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Sea Turtle Recovery Action Plan for Antigua and Barbuda

Prepared by:

WIDECAST
Wider Caribbean Sea Turtle Recovery Team and Conservation Network

CEP Technical Report No. 16

1992

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Sea Turtle Recovery Action Plan for Antigua and Barbuda

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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 damaged or eliminated nesting beaches and feeding grounds. Population declines are complicated by the fact that causal factors are not always entirely indigenous. Because sea turtles are among the most migratory of all Caribbean fauna, what appears as a decline in a local population may be a direct consequence of the activities of peoples many hundreds of kilometers distant. Thus, while local conservation is crucial, action is also called for at the regional level.

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

This CEP Technical Report is the fourth 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 Coordinators, and an extensive network of interested citizens. The objective of the recovery action plan series is to assist Caribbean governments in the discharge of their obligations under the SPAW Protocol, and to promote a regional capability to implement scientifically sound sea turtle conservation programs by developing a technical understanding of sea turtle biology and management among local individuals and institutions. Each recovery action plan summarizes the known distribution of sea turtles, discusses major causes of mortality, evaluates the effectiveness of existing conservation laws, and prioritizes implementing measures for stock recovery. WIDECAST was founded in 1981 by Monitor International, in response to a recommendation by the IUCN/CCA *Meeting of Non-Governmental Caribbean Organizations on Living Resources Conservation for Sustainable Development in the Wider Caribbean* (Santo Domingo, 26-29 August 1981) that a "Wider Caribbean Sea Turtle Recovery Action Plan should be prepared ... consistent with the Action Plan for the Caribbean Environment Programme." WIDECAST is an autonomous NGO, partially supported by the CEP.

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This report would not have been possible without the kind assistance and participation of many people. Fishermen Lucien Barreto, Edward Barreto, Johnny de Souza, and Vernon Joseph provided valuable insight and data. Historical information and programme support were supplied by the Museum of Antigua and Barbuda, especially Dr. Desmond Nicholson (Director) and Michele Henry (Director of Exhibits), and by Sarah Fuller. The Environmental Awareness Group (EAG), especially Veronica Michael (Environmental Education Coordinator), has been very active in sharing the message of sea turtle conservation in the schools and sponsoring sea turtle surveys in Antigua. The ongoing support of the Fisheries Department, especially Eustace Royer (Fisheries Officer), is greatly appreciated. We are also grateful for input from Bruce Horwith (NGO Programme Director, Island Resources Foundation), Martin Fuess (Museum of Antigua and Barbuda), and the merchants, divers, and knowledgeable residents who shared their experiences and ideas about sea turtles and sea turtle conservation with us.

The research biologists who have laboured for seven years to collect detailed information on the hawksbill turtles nesting at Pasture Bay beach (Jumby Bay Resort, Long Island) deserve special mention -- Lynn Corliss (1986-1989), Keven Holloman (1987), Cheryl Ryder (1987-1988), Anna Bass (1989-1990), Carla Melucci (1990), Meg Hoyle and Michelle Zacks (1991), and Wendi Webber and Ximena Prudencio (1992) -- as do the members and staff of the Jumby Bay Resort for their continuing support of this internationally important research. Special recognition goes to Paul Richnow and Karen Tate of the Jumby Bay Resort. A note of appreciation is extended to Janie Easton (Owner, Galley Boutique, Nelson's Dockyard) for donating her inventory of tortoiseshell jewelry to the Museum of Antigua and Barbuda for a display on Endangered Caribbean Sea Turtles. Finally, the WIDECAST Sea Turtle Recovery Team[1] provided scientific oversight for the Recovery Plan.

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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 WIDECAST has come from Monitor International, The Chelonia Institute, the UNEP Caribbean Environment Programme, and the U. S. National Marine Fisheries Service. Special appreciation is due Milton Kaufmann (President of Monitor International and Founder of WIDECAST) and Robert Truland (Trustee, The Chelonia Institute) for their unwavering personal commitment to WIDECAST since its inception more than a decade ago.

