of 230 kg and generally measure 95-120 cm straight-line carapace length (nuchal notch to posterior tip) (Pritchard et al., 1983). Individuals of varying sizes are present in the waters surrounding Barbados throughout the year.

Green turtles are herbivorous and in the Caribbean they feed primarily on the sea grass Thalassia testudinum (Bjorndal, 1982). Field studies indicate that individual turtles maintain feeding "scars" by returning to the same area of sea grass meadow to forage everyday (Bjorndal, 1980; Ogden et al., 1980, 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 generally abandons the scar and moves on to form another. Sea grasses are relatively rare in Barbados. The best developed foraging areas are found on the south coast and in protected bays on the east coast (section 4.111) (Map 2).

There are no documented incidents of green turtles nesting in Barbados, although a single hatchling was found in 1990 on land at a site far from the sea. Where it came from and how it got there are unknown. Adults are occasionally caught opportunistically offshore (usually speared), but they are rarely seen in coastal waters. In contrast, juveniles (5-18 kg in weight) are relatively common in coastal waters, especially on the east coast. Some fishermen take them opportunistically and more rarely set nets for them, although those they catch are often below the 30 lbs (13.6 kg) legal size limit (see section 4.21). Green turtles are long-lived and require 25-35 years to reach sexual maturity in the Caribbean (Frazer and Ladner, 1986). Age structure of the population(s) feeding in the waters of Barbados has not been studied.

2.3 Dermochelys coriacea, Leatherback Sea Turtle

Leatherbacks are the largest of all the sea turtles (nesting females often weigh 300-500 kg) and they have the most extensive geographic range of any turtle. Aside from their great size, leatherbacks are easily distinguished because they lack a bony shell. The smooth, black skin is spotted with white. The carapace is strongly tapered, measures 130-165 cm in length (straight-line, nuchal notch to posterior tip), and is raised into seven prominent ridges (Figure 1). Powerful front flippers extend nearly the length of the body. Adults, at least adult females, are excellent divers, having been recorded at depths exceeding 1000 meters in Caribbean waters (Eckert et al., 1989). Leatherbacks feed predominately on jellyfish and other soft-bodied prey (Den Hartog and Van Nierop, 1984; Davenport and Balazs, 1991). Based on offshore studies of diving by gravid (=egg-bearing) females nesting in St. Croix, Eckert et al. (1989) proposed that inter-nesting dive behaviour may reflect nocturnal feeding on vertically migrating zooplankton, chiefly siphonophore and salp colonies.

Yalimapo-Les Hattes, French Guiana, is the largest nesting colony in the Western Atlantic and supports an estimated 14,700-15,300 females (Fretey and Girondot, 1989). In contrast, most Caribbean populations, particularly those associated with islands, are small (<150 females). This is the case in Barbados, where only a few nestings occur each year between April and June on the remote and high energy Atlantic beaches of the east and southeast coasts (Map 3). Eight nests were reported between 1984-1987 (Horrocks and Willoughby, 1987). Based on data collected elsewhere in the region, we assume that individual females return on 2-3+ year intervals and deposit an average of 5-6 clutches/yr, each clutch averaging 80-90 yolked eggs (a variable number of smaller yolkless eggs are also laid). Nests are made on 9-10 day intervals.

The evidence currently available from tag returns and strandings in the western Atlantic suggests that adults engage in routine migrations between temperate and tropical waters, presumably to optimize both foraging and nesting opportunities. This appears to be the case in Barbados, where the leatherback is not resident but occurs only during the egg-laying season. Leatherbacks are not fished or killed whilst nesting; they are considered rather unusual and not very edible. Only the eggs are taken (illegally, see section 4.21). Fishermen have towed large leatherbacks back to Barbados to show people before returning them to the water, and newspapers have published photographs of large nesting females. In a very unusual occurrence, an adult female (149 cm curved carapace length, 109 cm curved width) washed ashore headless and limbless in early December 1991, apparently butchered at sea. Young juveniles occasionally strand on the east coast (Horrocks, 1987).

2.4 Eretmochelys imbricata, Hawksbill Sea Turtle

The hawksbill is distinguished by a narrow, pointed beak with which it pries sponges and other soft-bodied organisms from the reef. The carapace is often posteriorly serrated and carapace scutes overlap, like shingles on a roof (Figure 1). Adults rarely exceed 80 kg and a carapace length of about 90 cm (straight-line, nuchal notch to posterior tip). Bright mottled colouration (brown, orange, gold) is common. Hawksbills have proven difficult animals to study and very little is known about Caribbean populations in general. Gravid females often nest on isolated beaches, including those flanked by exposed coral and rock, and routinely retreat into supralittoral vegetation such as the sea grape tree (Coccoloba uvifera) prior to egg-laying. As a result, there may be little evidence of the nest aside from a faint asymmetrical crawl (about 0.7 m wide) leading to and from the ocean.

An island-wide survey by the Barbados Environmental Association in 1987, as well as reports by the public up to the present, have shown that hawksbills nest primarily on the more sheltered, more steeply sloping west and south coast beaches (Horrocks and Scott, 1991) (Map 4). An area of relatively concentrated nesting occurs on 1.5 km of the south coast where 5-7 females nest per annum. There are records of hawksbills nesting during all months of the year, with the exception of February; peak nesting occurs during June-August (Figures 2, 3). Nest counts indicate that, on average, fewer than 50 females nest in Barbados each year (see sections 4.112, 4.291). Mean clutch size is 139 eggs (n=81 nests), which falls within the range reported for other Caribbean populations (120-200 eggs: Witzell, 1983; Corliss et al., 1989). At Pasture Bay, Antigua, inter-nesting intervals average 14-15 days (Corliss et al., 1989); preliminary data from Barbados indicate likewise.

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). Specific feeding areas have not been identified in Barbados, but foraging is assumed to be more or less coincident with the distribution of coral reefs around the island (section 4.111). All size classes 23 cm straightline carapace length and larger are seen in Barbados' nearshore waters. The turtle fishery concentrates its efforts within the nesting season (May-October). At this time, entangling nets (20-30 cm mesh) typically 2.5-3.5 m deep and 20-150 m long are set close to shore where females are likely to be approaching and leaving beaches. Nets set within 100 yds of shore are illegal, but enforcement is problematic (sections 4.21, 4.22).

The illegal killing of nesting hawksbills remains a problem, primarily because the penalty (Bds. $100) is insufficient and enforcement of the present legislation is difficult. In 1987, 22% of nestings reported by the general public resulted in the female being slaughtered. In addition, poaching of eggs occurred in approximately 15.2% of all reported nestings. In 1991, Bellairs Research Institute received information on nesting by a total of fewer than 50 different turtles, and eight of these animals (>16%) were slaughtered. The habit of nesting on the highly developed west and south coast beaches has meant that hawksbills are also adversely affected by coastal development and beach erosion (see section 3.1). Jewelry and other items made from hawksbill shell are widely available in tourist-oriented shops and there is some export of shell to Japan (section 3.3).

2.5 Lepidochelys kempii, Kemp's Ridley Sea Turtle

There are no records of Kemp's ridleys foraging or nesting in Barbados, nor would the species be expected to occur. With the exception of a single recapture from Caribbean Nicaragua of a "head-started" individual (Manzella et al., 1991), which may have displayed altered behavior due to having been held captive during its first year (Woody, 1991), Kemp's ridleys are 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). Some 42,000 females were observed nesting in a single day at the primary rookery at Rancho Nuevo in 1947, whereas 200-400 females nest annually today (Richard Byles, U. S. Fish and Wildlife Service, pers. comm.). 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 Barbados. However, occasional individuals may be expected in view of the occurrence of this species in Trinidad and Suriname. In the Western Atlantic, 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, dropping from about 3,000 nests per year in the late 1960's to fewer than 500 nests per year today (Fretey, 1990). Diffuse nesting occurs in northwestern Guyana and in French Guiana (Reichart, 1989).

III. STRESSES ON SEA TURTLES IN BARBADOS

3.1 Destruction or Modification of Habitat

Beaches on the west and south coasts of Barbados are composed of coralline particles derived from the reefs offshore and are subject to seasonal erosion and accretion. Erosion generally occurs between January and March and accretion between April and September on west coast beaches; and erosion between March and September and accretion between October and February on south coast beaches. West coast beaches have diminished in size (presently they are about 15 m wide) at an average of 0.3 m/yr over the period 1954 to 1982. If this rate of erosion continues, some of these beaches may disappear by the year 2000. The south coast beaches, with a few notably bad exceptions, have remained fairly stable over this same period. Their stability may be due in part to the construction of groynes for sand entrapment. The east coast beaches have remained the most stable over this time period. The sand on these beaches is primarily siliceous and is derived from land-based sources, but they, too, are subject to erosion during the time when wave energy is at its highest on this coast (June-September). The erosion of beaches has serious implications for the future of tourism, and hence the economy of Barbados, apart from the effect on turtles nesting in Barbados.

The loss of beaches has been attributed in part to natural phenomena such as the rising sea-level, but a more immediate correlation with disappearing beaches is the extensive beach-front development and accompanying loss of stabilizing beach vegetation that has occurred over the past few decades. Seawalls and boulders are often used to protect sea-front properties. These structures may aggravate beach erosion by deflecting wave energy abruptly downwards, thereby increasing the scouring effect of waves. The construction of hotels and houses continues on the few remaining undeveloped beach front areas on the west and south coasts. Hotels modify nesting areas more seriously than private houses. Ornamental and security lighting, removal of beach vegetation, and heavy pedestrian use of beaches may discourage turtles from nesting, as well as increase hatchling mortality and aggravate erosion. Specific measures designed to mitigate the degradation of nesting beaches are discussed in sections 4.13 and 4.6.

As noted above, the lighting of beaches adjacent to houses and hotels may deter females from nesting (see also section 4.132). Moreover, several nesting females have been found on their backs in storm drains or wedged between boulders that have been placed to fortify the beach. There are now very few undeveloped beach front areas along the west and south coasts where females can emerge and nest in darkness. When nesting does occur adjacent to hotels and houses, hatchlings are invariably attracted to lights, and often not found until the next day or later. Mortality among disorientated hatchlings is high, and those that are found alive are often too exhausted to be released. Of 27 nests monitored in 1987-88, 14 (55.6%) were affected by beach lights at hatching, with up to 100% of hatchlings in affected nests orienting inland instead of toward the sea (section 4.132). In 1990, hatchlings from 83% of 35 monitored nests were disoriented by lighting. The problem may be worsening due to a generalized increase in security lighting.

The health of the west and south coast fringing reefs in terms of coral cover and diversity and fish abundance and diversity is generally acknowledged to have deteriorated over the past 30

years. In order to quantify and monitor the status of these reefs, an extensive data base has recently been obtained (section 4.11). Reef deterioration is likely to be attributable to poor nearshore water quality, over-fishing, poor fishing practises (e.g., careless deposition of traps and pots, illegal dynamiting for fish), and anchor damage. Since hawksbills appear to depend on sponges and other reef-associated invertebrates for food in the Caribbean, this species is likely to be adversely affected by the deterioration of coral reefs. In addition, it is the opinion of knowledgeable residents that sea grass beds, which provide important food for the herbivorous green turtle, have diminished in size over the past two decades. Degradation of sea grass beds may be attributable to increased inputs of sediment resulting in clouding of the water and a reduction in rates of photosynthesis, and increased inputs of herbicides and pesticides via land run-off (section 4.146).

Nesting and feeding areas on the less developed east coast are not affected as severely as those on the south and west coasts. Habitat stresses on leatherbacks, which nest primarily on the east coast and forage in the open ocean, are therefore minimised.

3.2 Disease or Predation

There are few data available to assess whether sea turtles are seriously stressed by disease or non-human predators in Barbados. In 1980-81, 5-10 juvenile green turtles were caught off the east coast with tumors over their eyes and on their flippers, indicative of a disease known as green turtle fibropapilloma. In 1990, 19 of 21 green turtles (weight range 5-18 kg) caught by two east coast fishermen were afflicted by this disease. The extent to which these tumors affect the survival of sea turtles in Barbados is not known, but to date the disease has been found only in green turtles caught on a small rocky outcrop surrounded by sea grasses off Barclays Park. Green turtles caught at other east coast sites 6-8 km away from this area were not affected (Gamache and Horrocks, 1991). Green turtle fibropapilloma has been documented extensively in Florida (Ehrhart, 1991) and has more recently been found in Curaçao (Jacobson, 1990), Venezuela (Guada et al., 1991), and Belize (Karen Eckert, WIDECAST, pers. comm.). The cause of this debilitating and often fatal disease is unknown.

In addition to disease, depredation is a factor impacting on sea turtle populations. During the incubation period, eggs attacked by insects in the nest can be subsequently infected with fungi and bacteria. Vertebrate predators, such as mongooses, are rarely seen on beaches, but on two occasions at one location mongooses were seen carrying eggs from nests. Both of these nests had been previously exposed, by poachers in one case and wave action in the other case. Dogs also sometimes consume turtle eggs (Horrocks and Willoughby, 1987). After hatching, ghost crabs (Ocypode quadrata) prey on hatchlings as they crawl across the beach and fishes consume the small turtles once they enter the sea. Since most nesting occurs on the west and south coasts where nearshore water quality and over-fishing have affected the abundance and size of potential predators, reef-associated predation of hatchlings may be less serious than that in the vicinity of healthier reefs elsewhere in the Caribbean. Two young juvenile leatherbacks (20-30 cm straight-line carapace length) have been found stranded in east coast rock pools since 1984. Each had a recently bitten-off front flipper, suggesting shark attack (Horrocks, 1987). An adult female with her right front flipper severed off in a manner again suggestive of shark attack stranded on the same beach (Cattlewash Beach) in February 1989 (Horrocks, 1989).

3.3 Over-utilization

Dr. Wayne Hunte of the Bellairs Research Institute reported to the Western Atlantic Turtle Symposium (Hunte, 1984) that, since fishery catch statistics began to be compiled in the early 1960's, there had been no specific record-keeping for sea turtles. Turtles were included under "any other deep water species" on Fishery Division's Recording Forms, suggesting that their harvest was never a very large enterprise. It is not possible to ascertain what portion of turtles landed were brought to landing sites, nor what portion of those were recorded; however, landing data are likely to represent an acceptable subsample of the catch as a whole. Three points are noteworthy: (1) there was a continuous decline in turtle catch between 1963 (nearly 1300 lbs/landing site) and 1974 (<100 lbs/landing site), whereafter the catch leveled off until 1982 (the last year for which data were presented by Hunte) at 200 lbs/landing site, (2) during the 1950's the mean number of turtles caught per fishermen per month was in the order of 35, whereas at the time of Hunte's (1984) writing this had declined to two turtles, and (3) the average size of turtles caught may also have declined.

Sea turtles are turned whilst nesting, or captured at sea using entangling nets (20-30 cm mesh) typically 2.5-3.5 m deep and 20-150 m long. Nets are set both at the surface and at the bottom. Sometimes turtles are speared. Turtle fishing is conducted by only a few fishermen, and only as a supplement to their other fishing activities (Hunte, 1984). Today, as was true a decade ago, it is generally acknowledged by fishermen that turtles are less common than in previous years. The fishery continues to target adult females, and the removal of this age/sex class is likely to affect the viability of remaining populations most severely. A high percentage of hawksbills observed nesting by the public is killed annually (16-22%, section 2.4). The female is either killed prior to laying and the eggs are removed and sold, or the eggs are taken from the nest. Some turtle poachers will take the female but leave the eggs. This is viewed as a conservation measure to ensure that there will continue to be sufficient turtles in the future, but the fact is that harvesting adult turtles, regardless of whether or not the eggs are left behind, is extremely detrimental to sea turtle populations (see section 4.233).

There are several market points around the island for the handling and sale of turtle meat, eggs and shell. Because the sale of sea turtle is increasingly covert, the exact number of turtles sold each year is not known. Approximately half of a turtle's weight is considered to be meat, which sells at an average of Bds. $2.80 (US $1.40) per lb. An adult turtle also yields a-bout 6-8 lbs of shell which sells at Bds. $15.00 per lb. Eggs sell at Bds. $2.00 per lb. An average adult hawksbill weighs approximately 160 lbs (average weight of breeding female; Olson, 1985). A turtle of this size is therefore worth Bds. $224.00 in meat and Bds. $105.00 in shell, making a total of Bds. $329.00 (Horrocks and Willoughby, 1987). Meat and eggs are sold and consumed domestically, as is some of the shell. Turtle shell (also known as 'tortoiseshell') articles are widely available in tourist-orientated shops. Until recently, when department stores were reminded of the laws protecting small turtles, whole stuffed juveniles were also offered for sale (Horrocks and Willoughby, 1987). Harvest is continuing, but restaurants have responded to ongoing public awareness campaigns and have voluntarily removed turtle meat from their menus (section 4.41).

Persons wishing to export turtle shells or shell products from Barbados require documentation from the Ministry of Trade, Industry, and Commerce (Barbados Export Promotion Corporation) and from the Ministry of Labour, Consumer Affairs and the Environment (Price Control Division). Permission from the Chief Fisheries Officer is also required. Present policy does not permit the exportation of turtle shells that originate in Barbados. Japanese Customs data indicate that 1,930 kg of "bekko" (hawksbill shell scutes) was imported from Barbados between 1970-1986 (Milliken and Tokunaga, 1987), and that a further 529 kg was imported in 1990 (Canin, 1991). It is unlikely that the population of hawksbills around Barbados could supply this amount of bekko and the data suggest that Barbados, a non-party to CITES [Convention on International Trade in Endangered Species], has been named as the port of export even though the shell did not actually originate from Barbados. This practice is not uncommon among dealers trying to evade CITES restrictions (Canin, 1991).

The lateral and vertebral scutes from the carapaces of two adult hawksbills caught in Barbados (82 cm and 95.5 cm curved carapace length) yielded an average of 1.4 kg bekko (J. Horrocks, unpubl. data). This agrees with the calculated average yield of 1.34 kg bekko per hawksbill imported into Japan from the Caribbean region (Milliken and Tokunaga, 1987). Based on the Japanese Customs statistics cited above and the average yield of bekko per hawksbill, we can estimate that 1,440 turtles were killed between 1970 and 1986, and nearly 400 more in 1990, in order to supply the bekko exported (or allegedly exported) from Barbados to Japan.

3.4 Inadequate Regulatory Mechanisms

It is illegal to take turtle eggs, to catch or attempt to catch turtles on the beach or within 100 yd (90 m) of the shore, or to buy, sell or possess any turtle of weight less than 30 lbs (13.6 kg) (section 4.21). If found guilty, offenders are punishable by confiscation of the turtle, eggs, and/or fishing gear and by a fine of Bds. $100 (US $50). The present legislation offers little deterrent since an "average" female is worth between Bds. $200-300 in meat alone (section 3.3). Confiscation of gear, such as boats, is a more serious deterrent, but since catching a female on the beach requires no gear that can be confiscated, the fine of Bds. $100 is totally insufficient to deter the widespread poaching of nesting females. Recognizing that present legislation is inadequate, new regulations are proposed in section 4.23. Improving local enforcement efforts is discussed in sections 4.22 and 4.616.

3.5 Other Natural or Man-made Factors

Four additional sources of mortality should be mentioned. First, the illegal practice of dynamiting coral reefs for fish (section 4.141) kills an unknown number of turtles each year. Second, there are increasing reports of turtles being struck by speed boats and jet skis in the waters off the west and south coasts. Third, compaction of sand over nests, caused by heavy pedestrian beach use, prevents the emergence of hatchlings, and has caused up to 100% mortality in some nests (Horrocks and Scott, 1991). Fourth, nest flooding by salt and freshwater is a serious threat to the successful hatching of eggs in some areas (Horrocks and Willoughby, 1987). All sea turtle embryos require oxygen during their development and will drown if submerged in water for an extended period of time.

IV. SOLUTIONS TO STRESSES ON SEA TURTLES IN BARBADOS

4.1 Manage and Protect Habitat

The protection of important foraging and nesting habitats is crucial to the survival of sea turtles in Barbados. As is true for many territories in the Caribbean, the decline in sea turtle stocks in Barbados has coincided with a decline in nearshore fishery resources in general, including lobster, conch, and sea eggs, and chronic deterioration of marine and coastal environments. Nearshore fisheries are both easily accessible, and so the first to be overexploited, and are the most vulnerable to land-based sources of pollution (see sections 4.143, 4.146, 4.147). Where the pollution of nearshore waters negatively impacts on coral reef health, the effectiveness of reefs as dissipators of wave energy is diminished and beach erosion can follow. Therefore, nearshore habitat deterioration will ultimately affect more than just the livelihoods of fishermen. The island's economy is heavily dependent upon tourism, and the management and protection of natural resources is beginning to receive high priority (sections 4.611, 4.612). Sea turtles are fortunate in that they should also benefit from most management and protection plans designed to mitigate the many threats posed by pollution and general neglect of the marine environment.

4.11 Identify essential habitat

In Barbados, coral reefs and sea grass beds are utilized by sea turtles for foraging and sandy beaches are utilized for nesting. Primary habitats are poorly known, although some survey work has been undertaken. There are no marine or terrestrial parks or reserves designated for the protection of sea turtles. However, turtles and other marine life are protected from pollution and harvest within the confines of the Barbados Marine Reserve, which extends 2.2 km along the west coast and 1000 m offshore (Map 5).

4.111 Survey foraging areas

Limited resources dictate that the management and conservation of sea turtles focus first on those habitats most critical to their survival in Barbados; further study is sorely needed in order to identify these areas. The Coastal Conservation Study (1984) mapped the locations of sea grass beds and coral reefs around the west and south beaches of Barbados (Map 2). These areas all represent potential foraging habitats for green and hawksbill sea turtles. Loggerheads, which are rare in Barbados, would be expected to forage on crustaceans and mollusks in reef, rock and other hard bottom areas. Leatherbacks have not been observed to feed in the waters of Barbados, and apparently remain in deep waters between nestings. This species would be expected to consume jellyfish and related animals either at the surface or in the water column. Foraging has been cited as an impetus for deep diving by gravid females in the U. S. Virgin Islands (Eckert et al., 1989).

Sea grasses are much less extensive around Barbados than around most other Caribbean islands and their role in the coastal ecosystem of Barbados has not been studied. The largest grass bed areas are on the south coast from Oistins to Bridgetown, and there are smaller beds in protected bays on the east coast. Along the western coast, sea grasses are very sparse. Knowled-

geable residents report that sea grass beds have diminished in size over the past two decades. Increased inputs of sediment, resulting in clouding of the water and a reduction in rates of photosynthesis, and increased inputs of herbicides and pesticides via land runoff are implicated in sea grass decline. Sea grass beds and coral reefs are both important to green turtles, for whom they provide food and shelter, respectively. The relative scarcity of green turtles as compared to hawksbills may perhaps be explained by the lack of sea grass around Barbados.

Barbados is a coral island dotted by fringing reefs and a more or less continuous bank reef approximately 1 km offshore along the western and southern coasts (Map 2). A principal component of the diet of hawksbill turtles is reef-encrusting sponge; thus, for hawksbills, reefs are used not only for shelter but also for food. Over the past twenty years the health of fringing reefs has declined, due primarily to poor nearshore water quality (see also sections 4.143, 4.146, 4.147). Bellairs Research Institute, under contract from the Coastal Conservation Project Unit of the Ministry of Labour, Consumer Affairs and the Environment, conducted the first quantitative benthic survey of the fringing and bank reefs on the south and west coasts of the island (Oxenford et al., 1989). The survey provided baseline data on the present state of the reefs and will allow any future changes in reef health to be quantitatively assessed. The survey also quantified fish abundance and diversity, and coverage of hard coral, soft coral and algae.

Preliminary nearshore surveys (line transects) at water depths of 3-15 m along a northern section of the west coast of Barbados were conducted by Bellairs Research Institute in July-August 1991 as part of their sea turtle conservation activities. Juvenile turtles (greens and hawksbills combined) were encountered at a rate of about 0.4 per km. No adults were observed. The only information available to date on foraging habitat used by sea turtles is qualitative, consisting of occasional sightings from the cliffs along the northeast coast and reports from SCUBA dive operators visiting the same areas repeatedly. A comprehensive long-term survey is needed in which dive operators, marine research scientists, and fishermen should all be encouraged to participate. The dive operators have already expressed a willingness to take part in small-scale surveying of nearshore foraging habitats. This cooperation will be very useful in assessing the relative importance of various coastal habitats.

4.112 Survey nesting habitat

The Coastal Conservation Project Unit (CCPU) is an agency within the Ministry of Labour, Consumer Affairs and the Environment. It was established in 1983 to advise on coastal erosion matters. Its routine activities include monitoring of beaches around the island and the review of applications made to the Town Planning Department (Ministry of Housing and Lands) for any proposed coastal development. The CCPU surveys 38 beaches at 3-month intervals, 20 at 2-week intervals, and 17 annually. The resulting profiles allow changes that have taken place over the past five years to be quantified, and strategies for subsequent beach stabilization measures to be developed. These data are also very useful for the long-term monitoring of sea turtle nesting habitat.

The first comprehensive attempt to survey beaches for sea turtle nesting activity was made in 1987 in preparation for WATS II, the Second Western Atlantic Turtle Symposium (Horrocks and Willoughby, 1987). It was estimated that from June to August (peak nesting period) there were about 44 km of suitable nesting beaches around Barbados; where a suitable

beach was defined as one for which some sand remains exposed at even the highest tides. This figure exaggerates the number of beaches actually used by turtles for nesting, since it does not take into account the presence of housing developments nor the amount of vegetation on the beaches. However, because hawksbills do sometimes nest on highly public beaches, all beaches that were suitable as defined above were included in the assessment of the total amount of potential nesting beach available. On the west and south coasts, changes in beach width can be dramatic between nesting and hatching, although most nesting activity has ceased by the time the largest swells arrive.

Information on nesting activity in 1987 was collected by two methods. First, as part of a national information campaign, the public was asked to call a telephone number provided for the purpose of reporting observations (night or day) of turtle nesting or hatching activity. Second, volunteers from the Barbados Environmental Association conducted a series of early morning beach surveys during the peak breeding season (June-August) (section 4.291). Reports of hawksbill nesting came from most beaches along the west and south coasts of Barbados, as well as some sheltered east coast beaches (Map 4). Data combined from nesting reports and beach patrols indicated that 120-362 hawksbill nestings occurred (Horrocks et al., 1987; see also section 4.291). Gravid hawksbills in Antigua deposit up to six clutches of eggs per season (Corliss et al., 1989), but the modal (most common) number is five clutches (Jim Richardson, University of Georgia, pers. comm.). Based on an average of five nests per female, an estimated 24-72 hawksbills nested in Barbados in 1987.

Public awareness and participation in the monitoring of sea turtle nesting activity has increased substantially since 1987. In 1989, 1990, and 1991, the number of hawksbill nests reported by residents was 71, 60, and 91, respectively (Figure 3). Analysis of the timing and placement of these nests suggests that 37, 25, and 47 females nested in Barbados in 1989, 1990, and 1991, respectively (see also section 4.291). In addition to valuable input from residents, 1.5 km of beach on the south coast from the Barbados Hilton east to Ocean View, where it was claimed that turtles nested in high numbers, was surveyed each morning throughout three consecutive nesting seasons (1989-1991) by a volunteer as part of the sea turtle conservation activities of Bellairs Research Institute. The results of this survey indicated there were 5-7 hawksbills nesting annually on this stretch of beach. Assuming a remigration interval similar to Antigua (Corliss et al. 1990), an estimated total of only 15 individual females nested on this beach over the entire three year period. Although these numbers are small, in the context of the estimated size of the Barbados population, this area warrants protective measures.

It is important for beach surveys to continue in order to further define essential habitat in Barbados, to monitor trends in nesting numbers, and to minimize threats to nesting turtles and their eggs. Systematic surveys should be initiated at beaches where hawksbills are known to nest and where the illegal killing of turtles is reported to occur; e.g., Long Beach on the south coast, a strip of beach between Heywoods and Six Mens on the northwest coast, and Bath on the east coast. Early morning surveys could be conducted by volunteers, but this would require collaboration between several organisations, including Bellairs Research Institute, Barbados Environmental Association, Barbados National Trust, the secondary schools, etc. Bellairs Research Institute (Lead Organisation for WIDECAST in Barbados) or Barbados Environmental Association could co-ordinate activities and provide training for volunteers. Alternatively, inter-

ested persons could be employed to monitor specific beaches throughout the nesting season. Night surveys are preferred in order to deter poaching and to permit the systematic tagging of females.

Persons employed to monitor beaches at night and tag post-nesting turtles will require specific technical training. Hawksbills can be very easily deterred from nesting by activity on the beach, and it is vital that survey activities of preferred nesting beaches do not result in these habitats being avoided by turtles. Training sessions could be conducted by Bellairs Research Institute staff. [N.B. An introductory training course in sea turtle biology and management is available from the Caribbean Conservation Corporation, see section 4.55.] The important Hilton-to-Ocean View stretch of south coast beach described above is already monitored in the early morning, but nocturnal surveys would enable tagging to be initiated. Night surveys would require the assistance and support of enforcement agencies.

4.12 Develop area-specific management plans

Presently, there are no specific management plans for sea turtles in Barbados. Although there are provisions in current legislation for establishing marine reserves and protected beach areas, the patchy spatial distribution of hawksbill nesting and the infrequency with which leatherbacks nest make it difficult to identify and protect the nesting areas of either species. However, the 1.5 km stretch of south coast beach described in section 4.112 (Barbados Hilton east to Ocean View) appears to warrant special consideration; a specific management plan is recommended. This beach is developed for most of its length, but buildings are set back and the beach remains relatively wide and dark compared to most other south coast beaches. The recent finding that a minimum of 15 hawksbills nested at this site during three consecutive years (1989-1991) makes this area important to protect from any future development that will negatively impact on sea turtle nesting. Hotels adjacent to the beach have already been cooperative in monitoring nesting activity and attempting to minimize disorientation of hatchlings from known nests by reducing the amount of light shining in the area of nests.

A disadvantage of designating particular areas for the protection of hawksbills is that this may be seen as an adequate measure of protection and result in the relaxation of regulations elsewhere on the island. In some cases, however, such as the site described above, specific protection is encouraged. In addition, it is likely to become necessary for a beach or section of beach to be reserved for nest reburial, perhaps through the Marine Areas (Preservation and Enhancement) Cap 392, 1976 legislation (see section 4.21). Ultimately, the most appropriate strategy for protecting nesting and feeding areas may lie in a coastal zone management plan applicable to the whole coast of Barbados. Atherley (1987) suggests an outline for comprehensive Coastal Zone Management legislation that would plug legal loopholes and give the responsibility for enforcement to one independent agency with skills in coastal zone management. A project for improving the institutional effectiveness of coastal zone management in Barbados was conducted in 1991 through the Coastal Conservation Project Unit. The challenge will be to integrate all the separate agencies into unified enforcement and policy implementation. Coastal zone management legislation is especially important for the management of the (as yet) largely undeveloped east coast.

4.121 Involve local coastal zone authorities

The Coastal Conservation Project Unit (CCPU) is the agency responsible for research and monitoring of the coastal zone (including beaches and reefs) and acts as an advisory body to the Town Planning Department, the Minister of Housing and Lands, and the Ministry of Labour, Consumer Affairs and the Environment. The CCPU has been advised of the ways in which coastal development affects sea turtles. They have already contributed useful ideas in discussions about how conflicts between the needs of sea turtles and the economic and social development needs of Barbados might be resolved. For instance, they have suggested that endangered nests be relocated to safer beaches or to beach hatcheries, and that beach vegetation receive similar protection to that given to trees over a certain size under the Trees (Preservation) Act 1981.

At present the coastal zone is managed and legislation is enforced by several different agencies. The National Conservation Commission (NCC) is responsible for the maintenance of beaches, and also acts as an advisory body to the Minister of Housing and Lands for decisions pertaining to the construction of beach recreational facilities, and prevention of beach erosion. NCC personnel include rangers, wardens, life guards and beach cleaners. Rangers and wardens have powers to arrest persons committing certain offences under the National Conservation Cap. 393. Beginning in 1991, NCC personnel have been incorporated into the programme (sponsored by Bellairs Research Institute and the Fisheries Division of the Ministry of Agriculture, Food and Fisheries) that is presently monitoring sea turtle nesting activity (see also section 4.291). Agency-specific measures recommended in the area of sea turtle conservation are discussed in section 4.6.

4.122 Develop regulatory guidelines

The following actions are of fundamental importance to the sustained protection of sea turtle nesting and foraging areas: (1) amend and/or rewrite existing coastal zone laws pending suggestions arising from the institutional strengthening project, increase penalties to act as a more serious deterrent, and strengthen enforcement efforts.

In addition to these general improvements, more specific regulations will be needed to protect particularly important foraging or nesting areas. When areas are defined as especially critical to remaining sea turtle populations, regulatory guidelines will be essential in order to establish a framework within which appropriate land use and development (commercial, residential, recreational) can occur. For instance, development proximal to important nesting beaches should be required to design beach front lighting in such a way as to preclude or minimize the disorientation of hatchlings or nesting adults (section 4.132). Construction of solid jetties and beach walls, and activities such as sand mining (section 4.131) and dredging should be regulated in such a way as not to result in the erosion of nesting beach habitat. Similarly, boaters should be prevented from indiscriminate anchoring in reef or sea grass habitats (section 4.147) and from discarding refuse at sea (section 4.144). These are, in many cases, common sense measures which will not only defend important habitat for the benefit of endangered and declining sea turtle populations, but also ensure that sensitive areas are properly safeguarded for future generations of Barbadians.

4.123 Provide for enforcement of guidelines

Enforcement is the responsibility of the Royal Barbados Police Force, the Barbados Coast Guard, and to a lesser extent the National Conservation Commission (NCC). These agencies have recently been sensitized to the legislation pertaining to sea turtles. Enforcement of legislation protecting turtles and their nesting and feeding habitats should be shared between the police, Coast Guard and, ultimately, trained coastal zone rangers. The National Conservation Commission already employs personnel with limited powers of arrest for offences committed on beaches; e.g., selling goods or services on a beach without an appropriate license. Training NCC personnel to assist the Barbados Police Force to enforce legislation protecting nesting turtles and their eggs would be very valuable.

4.124 Develop educational materials

Since no specific area or zone for official protection has been designated to date, it is desirable that citizens throughout the country continue to be made aware of efforts to conserve turtles and be told what they can do to assist these efforts. A number of pamphlets, books, posters and car stickers are already in circulation in Barbados, and these are supplemented by radio and television broadcasts throughout the sea turtle breeding season (section 4.41). In the past, the Barbados Environmental Association has surveyed the beaches of the whole island once a month during the breeding season. They are planning to repeat these surveys and to encourage the public to participate. The Association is seeking funding to produce posters targeting tourists at the airport and sea port, advising them against buying turtle products (section 4.43). They are also planning to make a wildlife documentary of Barbados that will include a section on sea turtles.

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. With the loss of sandy beaches, the coast's potential to support recreation, wildlife (e.g., sea turtles), tourism, and commercial development is reduced. It is presently illegal to remove sand from the foreshore of Barbados, and specific areas adjoining the foreshore have been identified for protection against sand mining (section 4.21). Recently, however, the illegal removal of sand from beaches (e.g., Long Beach, which is reported to be an important hawksbill nesting area) has been observed. It is the recommendation of this Recovery Action Plan that the law banning the removal of sand from beaches be enforced diligently.

4.132 Lights

Beach front lighting is a serious cause of mortality among hawksbill hatchlings, and may also be a deterrent to nesting females. Sea turtle hatchlings orient to the sea using light; that is, using the brightness of the open seaward horizon as their primary cue. As many as 100% of the

hatchlings emerging from nests exposed to beach front lighting have been found orienting away from the sea and toward the artificial light source (section 3.1). While there are presently no official regulations with regard to the lighting of beach front properties, several means to mitigate the problems caused by badly placed lights have been employed. These include the sending of a form letter to all hotels and restaurants along the west and south coasts early in the hawksbill breeding season. The letter asks that unnecessary lights be turned off, and that lights which cannot be turned off for security and safety reasons be checked each morning at dawn for disorientated hatchlings. This letter has produced very encouraging results. Bellairs Research Institute staff collect disoriented hatchlings for release at a suitable beach the following night.

Another approach has been to talk directly with architects and their clients about lighting plans for new developments along the coast (see section 4.621). When alerted to the problems caused by beach illumination, developers have proved to be quite willing to cooperate even in the absence of legal requirements to do so. Lighting problems can be minimized by keeping lights low to the ground, shielding them from shining directly on the beach (this is accomplished using structural shields or attractive hedges of vegetation), and using low sodium vapor lamps which emit light in the range of 590 nm, which is known to be far less attractive to hatchlings than full-spectrum white lights (Raymond, 1984; Witherington, 1990). Although it would be beneficial, it is very unlikely that any lighting restrictions will be legislated in the foreseeable future. Thus, voluntary compliance with lighting alternatives and restrictions is seen as crucial to the reproductive success of sea turtles in Barbados.

4.133 Beach stabilization structures

Beach erosion is a serious problem on the west and south coasts of the island (section 3.1). Many properties built before legislation governing set-back limits were enforced have erected beach walls, or revetments such as rock-filled wire baskets (gabions) or boulders to minimize loss of their land to the sea. For much of the coastline, turtles are unable to climb very far above the normal high water mark due to these coastal protection structures. The annual loss in beach width of 0.3 m along the west coast means that there is likely to be an increasing need for coastal protection and armouring in the near future. This will decrease the amount of suitable nesting habitat left available to hawksbills if the structural solutions to coastal erosion outlined above (e.g., the placement of boulders) are implemented. Some hotels have also erected groynes in attempts to increase the width of their beaches. These groynes have altered sand movements along extensive stretches of the coast and have sometimes resulted in the complete loss of adjacent beaches at certain times of the year. On some beaches, sea turtle nesting may also have been adversely affected (see also section 4.135).

The conservation of beaches in Barbados, because of their social and economic importance as recreational areas, has recently been, and will continue to be, given high priority by Government. The Coastal Conservation Project Unit (an agency within the Ministry of Labour, Consumer Affairs and the Environment) has implemented remedial measures suggested by the Coastal Conservation Study (1984), including the removal of some private, destructive groynes and the erection of a few reconstructive groynes. It is the recommendation of this Recovery Action Plan that the use of set-backs (prohibiting the construction of buildings seaward of the primary dune line or zone of permanent woody vegetation) and native vegetation (to retain

and stabilize beach sands) be considered favorable alternatives to armouring the beach. It is presently illegal to construct any building within 100 ft (30 m) of the high water mark (section 4.21).

4.134 Beach cleaning equipment and vehicular use of beaches

Mechanized beach cleaning equipment can puncture or crush incubating sea turtle eggs and its use should be avoided. Rakes which reach deep into the sand and compaction resulting from tractors and trucks all diminish the hatching success of eggs incubating on the affected beach. Fortunately, mechanical cleaning of beaches in Barbados is rare, although it does occur adjacent to Sandy Lane Hotel and on the main Barbados Hilton beach, among others. The positions of any nests made on these beaches are reported to Bellairs Research Institute and nests are marked so that beach cleaning machinery does not run over them. The sandy beaches in front of most hotels are hand-raked by hotel personnel in the early morning. On some other beaches, cleaning is done by employees of the National Conservation Commission. All beaches in Barbados are public.

In recent years there has been increasing use of cars and jeeps on beaches. Driving vehicles on the beach compacts the sand, damages beach vegetation, and can cause or exacerbate coastal erosion. Erosion exposes eggs *in situ* to wave action and reduces the amount of beach available for sea turtles to nest on. Compaction adversely affects sea turtles by crushing eggs and killing hatchlings. After breaking free from their eggs, full-term hatchlings work together with their siblings to reach the surface of the beach and then remain just below the sand until nightfall. When the sun sets and the beach cools, they are cued by the change in temperature to emerge fully and crawl to the sea. If vehicles run over the unseen hatchlings waiting below the surface, they can be fatally crushed. In addition, tyre ruts left in the sand can trap hatchlings and prevent them from reaching the sea (Hosier et al., 1981). Vehicles can also strike and kill hatchlings crawling to the sea, or frighten females away from nesting.

4.135 Beach rebuilding projects

Beach rebuilding projects are generally closely related to beach stabilization efforts in Barbados (see section 4.133). Beach rebuilding projects typically involve the redistribution and trapping of sand from existing beaches, and herein lies the problem. The existence of hotels more or less continuously along the south coast means that trying to rebuild beaches at one hotel may affect adjacent beaches and hotels. Solving such beach erosion problems has been the responsibility of the Coastal Conservation Project Unit (CCPU). For instance, the CCPU advised that the length of an already existing groyne at Sandhurst on the south coast be reduced after complaints had been made that the groyne was starving a beach on its down drift side. The CCPU also advised that a second breakwater be constructed off the Barbados Beach Village on the west coast, after the hotel became concerned about erosion. This caused considerable reaction from local residents who were worried about the erosion that had been caused in 1982-1983 by a poorly designed groyne that had been erected privately by the same hotel. The same beach that was affected in 1982-1983 is well known for hawksbill nesting activity. So far, there have been no adverse effects on this beach from the new breakwater.

As an alternative to the use of impermeable structures, the CCPU has been carrying out the re-vegetation (primarily using native "sea grape", Coccoloba uvifera) of selected beaches. The use of vegetation such as sea grape for beach stabilization will have an additional benefit for nesting hawksbills, since they often prefer to nest amidst vegetation (Mortimer, 1982). Adequate protection of supralittoral vegetation cover on beaches may require additional legislation (section 4.23). Another alternative which has been used to promote the accretion of beach sand is synthetic seaweed. Synthetic seaweed was installed at Rockley Beach on the south coast on an experimental basis in 1985. After some initial success and noticeable sand build up, the seaweed fronds started to sink under the weight of enmeshed sand and beach erosion resumed. There are no immediate plans to install any more synthetic seaweed in Barbados unless the weighting problem is resolved.

The reconstruction of beaches elsewhere in the region is sometimes accomplished by dumping sand dredged from offshore onto a beach or former beach. This causes several problems for sea turtles, aside from the danger that heavy equipment on the beach and/or in adjacent waters can obstruct or preclude nesting and the new over-burden can smother incubating eggs. The most serious concern is that physical and organic characteristics of offshore sediments generally lead to compaction on the beach. This is well documented in Florida (USA) and was recently observed in Belize when a "renourishment" effort on Caye Chapel resulted in a hard compacted sand beach unusable to sea turtles for nesting (Smith et al., 1992). If this expensive method of reconstruction occurs in Barbados, the new sand should reflect the original material (e.g., organic content, grain size) and rebuilding should not occur during the nesting season.

4.14 Prevent or mitigate degradation of marine habitat

4.141 Dynamiting reefs

Dynamiting for fish is illegal (section 4.21), but occurs quite regularly on both fringing and bank reefs on the west, south and southeast coasts. Dynamiting is an extremely destructive form of fishing. Many fish killed by dynamiting do not float to the surface and therefore are not collected. Moreover, the destruction wrought on slow-growing coral reef environments reduces the fish carrying capacity of the system. Localized reef blasting has been conducted to improve fishing boat navigation channels at several points along the east coast (Tent Bay, Foul Bay, Skeete's Bay and Conset Bay). The long term effects of these actions are not fully known, but it appears that the exposed coral and coral rubble created by the blast are very susceptible to erosion, the navigation channels are already quite undercut, and the beaches parallel to reef cut channels may be more prone to erosion.

Because healthy coral reef ecosystems are vital to sustainable fisheries and tourism (both economically important industries in Barbados), as well as to endangered sea turtles, it is the recommendation of this Recovery Action Plan that laws prohibiting the use of explosives for the purpose of fish extraction be rigorously enforced. In addition, blasting to improve access for marine vessels should be closely regulated, if not prohibited, and ongoing studies to evaluate the long-term effects of past blasting should be conducted. Penalties for fishing with explosives should be severe and include heavy fines, in addition to the confiscation of vessels and other equipment in use at the time of violation.

4.142 Bleaching reefs (by man)

It is illegal to use bleach or other chemicals for the purpose of fishing in Barbados (section 4.21) and this practice is not known to occur. However, many houses and hotels on the west and south coasts have swimming pools with filter backwashes discharging into the coastal zone. Chlorine is extremely toxic to corals, and local deleterious effects on coral reefs have been documented. As part of the Coastal Conservation Project Phase II, the sources of near-shore pollutants, including chlorine from swimming pools, industrial and agricultural pollutants and sewage are being identified. Because healthy coral reef ecosystems are crucially important to sustainable fisheries and tourism (both economically important industries in Barbados), as well as to sea turtles (providing them with food and shelter), it is the recommendation of this Recovery Action Plan that deleterious discharges of chlorine into the sea be illegal at all times and under all circumstances. Penalties should be stiff enough to serve as a deterrent to the use or discharge of chlorine and other toxic chemicals in the marine environment.

4.143 Industrial discharges

Toxic effluents from the rum refinery and heated effluents from the power station pose serious pollution problems in the area where they are released (Brighton), with decreasing effect on reef quality with distance from the source (Tomascik and Sander, 1985). The rum refinery effluent contains yeast, methanol, higher alcohols, aldehydes, ketones and esters and has a high BOD [biological oxygen demand] loading (Coastal Conservation Project, 1984). The Coastal Conservation Project (1984) advised that a long term solution may be to link these sources of nearshore pollution to planned sewage systems. However, sewage systems are not generally designed to handle these chemicals and another method of disposal may be more effective. Solutions are sorely needed in this regard, and field studies are necessary to ascertain the extent to which effluents of other types are degrading the marine environment of Barbados.

4.144 At-sea dumping of garbage

The discharge of sewage, oil, garbage, plastic, toxic materials, discarded fishing gear, styrofoam and a myriad of other materials into the ocean is a serious regional and global problem (e.g., O'Hara et al., 1986; CEE, 1987; Laist, 1987). The beaches of the east and southeast coasts of Barbados are most affected by garbage, sometimes dumped from boats at sea and sometimes derived from land-based sources. Fishing boats, yachts, cruise-liners, and military vessels dump their refuse at sea; sometimes the country of origin can be identified by examining the refuse. The discharge of garbage into the sea is a particular problem for sea turtles; both ingestion of and entanglement in persistent debris can be fatal to sea turtles.

The Barbados Environmental Association monitors the amount and types of garbage found on beaches during sea turtle nesting beach surveys and clean-ups, and supplies this information to the Center for Marine Conservation, an organization in Washington D. C. that is analyzing the occurrence of marine debris on a regional and global scale. Bellairs Research Institute has recently started monthly monitoring of garbage on two beaches as part of the marine debris monitoring programme of IOCARIBE/CEPPOL. Legislation prohibiting pollution of territorial waters already exists (section 4.21), but more effective enforcement is needed.

4.145 Oil exploration, production, refining, transport

The National Petroleum Corporation of Barbados, through Exploration Consultants Ltd. (U. K.), as well as private companies who have bought exploratory concessions from the Government of Barbados, have conducted preliminary oil exploration off Barbados over the past few years. The results of seismic soundings and preliminary drilling suggest that there are large reserves of petroleum (crude oil) within 30 km of the west coast of Barbados. The water there is at least 1 km deep; thus, production from this reserve will be expensive. However, if oil prices rise sufficiently, it is expected that large-scale drilling will take place. Sea turtles are potentially very vulnerable to oil spills. Studies suggest that the 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 (=nostrils) and eyes and in the upper portion of the esophagus; oil was also found in the feces.

Beach tar deposits have been monitored at selected sites around the island as part of the CARIPOL programme, the marine pollution research and monitoring programme of IOCARIBE [Intergovernmental Oceanographic Commission's Regional Sub-commission for the Caribbean and Adjacent Regions]. Owing to the current direction, east coast beaches are susceptible to any current-bourne pollutants. Most of the tar ball deposits on these beaches are thought to be derived from oil tankers washing out their holds between cargoes. Barbados is in a vulnerable position in that it lies in the path of tankers passing to the north and south of the island en route for Trinidad, South America, and the Gulf of Mexico. An additional source of beach tar may be derived from natural sea floor oil seeps off the east coast of the island.

Relatively small amounts of high grade oil are pumped from land-based wells to the southeast of Barbados. More refined hydrocarbons such as gasoline, diesel, and kerosene are pumped ashore from tankers moored off Oistins on the south coast and off Brighton on the west coast. Legislation exists to protect against fouling of territorial waters and beaches by oil (section 4.21). Nonetheless, every precaution should be taken to protect Barbados from the degradation and expense of a spill or accident. The vast expense of cleaning up oil spills could probably be met only through international cooperative agreements and sharing of costs, as encouraged by the Protocol to the Cartagena Convention [Convention on the Protection and Development of the Marine Environment of the Wider Caribbean Region] concerning Oil Spills. Barbados ratified the Cartagena Convention and the Oil Spill Protocol in May 1985 (section 4.32).

4.146 Agricultural runoff and sewage

Run-off and soil erosion are serious problems in Barbados. Most agricultural land is still under sugar cane cultivation and field peripheries are lined with low hedges of khus khus grass (Vetiveria zizanioides). The khus khus serves to keep top soil on the field following cane harvest. With the increasing mechanization of cane harvest, khus khus hedges are being removed for vehicle access and soil erosion and run-off are worsening. Attempts to diversify agriculture away from cane cultivation and into vegetable production are underway. However, since vegetables cannot compete with weeds as well as the taller sugar cane can, farmers resort

to large amounts of herbicides. The relative bareness of the soil under vegetable cultivation compared to that under cane cultivation means that more soil is eroded by wind and rain. In addition, the soil is heavily fertilized (nitrates and phosphates) to allow several vegetable crops to be grown on each field per season. The increasingly heavy use of herbicides, pesticides, and fertilizers increases the pollutant composition of run-off. Changing agricultural practises may also cause an increase in the suspended particulate matter (SPM) load, as well as the amount of nitrates and phosphates in coastal marine waters.

SPM stresses marine organisms in a number of ways, such as by decreasing light penetration and reducing the growth rate of corals, by physically smothering corals, and by impairing fish respiration. Sediment-covered surfaces restrict larval settlement, and large quantities of SPM settling and decomposing on a reef cause an increase in bacterial activity. In small quantities, nitrates and phosphates are important nutrients needed for the metabolic processes of living organisms. In excessive quantities, however, they cause phytoplankton blooms blocking light and decreasing the rate of coral growth. Sewage is another source of SPM, and of inorganic nutrients as well. With the exception of one major sewage treatment system in Bridgetown, sewage is disposed into septic tanks or pits. These are either 'soak-aways', or the contents are piped a short distance offshore and released. A sewage treatment system will be constructed to serve the needs of the south coast in the near future, and one is also planned for the west coast. One option is that lightly treated sewage will be deposited offshore beyond the bank reef and in-to currents which will carry the sewage away from the island. Such a system is preferable to heavy chemical treatment and deposition closer to shore. Some of the chemicals used in sewage treatment (e.g., chlorine) may be more lethal to corals than the sewage itself, and treatment to remove nitrates and phosphates is too costly.

The effects of pesticides and herbicides on nearshore marine communities in Barbados are unknown, but east coast fishermen partially attribute the decline in sea eggs (Tripnuestes ventricosus) to the effects of pesticides on nearshore sea grass communities. Attempts to investigate this problem quantitatively are currently underway. Since a variety of nearshore marine communities, most notably sea grass beds and coral reefs, are essential for the survival of depleted sea turtle stocks in Barbados, this information will also be useful in implementing a national recovery strategy for sea turtles.

4.147 Others

Careless anchoring of boats on coral reefs and the dragging of anchors and anchor chains causes an unquantified amount of damage, particularly to coral reefs situated off the west coast. Mooring facilities are greatly needed, particularly on the west coast, to accommodate visitation to coral reef areas. The Barbados Marine Reserve is protected by legislation (section 4.21) that prohibits damaging anchoring and fishing practices within a small designated area of the west coast nearshore waters. Elsewhere, inexpensive and effective mooring technologies, such as those designed by Halas (1985), should be installed in Barbados as soon as possible. Land has recently been reclaimed and the sea floor dredged for the construction of fish markets at Oistins and in Bridgetown. The effects of these constructions on current movements are unknown, but a short-term effect has been a substantial lowering of the clarity of water in the area. Hotels and houses on the west and south coasts often dispose of kitchen waste water through short drainage

pipes that discharge directly onto nearshore reefs. Kitchen waste water contains high concentrations of phosphates which are known to be detrimental to corals. Phosphate-free detergents are now sold in supermarkets and their use should be encouraged.

4.2 Manage and Protect all Life Stages

4.21 Review existing local laws and regulations

The Fisheries Regulation Act was passed in 1904 to consolidate the Acts of the island relating to Fisheries under one piece of legislation. The Fisheries Regulation Act presently encompasses turtle preservation, sea egg preservation, whaling, and the destruction of fish by explosives and poisons. The Turtle Preservation section of the Act (1904) makes it unlawful (1) to take or capture, or attempt to take or capture, any turtle or turtle eggs on the beach or within one hundred yards of the shore; (2) to set or attempt to set any net or seine or other instrument for the purpose of taking, capturing or fishing for turtles within one hundred yards of the shore; (3) to buy, sell or expose for sale any turtle of weight less than 30 lbs (13.6 kg). No sea turtle species is specifically named in the Act, and so it can be used to protect all species. Any person caught in the process of contravening the above restrictions is liable to a fine of Bds. $100 (US $50) and to the seizure of any turtles caught and any gear used, including boats. Proposed changes to the Act to provide for more effective conservation of sea turtle resources are summarized in section 4.23.

In 1981, a Designation of Restricted Areas Order designated the first restricted area, known as the Barbados Marine Reserve. The Marine Areas (Preservation and Enhancement) (Barbados Marine Reserve) Regulations 1981 protect marine life within the Reserve from pollution and harvest. The Reserve extends 2.2 km along the west coast and 1000 m offshore (Map 5). It is illegal to fish for turtles of any size within this area. However, the Reserve has not been demarcated with buoys and so prosecution of persons breaking the law within the Reserve is unlikely to be successful. There are also many laws and statutory instruments in existence to assist in the protection of the beaches and territorial waters of Barbados. These have been compiled into one document, with accompanying suggestions as to how their effectiveness may be improved (Atherley, 1987; see also section 4.22). Legislation that is most important from the perspective of preserving sea turtle nesting and feeding grounds is described briefly below.

Beach protection

The National Conservation Commission Cap 393, 1982, confers responsibility for beach maintenance to the Commission. In this legislation the beach is defined as land adjoining the foreshore for 33 m landwards. The Town and Country Planning Act Cap 240, 1968, includes provisions guiding the development of land. Supplementing this Act, a Statutory Instrument (No. 75, 1972) advises that no gate, fence or wall should be erected closer than 30 ft (9 m) from high water mark and that no building development should take place closer than 100 ft (30 m) to the high water mark. The Beach Protection Act Cap 389, 1980, prohibits the removal of beach sediment from the foreshore with boat or vehicle, and protects certain named areas adjoining the foreshore. The Land Acquisition Act Cap 228, 1980, authorizes the acquisition of land for public purposes, such as for public access to beaches.

Water quality and reef health

The Marine Areas (Preservation and Enhancement) Cap 392, 1976, makes provisions for the assignment of certain areas as protected marine reserves. The Barbados Territorial Waters Act, Cap 386, 1979, defines the limit of territorial waters around Barbados as 12 nautical miles. It prohibits the unlicensed extraction of living and non-living resources by foreign ships, and prohibits pollution likely to damage the marine environment and its resources. The Health Services Act Cap 144, 1969, prohibits the disposal of any filth or offensive matter into a watercourse or onto a beach. The Oil in Navigable Waters Act Cap 394, 1927, prohibits the fouling of territorial waters from vessels, land-based activities or apparatus used to transfer oil from or to any vessel or place. The Petroleum Winning Operations Act Cap 281, 1951, prohibits the searching for oil on Barbados or within the territorial waters of Barbados without a license or lease. Licensees are to take all practicable precautions to prevent pollution of coastal waters by oil, mud or any other fluid which might contaminate the shoreline of Barbados. The Barbados Water Authority Act Cap 274A, 1980, gives to the Barbados Water Authority the power to regulate sewage disposal and to determine standards of water quality for waste effluents.

Enforcement

The Marine Boundaries and Jurisdiction Act Cap 387, 1979, identifies marine conservation officers to be police, Fisheries and Coast Guard personnel, and the Defense Force. The responsibility for the enforcement of laws relating to Fisheries, territorial waters, beach mining, etc., is given to the Barbados Coast Guard in The Defense Act Cap 159, 1979.

4.22 Evaluate the effectiveness of law enforcement

This is an area where there is potential for considerable improvement and suggestions are offered in section 4.616. In general, environmental laws are not well publicized and/or not well respected by the public. This situation is aggravated by the large size of the area of coastal water that has to be patrolled by the Coast Guard, making it difficult for them to be effective law enforcers. With regard to the turtle preservation section of the Fisheries Regulation Act, effective enforcement has been lacking. The slaughter of turtles is generally considered a petty offense, and this is reflected in the small penalty for offenders (Bds. $100). As part of the sea turtle conservation activities of Bellairs Research Institute and the Fisheries Division, the public has been encouraged every year to call in and report all nestings. Callers reporting poaching incidents are advised to call the police immediately. The Royal Barbados Police Force are willing to assist, but can rarely reach the beach in time to catch the poachers.

An additional problem with enforcement of the present turtle legislation is that it may be difficult to obtain a successful prosecution since poachers must actually be caught in the act of taking a nesting female, or an animal within 100 yds (92 m) of shore. Usually poachers can argue that the turtle was merely being dragged ashore from a boat, having been caught legally offshore. The police are not equipped with boats and so have to depend on the Coast Guard to check how far offshore nets are set. No prosecutions have ever been made for violating legislation protecting turtles. The fact that the slaughter of turtles on land is illegal would be emphasized if perpetrators were successfully convicted. Increasing environmental awareness a-

mong the judiciary may assist the efforts of the Royal Barbados Police Force to enforce environmental legislation. The Fisheries Division, recognizing that the turtle preservation section of the Fisheries Legislation Act is presently both inadequate to deter poaching and difficult to enforce, is advising prohibition of sea turtle harvesting within the jurisdiction of Barbados. This proposal is strongly supported by this Recovery Action Plan.

Atherley (1987) identifies problems with the legislation pertaining to the coastal zone as it presently stands and makes suggestions for improvement. A primary problem is that in the absence of local statutes governing specifically identified sensitive areas, such as seriously eroding beaches, Common Law gives owners the right to defend their seaward boundaries and to claim naturally accreted land as part of their own property. Accretion at one site as a result of groynes and sea defenses usually means erosion of property elsewhere. Present legislation contained in the Town Planning Act makes it illegal to erect such structures without permission from a central advisory body. However, terms such as "foreshore" and "high water mark" need to be clearly defined and standardized from one law to the next in order for the legislation to be effective.

4.23 Propose new regulations where needed

It is the recommendation of this Recovery Action Plan that the present legislation protecting juvenile and adult sea turtles, as well as sea turtle eggs, should be expanded to a moratorium with large fines for violators. The present penalties are wholly inadequate. The fisheries legislation has been re-drafted and is presently being considered by Cabinet. The proposed legislation will give full protection to all species of sea turtles and their eggs and prohibit the use of trammel or entangling nets in Barbados waters. Penalties will be increased substantially over current levels. It is also important for Barbados to accede to CITES in order to reinforce planned improvements to national legislation with international trade restrictions on sea turtles and their products. Accession to CITES will restrict the import and export of turtle meat and products into and out of Barbados (see section 4.31).

4.231 Eggs

Although current regulations are theoretically sufficient to protect sea turtle eggs (harvest is illegal at all times), the penalty is inadequate to serve as a deterrent. As part of holistic turtle preservation legislation, there must be an increase in the penalty incurred for egg poaching.

Eggs need protection from beach erosion. In this context, existing coastal zone legislation concerning beachfront development must be enforced. Many contemporary development practices serve to exacerbate erosion and promote beach loss (section 3.1). Trees with a circumference of >1 m measured 1 m from the ground are protected in the Trees (Preservation) Act 1981, but additional legislation to protect beach vegetation such as sea grape and crab grass from clearance is necessary. The removal of beach vegetation accelerates erosion and can precipitate the loss of sea turtle nests.

Eggs need protection from beach compaction. This can be achieved through temporarily fencing off nests, digging up nests at the end of incubation to release hatchlings, or carefully

collecting threatened eggs within 12 hours of being laid and reburying them on quiet beaches. It is the recommendation of this Recovery Action Plan that vehicular use of beaches be carefully controlled and vehicles be prevented from driving on beaches above the high tide mark. It is also recommended that new coastal developments be required to install lighting that minimizes beach illumination in order to reduce hatchling disorientation and mortality (section 4.132).

4.232 Immature turtles

Present legislation protects immature turtles under 30 lbs (13.6 kg) in weight; nevertheless, until recently there was a relatively thriving business in preserving and selling juvenile hawksbills smaller than 30 lbs, apparently in ignorance of legislation protecting these small animals. Informing businesses of the legislation resulted in the removal of preserved turtles from display and presumably a decline in this form of exploitation. New legislation that will result in the protection of all size classes of sea turtles (all species) is currently under consideration by Cabinet, and it is the recommendation of this Recovery Action Plan that the proposed legislation be adopted and implemented as soon as possible.

If there is to be a prolonged period prior to the implementation of a ban on sea turtle harvest, then interim regulations should be considered. The recommendation of this Recovery Action Plan is that the first choice for interim regulations be a temporary moratorium on sea turtle harvest, to remain in effect until a complete ban can be implemented. In the event that a temporary moratorium is not practicable, then the second choice for interim regulations should be to restrict the harvest to juvenile green and loggerhead sea turtles, and further confine the take to turtles with a curved carapace length less than 24 inches (60 cm). The harvest of olive ridley, hawksbill, and leatherback turtles *of any size* should be forbidden. Olive ridleys and hawksbills are seriously depleted in the Western Atlantic and no amount of harvest can be justified; as for leatherbacks, only breeding adults are likely to be encountered.

Turtles are long-lived and may require decades to reach sexual maturity; thus, older turtles are progressively more valuable to their populations. Any continued harvest can be assumed harmful to already depleted sea turtle stocks. The harvest of large juveniles and breeding adults, in particular, will only accelerate population decline and eventual extinction.

4.233 Nesting females

It is estimated that fewer than 1% of the hatchlings that reach the sea will survive to adulthood. Therefore, nesting females (the producers of eggs) are extremely valuable to the maintenance and growth of population size. Frazer (1983) calculated that the reproductive value (or the relative worth) of a loggerhead sea turtle just reaching reproductive age was approximately 500 times that of an egg. Adult sea turtles represent decades of selective survival. Sexual maturity is reached at about 20-40 years of age in the Caribbean, depending on the species. Because mature adults are so difficult for a population to replace, they should receive the most stringent protection.

Although already protected under existing legislation whilst on, on the way to and on the way back from the nesting beach, it is necessary for penalties to be increased (section 4.25) and

for the legislation to be revised to protect adults and near-adults (>24 in [60 cm] shell length) in all areas. Measures to protect habitat and nests are very important, but the protection of large juveniles (nearing breeding age) and adults must have priority. Regardless of the expense and care taken to protect habitat, eggs, and juvenile life stages, declining populations are not likely to recover if the larger size classes are not fully protected. It is inevitable that we will lose our sea turtles in Barbados if we continue to harvest egg-laying females.

4.234 Unprotected species

Species are not named in current turtle legislation, but the emphasis is on the protection of nesting females and therefore primarily hawksbills. As presently written, the legislation offers no protection to non-nesting sea turtles of any species >30 lbs in weight. All five sea turtle species actually or potentially occurring in the waters of Barbados (see section II) should be named specifically in revised legislation and included in the proposed moratorium.

4.24 Augment existing law enforcement efforts

At present, the general public (from fishermen to tour operators to hoteliers) is effectively augmenting law enforcement efforts by reporting the poaching of nesting females. The police are being called upon with increasing frequency to deal with incidents of turtle poaching. Unfortunately, these incidents are of low priority to an already over-extended police force, and the Coast Guard is primarily concerned with law-breaking at sea. The suggestion that all aspects of coastal zone law enforcement be the responsibility of one agency rather than several (Atherley, 1987) is fully supported by this Recovery Action Plan. It will be necessary for these personnel to receive specific training in environmental legislation and its enforcement.

4.25 Make fines commensurate with product value

The present fine of Bds. $100 and forfeiture of gear is insufficient to deter violators. Most sea turtles are caught on the beach, meaning that there is no gear to forfeit. Not only does the market value of a turtle (on average, Bds. $200-300) substantially exceed the fine, but the size of the fine is itself a reflection of the lack of seriousness with which the offense is viewed. It is the recommendation of this Recovery Action Plan that the penalty for violation of the proposed sea turtle legislation be set at a minimum of Bds. $1,000 (US $500).

4.26 Investigate alternative livelihoods

It is unlikely that alternative livelihoods for turtle fishermen will need to be considered in Barbados. Turtle fishing is conducted by only a few persons, and then only as a supplement to other fishing activities. Similarly, encountering a nesting turtle is simply a fortuitous bonus that supplements primary employment. Craftsmen who use turtle products utilize other natural resources, such as coral and shells, as well. It seems likely that restrictions on the use of local coral for jewelry-making will also be necessary soon, so local craftsmen will be forced to look for alternative materials (e.g., seeds and wood).

4.27 Determine incidental catch and promote the use of TEDs

There is no local or foreign shrimping around Barbados. Commercial trawling does not therefore pose a threat to sea turtles locally and there is no reason to promote the use of a trawl-inserted Turtle Excluder Device (TED). There are presently about six local long-liners (swordfish and other oceanic fish) in operation, but foreign long-liners also fish illegally in Barbados' territorial waters. The amount of sea turtle mortality associated with long-lining is unknown and should be investigated. The capture of leatherback turtles by long-lines has been documented elsewhere in the Caribbean, such as in the British Virgin Islands (Cambers and Lima, 1990).

4.28 Supplement reduced populations using management techniques

There are few data as yet to enable the specific costs and benefits of management options to be evaluated. In general, however, the protection of important nesting and feeding grounds in conjunction with a ban on harvest should provide a basis for sustained sea turtle recovery in Barbados. Some specific management practices (e.g., moving nests threatened by the sea or in danger of being poached, collecting and releasing hatchlings disoriented by beach lighting) are already in use. Should other efforts be deemed desirable, methodology should follow that described in the Manual of Sea Turtle Research and Conservation Techniques (Pritchard et al., 1983). WIDECAST personnel are available to provide advice and assistance in the design and implementation of specific management techniques. The protection of habitat can also constitute an important management decision. Solutions to several common habitat threats are provided under subheadings in sections 4.13 and 4.14. An example of important habitat is the Barbados Hilton to Ocean View stretch of beach, which is the most important nesting site on the south coast (section 4.112); a specific turtle management plan is recommended for this site.

4.29 Monitor stocks

4.291 Nests

The first quantitative estimate of nesting frequency in Barbados was made in 1987. The heavy pedestrian use of most beaches combined with the relative faintness of hawksbill tracks made aerial survey techniques inappropriate for west coast and south coast beaches, so members of the Barbados Environmental Association (BEA) divided themselves into eight groups and walked around the whole island on three separate occasions (June, July, August). The divisions were such that the groups could walk their designated route between 0530-0730 hrs, prior to human activity on beaches. All nests and false crawls were recorded by each group, as was the position of the nest, evidence of poaching, and any potential threats such as lights, nearby storm drains, etc. Any nests that were considered to be threatened by erosion, freshwater flooding or building development were relocated as soon as possible (<2 days) by staff from Bellairs Research Institute using techniques recommended by Pritchard et al. (1983). Careful movement of eggs results in hatching success equivalent to eggs in naturally incubated nests.

Between one and three nests were recorded during each of the three 1987 surveys. These figures were extrapolated to represent the entire three month period, giving an estimate of 90-270 nestings for the peak hawksbill nesting period. Over the same time period, the public reported

39 nesting activities, indicating that residents were observing 14-43% (39/90 - 39/270) of the actual nesting activity. Using public reports for each month, and adjusting each by a factor of 14-43%, the total number of nestings for each month was estimated and, from this, the total number per year. The estimated number of hawksbill nests in 1987 ranged between 120-362. Public involvement in monitoring has increased markedly since 1987, with residents reporting 71, 60, and 91 nests in 1989, 1990, and 1991, respectively. Close examination of the dates (eggs laid fewer than 12 days apart are unlikely to have been laid by the same female) and locations of these nests suggests that a minimum of 37 individuals nested in 1989, 25 in 1990, and 47 in 1991. Based on five nests per female (per breeding season), an estimated 120-230 nests may have been made annually between 1989-1991; if so, the public reported roughly one-third of them.

In addition to valuable monitoring efforts on the part of the general public, an intensive survey was carried out on 1.5 km of the south coast during 1989-1991 (see also section 4.112). The number of nests deposited on this beach per year was calculated based on daily early morning beach censuses. This information was supplemented by reports from hotel nightstaff. The data indicate that five to seven hawksbills successfully nested on this stretch of beach each year. Assuming a 2-3 year nesting remigration interval (Antigua: Corliss et al., 1990), an estimated 15 different females nested over the three year period. The site does, therefore, seem a good candidate for an intensive tagging study to determine the exact number of nesting females, as well as their nest site fidelity, nest fate, and inter-nesting and re-migration intervals (section 4.293). Long-term study of this "index beach" is considered vital to any successful effort to evaluate trends in sea turtle nesting activity in Barbados.

Based on stock monitoring efforts to date, as described above, it is unlikely that the annual nesting population of hawksbill sea turtles exceeds 50 individuals. The importance of the national volunteer effort is clear, and continued participation will be encouraged. In addition, a comprehensive multi-year, island-wide survey should be undertaken as soon as possible in order to further define essential habitat, monitor trends in nesting numbers and hatch success, identify significant threats to nesting and hatching sea turtles, and refine estimates of the proportion of nesting activity actually reported by the public each year (see also section 4.112).

4.292 Hatchlings

Data on nesting (natural and relocated) and hatching activities are compiled at Bellairs Research Institute. The fates of most nests are monitored; nest contents are examined after an incubation period of 60-65 days. This allows an estimate to be made of hatching success in different months and on different coasts (see Horrocks and Scott, 1991) and gives an indication of causes of mortality within the nest. If resources become available, a more in-depth study of the susceptibility of embryos at different ages to various mortality factors in the nest would be useful. Bellairs Research Institute is alerted to any episodes of hatchling disorientation by artificial lighting and records the probable cause of mortality in the case of disoriented hatchlings; e.g., crab depredation, dehydration. A sub-sample of living disoriented hatchlings from each nest are measured (SCL and CW) before releasing them.

4.293 Immature and adult turtles

Monitoring populations of juvenile turtles and non-nesting adults is difficult, yet some estimation of relative abundance over time is necessary in order to evaluate the success of conservation measures. Dive operators have expressed interest in collaborating with the tagging and monitoring of turtles seen regularly at their dive sites. Such cooperation is welcome and is encouraged. To date, Bellairs Research Institute has tagged 13 adult hawksbills, 40 juvenile hawksbills, 15 juvenile green turtles, and two juvenile loggerheads. Adults are tagged with Titanium tags marked "Bellairs, Barbados, Reward". Sub-adults are tagged with monel tags inscribed with a University of Florida, Gainesville, address; tags were supplied by Dr. Karen A. Bjorndal, Director of the Archie Carr Center for Sea Turtle Research.

One tagged adult female hawksbill re-nested two years after she had been tagged, and within a few hundred metres of the original nest spot. Several tags have been returned from turtles netted or speared by Barbados fishermen. One loggerhead tagged and released in Barbados was recaptured two years later in southwest France and was later released unharmed. This animal was one of two flown to Barbados after they stranded on a beach in Cornwall, U.K. No leatherbacks have been tagged.

Knowledge of immature and adult turtle offshore behaviour and habitat use could be furthered by the initiation of ultra-sonic or VHF-radio tracking of tagged animals. Ultra-sonic tags are self-identifying, transmitting unique aural codes that can be heard on the same frequency and thus allowing several animals to be tracked simultaneously. Ultra-sonic tags were used with success to track the inter-nesting movements of hawksbills nesting on Buck Island off the north coast of St. Croix, U. S. Virgin Islands, in 1991. In the same study, even greater success was realized using VHF radio transmitters (Scott Eckert, Hubbs-Sea World Research Inst., pers. comm.). A programme using either or both of these techniques is recommended for Barbados.

4.3 Encourage and Support International Legislation

4.31 CITES

If the harvest of all sea turtles is prohibited by national legislation (as is currently under consideration, see section 4.23), persons catching turtles or offering turtle products for sale can be prosecuted. In support of these improvements in national legislation, it will be important to terminate all international sea turtle shell and product trade. The problems created by trade are illustrated by the fact that while there was a ban on sea egg (Tripnuestes ventricosus) harvest in Barbados, some supermarkets continued to import sea egg products from Grenada, making it difficult to enforce the ban. One way to coordinate trade restrictions on sea turtle products is for Barbados to join the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), a powerful and effective global trade treaty that has been ratified by 112 countries (WWF, 1992). Discussion is ongoing between the Ministry of Agriculture, Food and Fisheries, the Ministry of Trade and Commerce, and the Ministry of Foreign Affairs on acceding to this Convention. It is the recommendation of this Recovery Action Plan that Barbados make accession to CITES a high priority. Japanese Customs statistics indicate that nearly 2,000 hawksbill turtles have been killed for export from Barbados to Japan since 1970 (section 3.3).

4.32 Regional cooperation

It is likely that hawksbill turtles move freely among the islands of the Lesser Antilles (as is known to occur in other sea turtle species), and collaborative conservation efforts by several different countries will be required to safeguard depleted populations. This may prove to be difficult since some other countries, such as St. Vincent and the Grenadines, rely relatively heavily on sea turtle exploitation. Nonetheless, the cooperation of neighbouring states is important to the success of any sea turtle protection measures instituted in Barbados. One mechanism for co-operation on a regional scale is the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (the "Cartagena Convention"). The Cartagena 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 in Montego Bay, Jamaica, in 1981. The representatives of Governments from 22 States in the region, including Barbados, 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 what would become known as the Cartagena Convention. Representatives from 16 States participated. The Conference adopted both the Convention and a Protocol concerning co-operation 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., at-sea dumping of waste, pollution from ships, land-based and airborne sources, and from sea-bed activities). Article 10 is of special interest to sea turtles 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." Barbados ratified the Cartagena Convention on 28 May 1985.

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 (these are: Caretta caretta, Chelonia mydas, Eretmochelys imbricata, Dermochelys coriacea, Lepidochelys kempii, L. olivacea) in Annex II (UNEP, 1991; Eckert, 1991). The unanimous vote on this issue is a clear statement on the part of Caribbean govern-

ments that the protection of regionally depleted species, including sea turtles, is a priority. Barbados played an important role in the adoption of the new SPAW Protocol and its Annexes, having attended both the January 1990 and June 1991 Conferences, but Government has not yet ratified the Protocol. It is the recommendation of this Recovery Action Plan that Barbados ratify the SPAW Protocol with its Annexes at the earliest possible opportunity.

4.33 Subregional sea turtle management

To establish whether nearby countries share with Barbados a common stock of sea turtles, especially hawksbill and green turtles, will require a cooperative effort amongst nations to tag juvenile and adult turtles. The extensive travels of adult green turtles are especially well known in the Wider Caribbean, in part because of many years of tagging at a large nesting colony in Tortuguero, Costa Rica (e.g., Carr et al., 1978; Meylan, 1982). It is also known that juvenile green turtles move from one "developmental habitat" to another, and may travel thousands of kilometres during the decade(s) of adolescence. Thus it is clear that no one nation can effectively manage or conserve green sea turtles. Green turtles, especially adults, are comparatively rare in Barbados. Nesting has never been documented.

Less is known of the movements of hawksbills, but long-distance tag returns are reported from the Wider Caribbean. For example, Nietschmann (1981) reported hawksbills tagged in Nicaragua and recaptured in Jamaica and Panama. Carr and Stancyk (1975) reported hawksbills tagged in Costa Rica and recaptured in the Miskito Cays of Nicaragua. On 20 July 1990, a juvenile hawksbill (74 cm SCL) tagged six months before at the Biological Reserve of Atol das Rocas in Brazil, was captured and killed in Dakar, Senegal. The distance traveled was at least 2,300 miles (Marcovaldi and Filippini, 1991). Relatively recent tagging projects implemented in Antigua, the U. S. Virgin Islands, and Caribbean Mexico will undoubtedly provide additional data in the future, as, hopefully, will tag returns from turtles tagged here in Barbados.

A joint hawksbill tagging programme involving at least Barbados, St. Lucia, St. Vincent and the Grenadines, and Grenada would contribute greatly to our understanding of the stock structure of hawksbills in the Wider Caribbean, and strengthen conservation efforts in the area. WIDECAST promotes such cooperative, international approaches to sea turtle conservation, and would offer technical support to such a project. Cooperative tagging projects are a priority in Appendix I, "Expansion of the Sea Turtle Project in Barbados". It is also the recommendation of this Recovery Action Plan that Barbados participate in regional efforts to define sea turtle stocks using mtDNA or other proven genetic analysis techniques.

With regard to the few seasonally occurring leatherbacks, it is certain that they travel widely amongst nations. There are several records of leatherbacks tagged on Caribbean beaches found later in New England (e.g., Pritchard, 1973, 1976; Lambie, 1983; Boulon et al., 1988), and studies of the rate and composition of barnacle colonization on Caribbean-nesting females corroborate the notion that these turtles embark from temperate latitudes on their way to tropical nesting beaches (Eckert and Eckert, 1988). Gravid individuals can be expected to return to Barbados at intervals of 2-5 years to repeat the nesting procedure, and in the process will pass through the waters of many nations. Barbados cannot protect its leatherbacks without the support of all Caribbean nations.

4.4 Develop Public Education

4.41 Residents

An information campaign jointly sponsored by Bellairs Research Institute and the Fisheries Division (Ministry of Agriculture, Food and Fisheries) is directed at residents. Turtle meat has long been a local delicacy, but turtle shell products are not popular locally. The few restaurants that were still serving turtle meat have responded to the information campaign and have removed turtle dishes from their menus. The Fisheries Division has produced a poster and a short television programme (1 minute), and has erected signs at beaches to inform people about existing legislation. Furthermore, personnel from the Fisheries Division and Bellairs Research Institute give talks to schools and Government departments involved in management of the coastal zone; e.g., the National Conservation Commission.

Bellairs Research Institute responds to all public reports with visits, and encourages the public to become involved in conservation activities. Bellairs personnel have also participated in radio interviews about sea turtles. Prior to the onset of the breeding season, a letter is sent to all hotels and restaurants advising them of the legislation and about problems hatchlings may have with beach illumination. In addition, the Barbados Environmental Association (BEA) has produced a poster on their turtle monitoring activities that was exhibited during National Environment Week, and a colourful leaflet providing information on sea turtles that is of interest to Barbadians and tourists. The BEA is seeking funding to make a 30-minute documentary on the environment of Barbados that will include footage on turtles. Several years ago a comprehensive full-colour booklet entitled "The Marine Turtles of Barbados" (Horrocks and Baulu, 1986) was produced by the Barbados Primate Research Center and Wildlife Reserve.

4.42 Fishermen

It is widely known and intuitively obvious that enforcement is impractical, if not impossible, in the absence of public knowledge of and support for the law(s) being enforced. This is especially true for user groups such as fishermen. The Fisheries Division has close and constructive ties with the fishing community, is already actively involved in turtle conservation, and has played a major role in advising fishermen about existing sea turtle legislation. Copies of the BEA leaflet (section 4.41) are available at the Fisheries Division and in some fish markets.

4.43 Tourists

Since most turtle shell products are bought by tourists, it is important for tourists to be advised about the endangered status of sea turtles. Signs specifically targeted at tourists need to be placed at the airport and sea port, and the role that tourists can play in sea turtle conservation through refusing to buy goods should be clearly outlined. Tourists should also be made aware that if the country they are returning to is a signatory of CITES, they can be prosecuted for importing turtle shell products. More than 100 countries have ratified CITES, including the USA, Mexico, and virtually all Central American, South American, and western European countries. Information contained in a BEA leaflet (described above) is also relevant to tourists. These leaflets are placed in hotels and restaurants at the beginning of the breeding season.

4.44 Non-consumptive uses of sea turtles to generate revenue

There is one small "turtle pool" in operation containing six turtles. The turtle display is aimed primarily at the entertainment and/or education of tourists. Providing that the turtles are heavier than 30 lbs (13.6 kg), it is not unlawful under the current legislation to keep them in captivity. If recently proposed legislation comes into effect, however, it will become illegal to hold sea turtles in captivity. An exemption for a few small captive sea turtles (<30 lbs), properly maintained, could be considered for educational purposes. Clear sign-boards or other materials should accompany any sea turtle display so that the public is made more aware of the local and global plight of sea turtle species. Displays should be designed with the well-being of the animals receiving foremost consideration.

It is possible that persons presently illegally harvesting sea turtles on the beach could become involved in revenue-generating non-consumptive use of sea turtles. Specifically, owners and managers of hotels along the south and west coasts are increasingly aware of the interest generated by turtles for visitors ('eco-tourism'). Visitors may be prepared to pay for the services of local 'guides' (perhaps ex-poachers) to supervise Turtle Walks on the beach for hotel guests during nesting and hatching seasons. A successful hawksbill sea turtle conservation and research project sponsored by Jumby Bay Resort in Antigua includes turtle watching carefully supervised by on-site field biologists. This programme has been extremely effective at attracting hotel guests and in conserving the turtles. Of course, a programme such as this can also discourage sea turtles from coming ashore; thus, visitors to the beach at night should be properly guided and should be briefed beforehand about "sea turtle etiquette" (minimal noise and movement, no lights or camera flashes, etc.).

4.5 Increase Information Exchange

4.51 Marine Turtle Newsletter

The Marine Turtle Newsletter (MTN) is presently received by Bellairs Research Institute, the Barbados Primate Research Center, the Ministry of Employment, Labour Relations and Community Development, the Ministry of Agriculture, Food and Fisheries, and the Caribbean Conservation Association headquarters in Barbados. The newsletter is distributed to readers in more than 100 nations and territories and is a good way to stay informed about sea turtle biology and conservation around the world. The newsletter is free and is published quarterly in English and Spanish. It can be requested from: 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)

Barbados participated in both Western Atlantic Turtle Symposia (WATS I, Costa Rica, 1983; WATS II, Puerto Rico, 1987) and plans to continue to participate in this important regional data base. The WATS Manual of Sea Turtle Research and Conservation Techniques (Pritchard et al., 1983) is used by the nesting beach monitoring programme in Barbados and updated information presented at WATS II is available to the Fisheries Division, the Town Planning Unit, the Coastal Conservation Project Unit, and the Barbados Environmental Association.

4.53 WIDECAST

The Wider Caribbean Sea Turtle Recovery Team and Conservation Network, known as WIDECAST, consists of a regional team of sea turtle experts which works closely with in-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 Barbados, in the Wider Caribbean. Each STRAP is tailored specifically to local circumstances and provides the following information:

1. The 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. Specifically, to develop and support a technical understanding of sea turtle biology and management among local individuals and organizations 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 sub-regional workshops on sea turtle biology and management.
5. Assisting governments and non-government groups with the implementation of effective management and conservation projects for sea 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 UNEP Caribbean Environment Programme, as well as by governmental and non-governmental agencies and groups. The Country Coordinator in Barbados, also a member of the WIDECAST regional Recovery Team, is Dr. Julia Horrocks of the Department of Biology, University of the West Indies and Bellairs Research Institute. Bellairs Research Institute is the Lead Organization for

WIDECAST in Barbados. The WIDECAST-Barbados network consists of biologists, civil servants from several different Ministries and agencies, and members of the Barbados Environmental Association (BEA). WIDECAST-Barbados and the BEA support an ongoing programme to survey sea turtle nesting beaches, foster public awareness of the plight of sea turtles, and encourage revised legislation to more effectively promote the recovery of local sea turtle stocks.

4.54 IUCN/SSC Marine Turtle Specialist Group

Sea turtle conservation activities in Barbados have received support and encouragement from Dr. Karen Bjorndal, Chair of the IUCN/SSC Marine Turtle Specialist Group (MTSG). In addition, an active WIDECAST network has already been identified in Barbados and consists of biologists and civil servants, most of whom are members of the Barbados Environmental Association and one of whom (Julia Horrocks) is also a member of the IUCN/SSC MTSG.

4.55 Workshops on research and management

Traveling scholarships or fellowships for individuals involved in turtle conservation efforts to join established field conservation projects, such as those at Tortuguero (Costa Rica), Sandy Point National Wildlife Refuge (U. S. Virgin Islands), or Jumby Bay (Antigua) for short periods would be extremely valuable. The Caribbean Conservation Corporation offers annual training courses at Tortuguero (write: CCC, P. O. Box 2866, Gainesville, FL 32602 USA). Workshops for sub-regional groups (e.g., small islands with extensive turtle subsistence problems to overcome, or small islands with extensive tourist-associated problems to overcome) where practical, inexpensive solutions to problems could be discussed would also be useful. Members of the BEA are provided information and a slide show by Julia Horrocks (WIDECAST Team Member) on sea turtle biology and techniques before they begin to survey beaches.

4.56 Exchange of information among local groups

There is already considerable dialogue between governmental and non-governmental agencies and individuals with environmental concerns in Barbados; many of these working relationships have been previously elaborated in the text of this document. In terms of turtle conservation, this has proved an extremely constructive approach and is encouraged to continue.

4.6 Summary Sectorial Recommendations

4.61 Government organizations

4.611 Coastal Conservation Project Unit (CCPU)

The Coastal Conservation Project Unit (CCPU) is the advisory agency to the Minister of Labour, Consumer Affairs and the Environment, and to the Town Planning Department (TPD) of the Ministry of Housing and Lands. In order to minimize coastal deterioration (poor near-shore water quality, reef death, beach erosion), the CCPU monitors environmental changes in the coastal zone and makes recommendations on the suitability of applications received by the TPD for construction planned within the zone. The CCPU has been sensitized to the general issues of

sea turtle conservation. The major role of the CCPU in terms of sea turtle recovery lies in continuing to monitor the beach and nearshore environment, and in making recommendations on how these areas can best be conserved. The objectives of the second phase of the Coastal Conservation Project are to identify major sources of environmental stress on the coastal zone and to suggest methods of mitigation. An institutional strengthening project will review existing laws pertaining to the coastal zone and the present infrastructure for coastal zone management.

Recommendations

- Information on sea turtle nesting activity at specific locations should be made available to the CCPU upon request to Bellairs Research Institute, and passed to the Town Planning Department as part of the recommendations of the CCPU.

- Wherever possible, vegetation should be used in preference to boulder placement for beach stabilization at turtle nesting beaches. Furthermore, the use of vegetation should be recommended in preference to physical structures in order to delineate seaward boundaries of properties adjacent to beaches.

4.612 Town Planning Department (TPD)

The Town Planning Department (TPD) has the responsibility of ensuring that the land resources of Barbados are used efficiently for the wide range of demands made upon them. Since Barbados is densely populated and also supports a large tourist industry, pressure to build along the coastal zone is particularly intense. However, it is extremely important that the TPD take into consideration the long term effects of development on the environment. It was partly for this advisory function that the CCPU was established in 1983. The TPD takes the advice of the CCPU into account when deciding whether to grant planning permission for construction in the coastal zone. Nonetheless, at his discretion, the Minister of Housing and Lands can over-ride a decision of the TPD, such as when the economic advantages to Barbados of developing a particular site appear to outweigh potential environmental degradation.

Recommendations

- The TPD should take into consideration the level of sea turtle nesting activity at sites where planning permission is being sought, particularly in regard to the positioning of seaward boundary walls and fences. If the CCPU has recommended the use of beach vegetation in place of a seaward boundary wall, this should become a condition of planning permission.

- The TPD should advise architects, landscape architects and developers when the property they are designing/developing is adjacent to a sea turtle nesting beach.

- The TPD should consider restricting the types of lights permitted on all new developments adjacent to beaches along the west, south and east coasts. There is recent evidence that low pressure sodium (LPS) lighting, emitting light in the range of 590 nm, is less attractive to sea turtle hatchlings that full spectrum white light (Witherington, 1990).

- The TPD should grant permission to establish a protected beach hatchery if it becomes necessary (perhaps at Folkestone Park, St. James). A hatchery would allow threatened sea turtle nests to be relocated and their progress and hatching success to be closely monitored.

4.613 National Conservation Commission (NCC)

The National Conservation Commission (NCC) has an important role to play in the recovery plan for sea turtles in Barbados, both indirectly and directly. Employees of the Commission include beach park rangers and wardens, life guards, beach cleaners and a park naturalist (Folkestone Park and Marine Museum). Many of these personnel are working on beaches from early morning, and therefore have the potential to contribute greatly to the monitoring of sea turtle nesting and hatching activity. NCC employees are also engaged in "de-bushing" in efforts to beautify and enhance the safety of wastelands.

Recommendations

- De-bushing of areas within the coastal zone should be kept to a minimum in order to reduce soil erosion and the consequent deterioration of nearshore water quality resulting from an influx of sediment-loaded run-off.

- Beach cleaning should be restricted to the raking of dead plant material and garbage, rather than the removal of living beach vegetation. It may be useful to legally protect beach vegetation, perhaps under the National Conservation Commission Act. Burning of beach garbage at numerous points along the East Coast road, followed by the burial of ashes and non-combustible items, is the method presently used for disposal of raked material. A small number of sites for the burning of garbage should be designated, and a method devised to transport garbage to these sites. Widespread burning of garbage on the beach is unsightly, causes pollution of the sand, kills embryos developing in eggs buried beneath the sand, and may deter turtles from using affected stretches of beach for nesting.

- The participation of the NCC in turtle monitoring activities should be formalized. The ways in which the NCC staff can assist in turtle monitoring activities could be incorporated into a short series of talks and slide shows aimed at increasing the awareness of NCC employees about the beach environment. This series could be presented by the Bellairs Research Institute.

4.614 Ministry of Agriculture, Food and Fisheries

The Fisheries Division, a unit within the Ministry of Agriculture, Food and Fisheries, has as one of its functions to monitor public compliance with the Fisheries Regulation Act of 1904. The Fisheries Division is aware that the present legislation protecting sea turtles (see section 4.21 for details) is insufficient.

Recommendations

- The Fisheries Division should pursue a permanent alteration to the Fisheries Regulation Act, giving full protection to sea turtles of all size classes and species, and prohibiting the use of

nets that capture sea turtles. Fines and other penalties (such as the confiscation of equipment and catch) should be strict enough to act as effective deterrents.

- If permanent alteration of the Act is not likely to be legislated within the next 1-2 years, the Fisheries Division should consider a temporary moratorium on all sea turtle harvesting under the existing legislation. If a temporary moratorium is not possible, then interim full protection should be given at least to the larger size classes (see section 4.232).

4.615 Ministry of Trade, Industry and Commerce

Recommendations

- A review of the process whereby permits are issued to persons involved in the trade of turtle shell and turtle products between Barbados and other countries is very desirable.

- It is strongly recommended that Barbados become signatory to the Convention of International Trade in Endangered Species (CITES). Although trade into and out of Barbados is not substantial at present, there is growing evidence to suggest that dealers from some countries, including Japan, wishing to buy large quantities of turtle shell are using non-signatory countries as ports of export from the Caribbean region. By joining CITES, Barbados could protect itself against this type of exploitation.

4.616 Royal Barbados Police Force and the Coast Guard

The Royal Barbados Police Force (RBPF) is a Division within the Ministry of Justice and Public Safety, and the Coast Guard forms part of the Barbados Defense Force (Defense and Security Division). To date, there have been no successful prosecutions of persons contravening legislation protecting turtles. The serious consequences of the illegal slaughter of turtles would be emphasized if perpetrators were successfully convicted.

Recommendations

- Enforcement of environmental legislation including the Fisheries Regulation Act and other legislation to prevent pollution and destruction of coral reefs, could be improved by increased linkages between these agencies.

- Increased awareness and cooperation could be fostered through a series of talks presented to the RBPF and the Coast Guard jointly. These talks on environmental legislation could be given by representatives from Bellairs Research Institute, the Environmental Unit of the Ministry of Labour, Consumer Affairs and the Environment, the Fisheries Division, and a lawyer.

4.62 Non-government organizations

4.621 Architects and landscape architects

There are about 30 architects and landscape architects conducting business in Barbados.

Recommendations

- Architects and landscape architects are encouraged to seek advice from Bellairs Research Institute on ways to develop an area in such a way as to minimize disturbance to sea turtles. These professionals should familiarize themselves with environmentally sensitive development practices on land that is adjacent to beaches.

- If development is taking place on a known nesting beach, this should be discussed with clients. Hotels may want to make sea turtle nesting a feature for their visitors. "Turtle watching" programmes should be implemented with care, however, in order not to discourage egg-bearing turtles from coming ashore.

- Vegetation boundaries delineating property should be advocated to clients, rather than the construction of solid structures. The construction of beach walls within 30 feet (9 m) of the mean high water mark is illegal. Hedges or other vegetation are also recommended as attractive, natural shields to minimize the amount of light shining on a nesting beach.

- Shielded, low intensity, low elevation lights that minimize hatchling disorientation should be advocated to clients, and/or the installation of timers that switch beach lights off during peak hatching periods (July-October, 1900-2400 hrs). Full-spectrum lights, especially high intensity lights (e.g., mercury vapor lamps), should be consistently discouraged. No lights should be placed between potential nesting sites and the sea. In the absence of legislation, architects can strongly influence the choice of beach lighting made by their clients.

4.622 Bellairs Research Institute (BRI)

Bellairs Research Institute (BRI) conducts multi-disciplinary research and teaching programmes on tropical issues. Ongoing research includes pure science programmes in marine and behavioural ecology, applied projects on fisheries biology and pollution effects on coral reefs, and environmental assessment and monitoring. BRI is the Lead Organization for WIDECAST in Barbados.

Recommendations

- BRI should continue to act as a clearing house for information provided by the general public on sea turtle nesting activity in Barbados.

- BRI should continue to tag turtles and to provide facilities for holding limited numbers of turtles for conservation and education purposes.

- BRI should take a more active role as an advisory body to the various organizations referred to in section 4.6.

- BRI should continue to collaborate with the Barbados Environmental Association on activities designed to promote awareness about the need for sea turtle conservation.

- BRI should continue to provide technical support and training for beach surveys.

- The BRI should establish and monitor a beach hatchery if it becomes necessary.

- The BRI should undertake projects to obtain further information on foraging and nesting habitats around Barbados, and to determine whether Barbados shares common sea turtle stocks with other islands.

4.623 Barbados Environmental Association (BEA)

The Barbados Environmental Association (BEA) has played an important role in the conservation of sea turtles by providing volunteers to survey all the beaches in Barbados for nesting activity over the last two years. The BEA has also been very active in the distribution of public awareness materials concerning sea turtles and other aspects of the environment.

Recommendations

- The BEA should repeat their monitoring of all beaches in Barbados annually during the nesting season. This is essential in order to obtain quantitative data on temporal and spatial differences in nesting frequency island-wide.

- The BEA should start a new beach monitoring programme in collaboration with Bellairs Research Institute, whereby members of the BEA are encouraged to monitor nearby beaches on a daily basis.

- The BEA should continue to make Sea Turtle leaflets and their poster display on the Turtle Walks available to hotels, schools, and exhibitions.

4.624 Barbados Wildlife Reserve

The Barbados Wildlife Reserve restored and now operates a sea turtle "holding pool" at Sam Lord's Castle Hotel. The pool contains six turtles (juvenile hawksbills and green turtles and an adult loggerhead turtle).

Recommendations

- The Turtle Pool should contain young juvenile sea turtles only. Young turtles are easier to feed and care for, and are relatively less valuable to wild populations than adults and near-adults. Adults currently held captive should be tagged and released back into the sea.

- Water quality and temperature in the Pool should be routinely monitored. Consideration should be given to planting trees to create shade so that water temperature is maintained at approximately 27-28^{o}C even when the water level is low. More rock outcrops suitable for turtles to take refuge under are recommended.

- The pool could be made into a more educationally valuable display by placing increased emphasis on the conservation of endangered sea turtles. This educational effort would complement the existing booklet on sea turtles produced by the Barbados Wildlife Reserve, which places heavy emphasis on conservation (Horrocks and Baulu, 1986).

- Sam Lord's Castle might consider making the display more accessible to school children by offering a limited number of free "open days" during the year. Open days could feature short talks on sea turtles by members of the BEA or Bellairs Research Institute.

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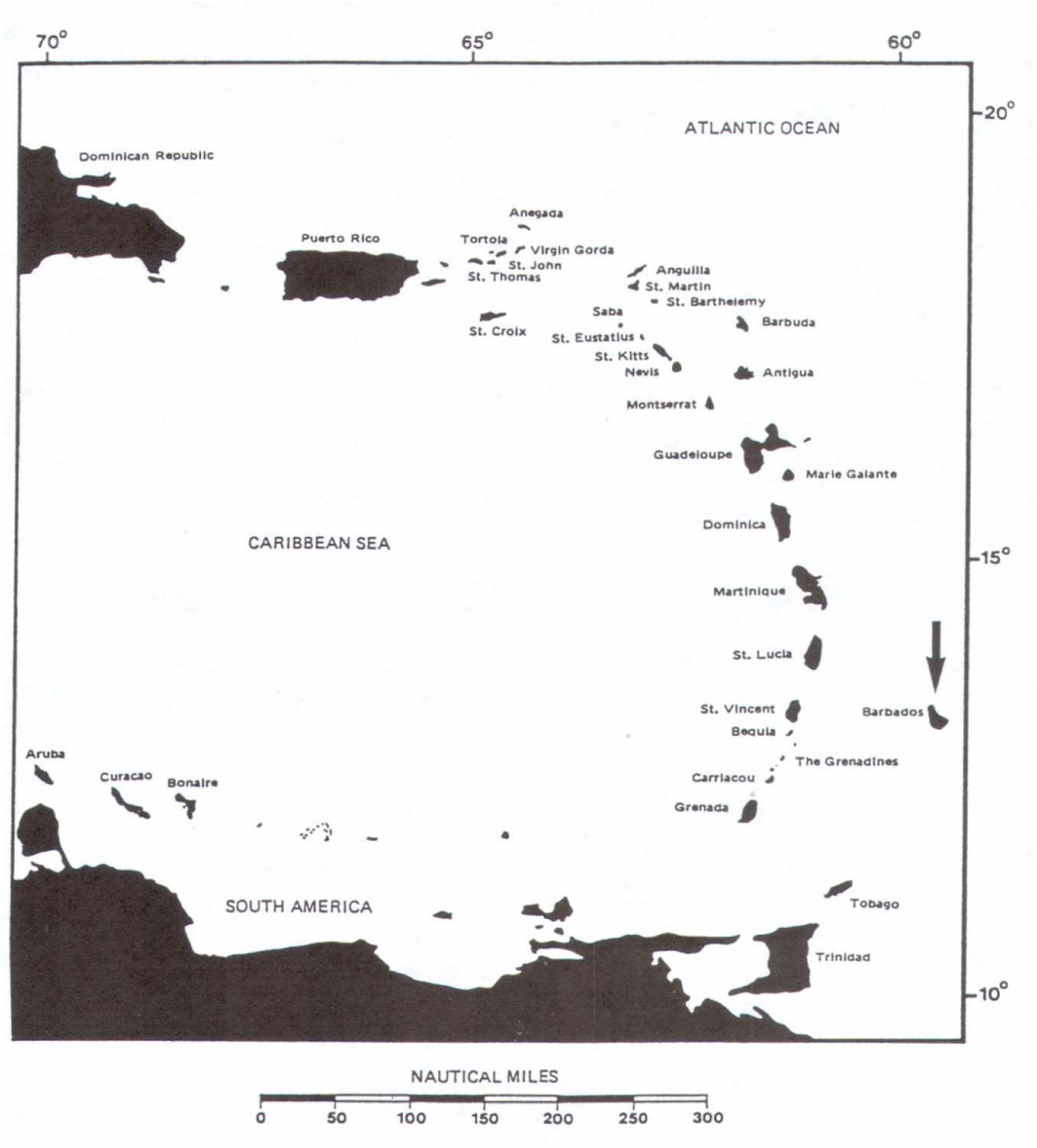
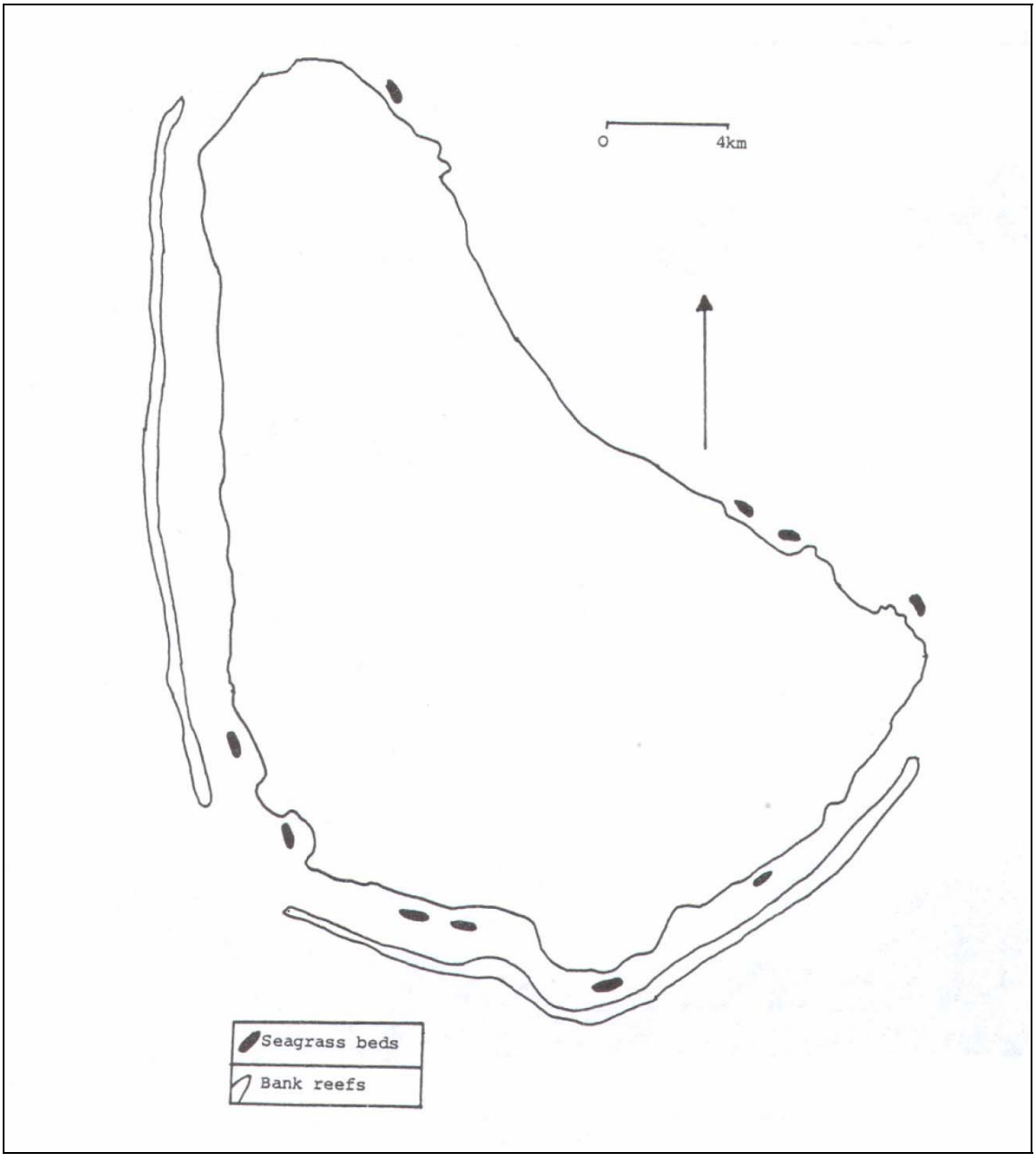
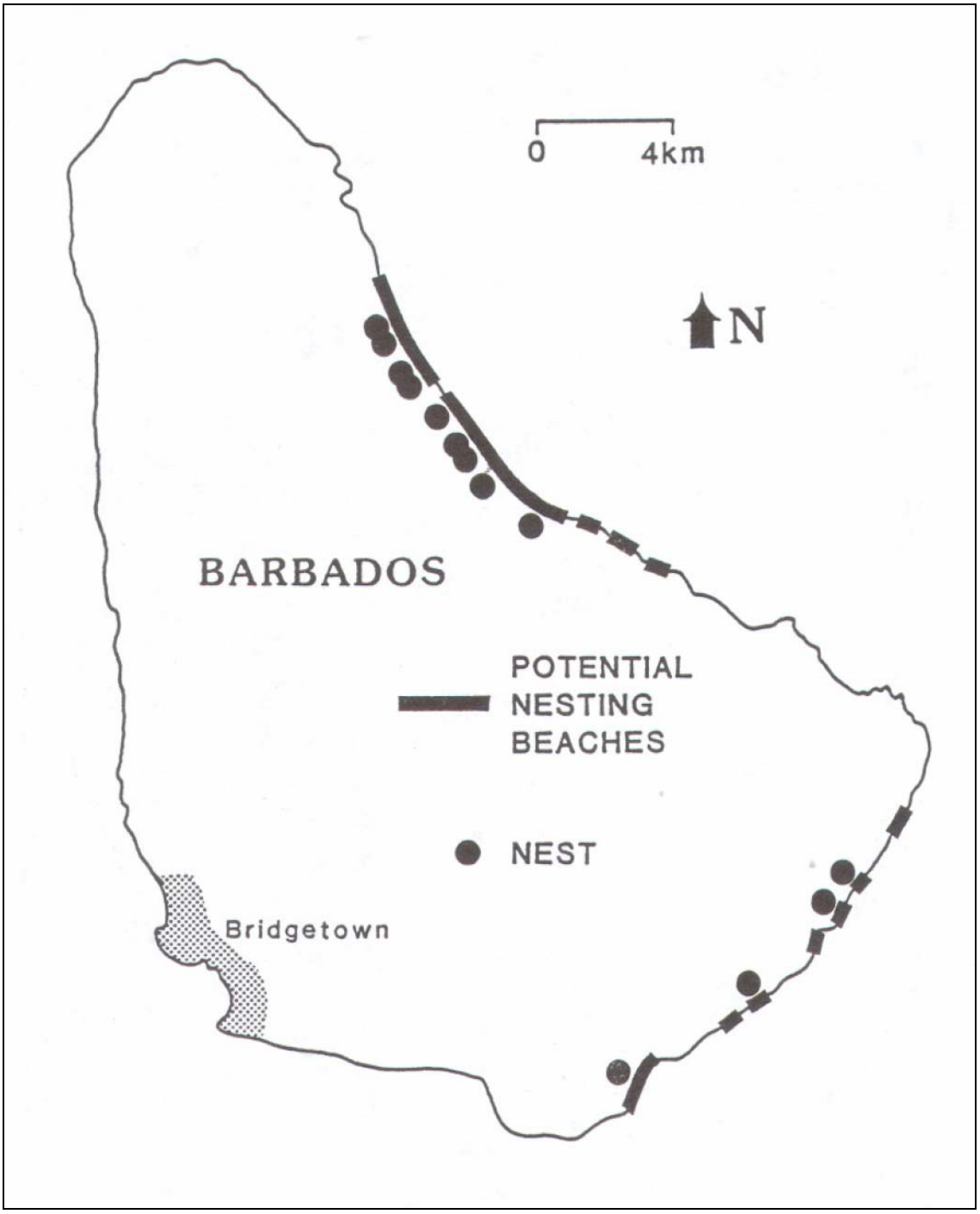


Map 1. Barbados is the most easterly island in the Lesser Antilles [source: ECNAMP, 1980].

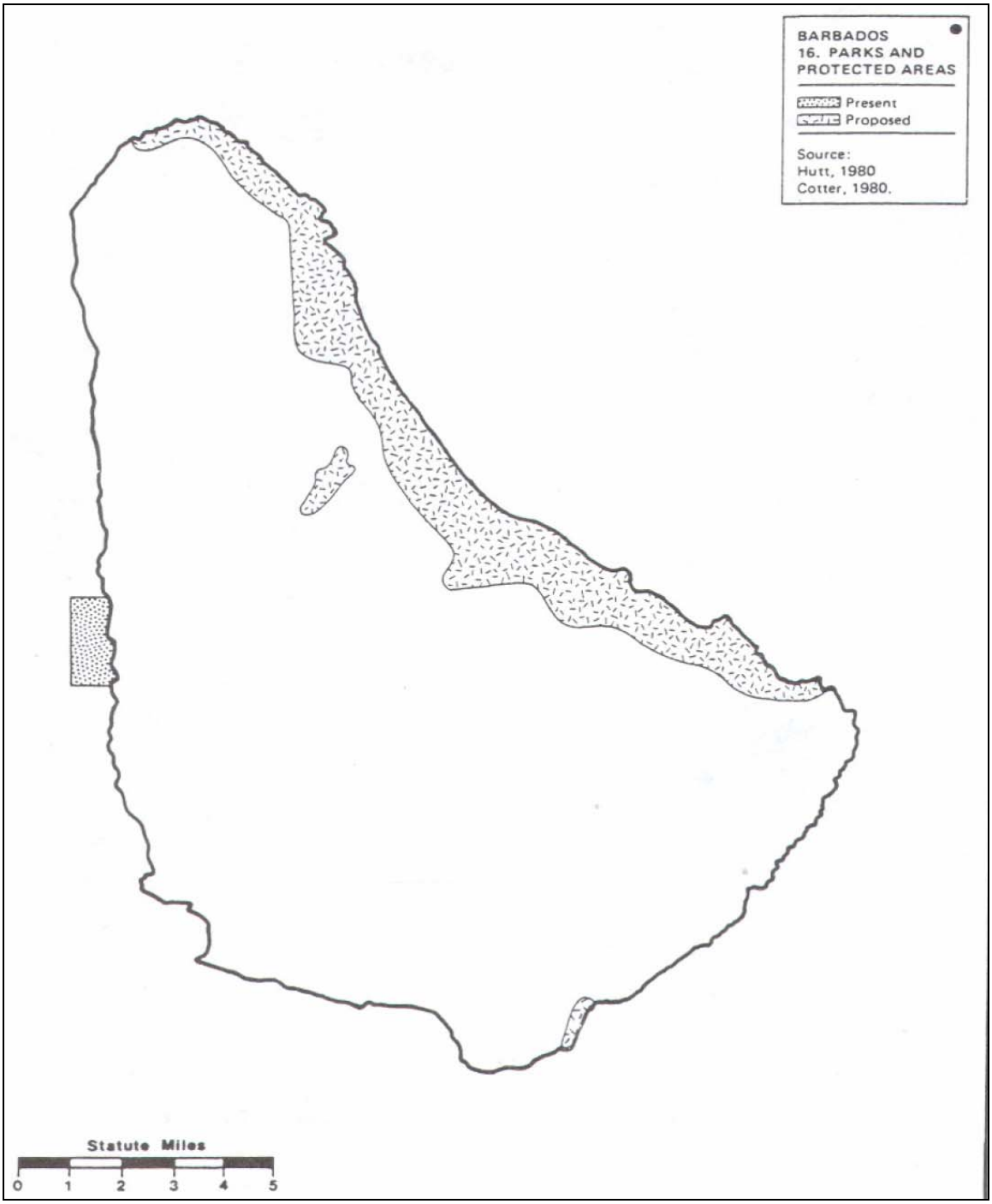


Map 2. Locations of sea grass and offshore bank coral reefs around Barbados, West Indies.



Map 3. Locations of potential nesting beaches and actual nests for the leatherback sea turtle (Dermochelys coriacea) in Barbados, West Indies, 1984-1991.

Map 4. Locations of hawksbill sea turtle (Eretmochelys imbricata) nests reported by the public in 1990 (stars) and 1991 (dots) in Barbados.



Map 5. The Barbados Marine Reserve includes 2.2 km along the west coast and extends 1000 m offshore. The Marine Areas (Preservation and Enhancement) (Barbados Marine Reserve) Regulations 1981 protect marine life within the Reserve from pollution and harvest. It is illegal to fish for turtles of any size within this area. Map source: modified from ECNAMP, 1980.

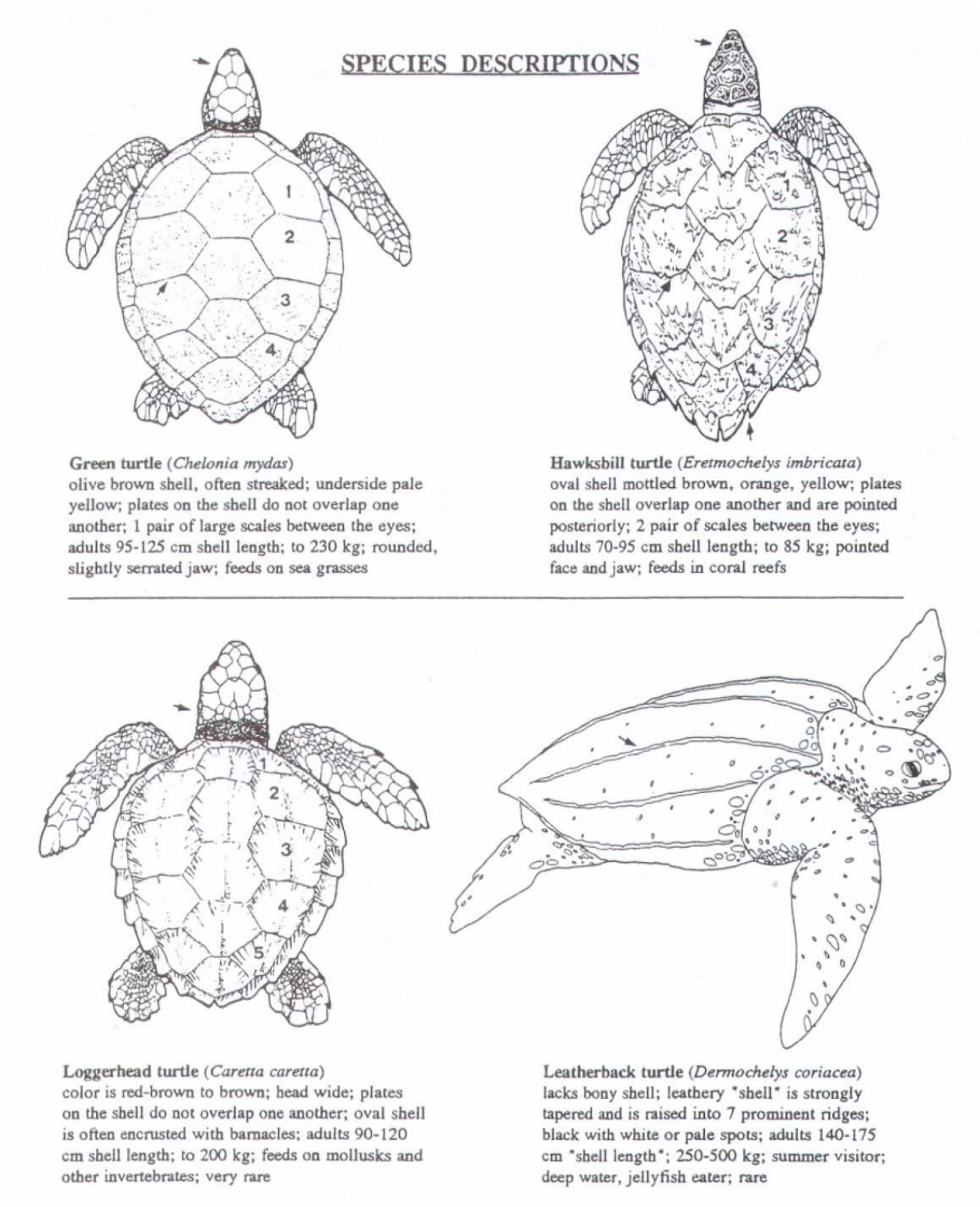


Figure 1. Four species of sea turtle are reported from Barbados. These species are, in decreasing order of abundance, the hawksbill (Eretmochelys imbricata), the green turtle (Chelonia mydas), the loggerhead (Caretta caretta), and the leatherback (Dermochelys coriacea).

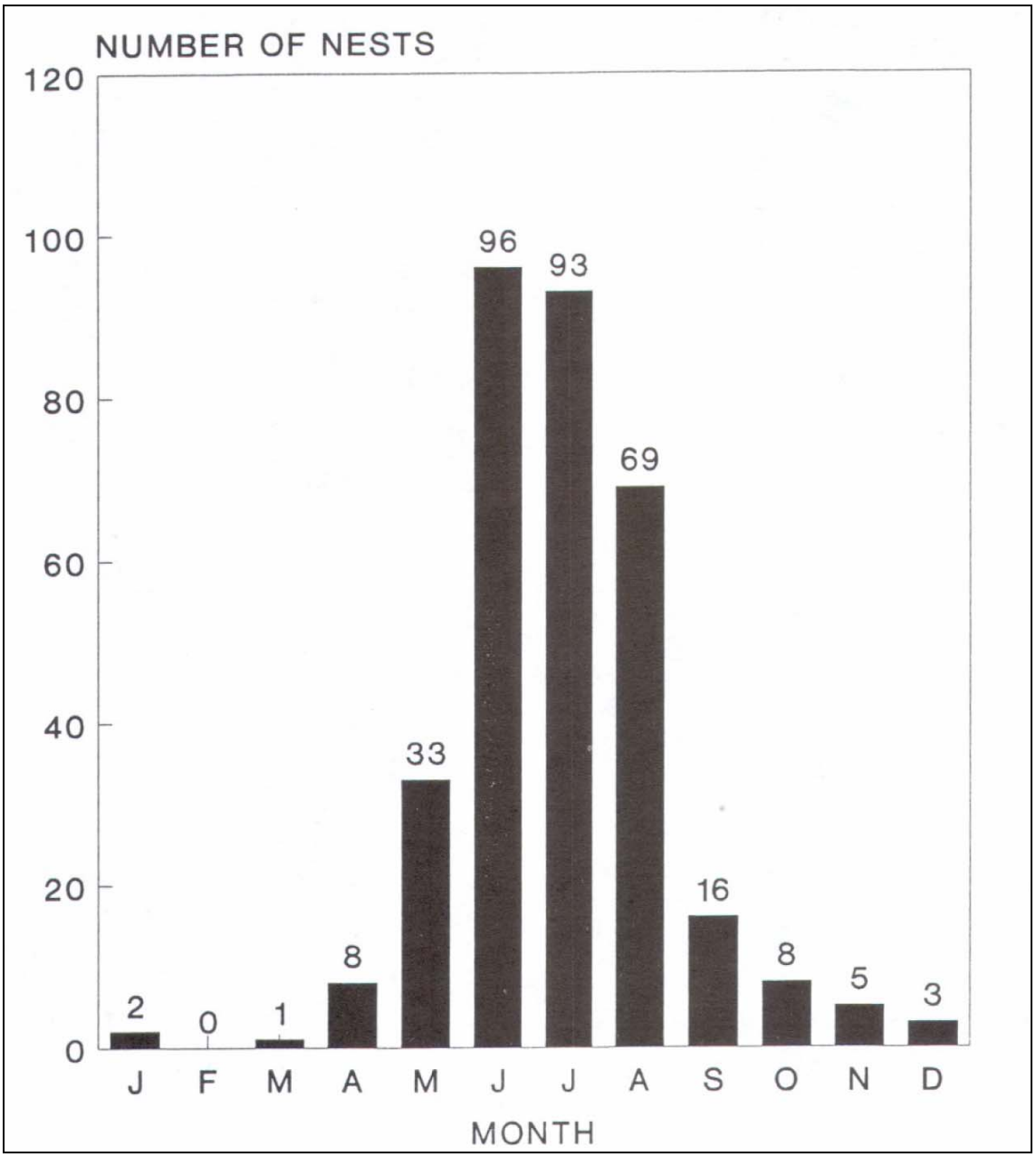


Figure 2. The number of hawksbill sea turtle nests laid per month in Barbados, West Indies, as reported by the general public, 1987-1991. It has been estimated that these data represent approximately 30% of the actual number of nests laid during this period.

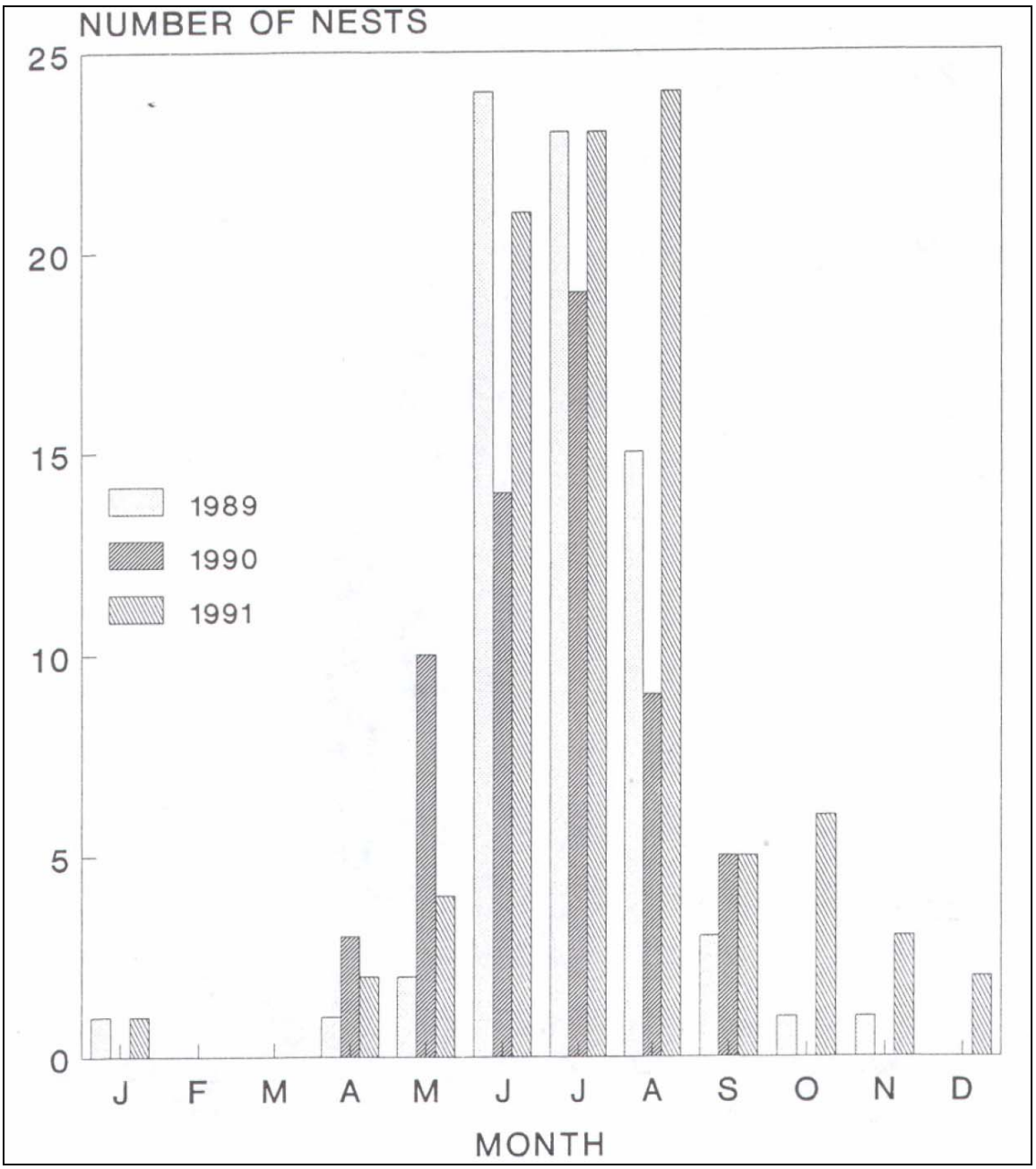


Figure 3. The number of hawksbill sea turtle nests laid per month in Barbados, West Indies, as reported by the general public, 1989-1991. Based on the dates and locations of these nests (some are repeat nestings by the same turtles), the average annual nesting population is not likely to exceed 50 females.

APPENDIX 1

EXPANSION OF THE SEA TURTLE PROJECT IN BARBADOS

BACKGROUND

Sea turtle conservation activities have been underway in Barbados since 1987. The activities have to date been implemented and sponsored by Bellairs Research Institute (BRI), and the Fisheries Division of the Ministry of Agriculture, Food and Fisheries. The Barbados Environmental Association (BEA) has organised beach surveys and produced posters and leaflets on sea turtle conservation. Most of the activities are conducted by volunteers trained at Bellairs Research Institute. An outline of current activities follows:

Monitoring of nesting activity: Reports of nesting by the public and National Conservation Commission beach staff (rangers, life guards) are made to BRI and/or the Fisheries Division. Reports are followed up with site visits by BRI staff to confirm nesting activity. The most important stretch of nesting beach on the south coast (Hilton to Ocean View) is surveyed for nesting activity each day by a trained volunteer (private citizen).

Tagging of post-nesting females: When public reports are made to BRI whilst nesting is still in progress, BRI staff go to the beach immediately. Nesting animals are measured and tagged before they leave the beach. Titanium tags (Stockbrands Company, Australia) marked with a number and the wording "Bellairs, Barbados, Reward" are used. Tagging training was originnally received at the Caribbean Conservation Corporation's field station at Tortuguero, Costa Rica. Three BRI staff are currently trained to tag turtles.

Movement of nests endangered by a significant threat: Nests threatened by predation, beach erosion, storms or compaction are moved to safer locations on the same beach or, rarely, to styrofoam containers for laboratory hatching.

Monitoring of hatching events: All nests are re-visited by BRI staff 65-70 days after nesting. Nests are excavated and nest contents examined to assess hatch success and possible causes of embryo and hatchling mortality. Nests made on brightly-lit beaches are re-visited 57 days after nesting and persons working/living in the immediate area are asked to dim lights and/or look for disoriented hatchlings. Where disorientation is inevitable and will lead to high mortality (e.g., nests made too close to brightly-lit highways), the nest is excavated and brought to the laboratory for hatching. Hatchlings are then returned to the same beach (or nearby beach, if lighting cannot be switched off) for release. Disoriented hatchlings collected by the public/NCC wardens during the day following hatching are collected by BRI staff and released the same night from the natal beach or as near as possible to it. Exhausted or injured animals are treated (see below).

Strandings and the care of sick/debilitated sea turtles: Strandings of dead or injured sea turtles are reported to BRI or the Fisheries Division. BRI or Fisheries staff collect the animal

and take it to BRI. Dead animals are identified to species, measured, and examined for possible cause of death. Stomach contents and tissue samples are preserved. Injured animals (hawksbills and green turtles) are usually those that have partially drowned in nets, but human-induced injuries have also included embedded fish hooks, spear and bullet wounds, and injuries caused by dynamite blasts and boat propellers. Several leatherbacks have stranded alive with missing limbs caused by predators, presumably sharks. BRI staff and two veterinary surgeons treat sick and injured animals. BRI has several seawater tanks suitable for rehabilitation.

Sea turtle data-base: Data derived from the monitoring of sea turtle nesting activity (e.g., numbers and locations of nests, numbers of poached nests, numbers of disoriented hatchlings, data from nests excavated after hatchling emergence) and data derived from sea turtle strandings are compiled and maintained at BRI. Fisheries Division (and other interested agencies) are provided with data upon request.

Increasing environmental awareness: The frequent visits by BRI staff to beaches result in lengthy discussions and exchange of information with the person who made the report and other onlookers. Staff carry copies of the Barbados Environmental Association's leaflet with them and distribute this information to interested persons. Many people who report a nest also look out for the nest's safety (from poachers, storms, etc.) during the incubation period, and inform BRI of any potential problems. BRI and Fisheries personnel give talks on sea turtle biology and conservation to schools and Government departments, and provide information on sea turtles to the media. BRI library offers resource material for use by school teachers and students. Other public service activities, such as requesting beachfront properties to turn off or to redirect lights away from nesting beaches, are ongoing.

PROPOSED ACTIVITIES

In this section we have outlined six projects that specifically address issues identified in the Sea Turtle Recovery Action Plan (STRAP) for Barbados as priorities for implementation. A draft budget for these activities is presented in a later section.

1. Produce a video (1/2 hr duration) for reproduction on television to increase public awareness of contemporary stresses and threats faced by sea turtles around Barbados and the need for sea turtle conservation (see STRAP sections III, 4.124, 4.4). Responsible agency/group: Barbados Environmental Association and Bellairs Research Institute.

2. Obtain a cellular phone, provide mileage allowance, and employ a research assistant to enhance response capability of personnel to reach beaches where turtles nest at night. This will reduce depredation of females, increase the number of females tagged, and enhance ongoing activities (see STRAP sections 4.233, 4.293, 4.33 *inter alia*). Responsible agency/group: Bellairs Research Institute.

3. Initiate daily surveys of at least two additional important nesting beaches throughout the annual breeding season to increase our knowledge of the distribution and abundance of sea turtle nesting and nest fate, including quantifying depredation,

poaching, nest site erosion, hatch success, hatchling disorientation, etc. (see STRAP sections 4.112, 4.291). Responsible agency/group: Bellairs Research Institute and Barbados Environmental Association.

4. Initiate a systematic survey of nearshore marine habitats used or potentially used by sea turtles and increase the number of non-nesting turtles tagged annually in order to define important feeding and refuge areas, quantify species diversity, monitor population trends, and increase our knowledge of the threats to important foraging and refugia habitats (see STRAP sections 4.111, 4.293). Responsible agency/group: Bellairs Research Institute and SCUBA dive operators/shops.

5. Initiate a project to track juvenile green and hawksbill turtles using ultra-sonic telemetry in order to investigate the offshore behaviour, movements, residency, and habitat utilisation of juvenile sea turtles (see STRAP sections 4.11, 4.293). Responsible agency/group: Bellairs Research Institute.

6. Support/initiate tagging programmes on neighbouring islands to investigate whether Barbados shares sea turtle stocks in common with other countries (see STRAP sections 4.32, 4.34). Responsible agency/group: Bellairs Research Institute and the Fisheries Division.

RESULTS AND OUTPUTS

1. Increased knowledge of the most important sea turtle foraging and nesting habitats. This knowledge will enable the development of area-specific management plans, the designation of protected areas, and the identification of zones where beachfront lighting and other restrictions may be necessary for the conservation of endangered sea turtles.

2. Increased awareness of the status of sea turtles among the citizenry and tourists in Barbados. An increase in public awareness and knowledge will augment ongoing and planned monitoring programmes, foster support for conservation initiatives, and will assist relevant agencies in enforcing protective legislation.

3. Increased understanding of the population size and reproductive dynamics of hawksbills nesting in Barbados. The data collected will enable us to estimate the number of individual hawksbills nesting per annum, as well as their re-nesting (intra-annual) and re-migration (inter-annual) intervals.

4. Increased understanding of the local and international movements of sea turtles. This information will provide a basis from which to determine the extent to which Barbados shares its sea turtles with neighbouring nations, and thus the extent to which cooperative measures will be needed to ensure the success of local efforts to enhance the survival of sea turtles in Barbados.

BUDGET

Funds to support and expand the monitoring programme and information campaign in Barbados are needed. At present, the monitoring is done on a voluntary basis and Bellairs Research Institute (BRI) contributes towards costs such as are incurred through transport, the operation of sea water pumps, etc. BRI and the Fisheries Division (Ministry of Agriculture, Food and Fisheries) share the costs associated with the information campaign. The table below summarizes the funding needed to implement the six activities proposed above.

ITEM	COST (US $)	TOTAL (US $)
ACTIVITY 1		
Technical adviser	10 days @ 200.00/d	2000.00**D**
Office space	15 days @ 10.00/d	150.00**B**
Transportation	10 days @ 30.00/d	300.00**D**
Direction, camera work and equipment rental		15000.00**D**
Tape stock		1000.00**D**
Editing		7500.00**D**
Script writing		2000.00**D**
Voice over		500.00**D**
	Subtotal	28450.00
	D = **D**onor contribution	28300.00
	B = **B**RI contribution	150.00
Contingency (10%)		2845.00
	TOTAL	**31295.00**
ACTIVITY 2		
Programme co-ordinator	30 days over 6 mo @ 50.00/d	1500.00**B**
Cellular phone		1500.00**D**
Telephone operating costs	6 months @ 100.00/mo	600.00**D**
Mileage	2250 km @ 0.50c/km	1125.00**D**
Research assistant	6 months @ 750.00/mo	4500.00**B**
Office space	6 months @ 300.00/mo	1800.00**B**
Turtle tagging equipment		300.00**D**
	Subtotal	11325.00

Budget, *continued*.

ITEM	COST (US $)	TOTAL (US $)
ACTIVITY 2 (cont'd)		
	Donor contribution	3525.00
	BRI contribution	7800.00
Contingency (10%)		1133.00
	TOTAL	**12458.00**
ACTIVITY 3		
Programme co-ordinator	10 days over 3 mo @ 50.00/d	500.00**B**
Office space	10 days @ 10.00/day	100.00**B**
Survey personnel:		
2 sites, 2 persons/site	3 months @ 750.00/mo/person	9000.00**D**
Accommodations	3 months @ 300.00/mo/site	1800.00**D**
	Subtotal	11400.00
	Donor contribution	10800.00
	BRI contribution	600.00
Contingency (10%)		1140.00
	TOTAL	**12540.00**
ACTIVITY 4		
Programme co-ordinator	15 days @ 50.00/d	750.00**B**
Office space	15 days @ 10.00/d	150.00**B**
Aerial photography:		
Helicopter	600.00/hr for 8 hr	4800.00**D**
Camera equipment rental		200.00**B**
Film and developing		300.00**D**
Ground truth, turtle surveys, tagging:		
Boat/boatman, W coast	50.00 day for 30 d	1500.00**D**
Boat/boatman, S & E coasts	100.00 day for 30 d	3000.00**D**
SCUBA divers (2)	40.00/dive/person for 60 d	4800.00**D**
SCUBA tank fills	120 @ 4.00/fill	480.00**B**
	Subtotal	15980.00

Budget, *continued*.

ITEM	COST (US $)	TOTAL (US $)
ACTIVITY 4 (cont'd)		
	Donor contribution	14400.00
	BRI contribution	1580.00
Contingency (10%)		1598.00
	TOTAL	**17578.00**
ACTIVITY 5		
Standard receiver USR-4D		515.00**D**
Tracking tags CHP-87	10 @ 240.00/tag	2400.00**D**
Directional hydrophone DH-2		330.00**D**
Diver-held receiver/ hydrophone USR-88		1500.00**D**
Lithium cell batteries	10 @ 9.00/battery	90.00**D**
Electrical potting resin kits	10 @ 20.00/kit	200.00**D**
Freight charges (10%)		504.00**D**
Duty charges (20%)		1007.00**D**
SCUBA divers (2)	40.00/dive/person for 60 d	4800.00**D**
Boat and boatman	60 trips @ 25.00/trip	1500.00**R**
SCUBA tank fills	120 @ 4.00/fill	480.00**R**
	Subtotal	13326.00
	Donor contribution	11346.00
	Recipient contribution	1980.00
Contingency (10%)		1293.00
	TOTAL	**14619.00**
ACTIVITY 6		
Barbados return ticket to St. Lucia, Grenada, and St. Vincent		350.00**D**
Accommodations:		
3 days in St. Lucia	50.00/d	150.00**D**
6 days in Grenada	50.00/d	300.00**D**
6 days in St. Vincent	50.00/d	300.00**D**

Budget, *continued*.

ITEM	**COST (US $)**	**TOTAL (US $)**
ACTIVITY 6 (cont'd)		
Tagging equipment		1000.00**D**
Technical adviser	15 days @ 50.00/d	750.00**B**
	Subtotal	2850.00
	Donor contribution	2100.00
	BRI contribution	750.00
Contingency (10%)		285.00
	TOTAL	**3135.00**

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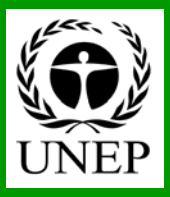

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The series of CEP Technical Reports contains selected information resulting from the various activities performed within the framework of the UNEP Caribbean Environment Programme (CEP). CEP was initiated in 1976 by UNEP with the assistance of ECLAC, 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.