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ABSTRACT

The history of commercial and subsistence harvest of sea turtles in Antigua and Barbuda extends to the pre-Columbian era. A warning that turtles, especially nesting assemblages, were declining has been sounded in literature dating back nearly twenty years. Some beaches which once supported nesting do not do so today; many others receive only a few nests per year. Several fishermen indicated that they no longer hunt turtles on the nesting beaches because the number of arriving females has declined to the point where the effort is rarely rewarded. A combination of depleted stocks and meager demand has reduced the number of active turtle fishermen to 2-3 individuals. The number of turtles landed probably did not exceed 30 per year in the 1990's, down from many hundreds 50 years ago. While direct harvest may be declining, incidental catch and opportunistic harvest by spearguns appear to be growing. The theft of eggs tallies in the several thousands per year. Green (Chelonia mydas) and hawksbill (Eretmochelys imbricata) turtles feed in near shore waters; loggerheads (Caretta caretta) are seen occasionally, especially in offshore waters. The leatherback (Dermochelys coriacea) is a seasonal visitor. All but the loggerhead nest locally. We estimate fewer than 130 females (combined) nest per year.

This Recovery Action Plan summarizes known information on the status and distribution of sea turtles and offers a wide variety of solutions to contemporary stresses. Enacting a moratorium on the harvest of sea turtles and their eggs is an essential first step in a national commitment to the conservation of these endangered species. Such a moratorium should remain in effect until such time as there is credible scientific evidence that a sustainable harvest is possible. Essential habitat must also be protected. Before comprehensive habitat management plans are developed, priority should be given to surveys designed to identify locally important nesting and foraging grounds. Top priority is recommended for an island-wide survey of Barbuda and surveys of three potentially very important hawksbill nesting grounds in Antigua -- Sandy Island, Pearn's Bay beach group, and Mill Reef beach. Index Beaches should be designated to serve as focal areas for long-term research and monitoring. Consideration should be given to designating the island of Barbuda a Sea Turtle Refuge. Systematic study of marine habitat use by sea turtles should also be undertaken as soon as possible.

Local authorities and NGOs should initiate studies designed to contribute to habitat management plans. Management plans should incorporate solutions to problems including sand mining, sewage and garbage disposal, artificial lighting, armouring (seawalls, groynes), and the illegal harvest of turtles and their eggs. Effective solutions are described in this Recovery Action Plan. At sea, dredging, blasting and anchoring should be prohibited in living reef and sea grass areas. Pollution from industry, agriculture, oil, and indiscriminate waste disposal should be regulated and closely monitored in order to minimise the potential for coastal habitat degradation. Sea turtle habitat usage should be taken into account in any management plans developed for coastal or marine parks. Monitoring of sea turtle nesting activity should be implemented as part of the Nelson Dockyard National Park's management authority; a Conservation Warden should be employed. The creation of a separate Division of Conservation Law Enforcement would enable Government to more effectively enforce a growing number of important environmental regulations, including pollution, protected species, mining and minerals, fisheries and marine resources, boater safety, game and hunting, and coastal zone management.

Coastal zone authorities and private citizens should be fully involved in the management of important nesting and foraging habitats. A mandatory 60-day period should be established for public review and comment on development projects that affect sea turtle and/or other wildlife habitat. When areas are defined as important to sea turtles, regulatory guidelines should seek to establish a framework within which appropriate land use and development can occur. The Jumby Bay Resort is an excellent example of a planned (and successful) co-existence between development and sea turtle conservation. Copies of approved Jumby Bay Club guidelines to safeguard the hawksbill nesting beach at Pasture Bay, Long Island, should be shared with other beach communities. Educational materials to alert residents and tourists to the plight of endangered sea turtles and regulations in force to protect them should be developed and widely distributed. A campaign should be undertaken to alert marine users of the threat to fisheries and turtles from the indiscriminate disposal of waste at sea. Other threats, such as spearguns and incidental catch, should be quantified and solutions developed. Mooring systems should be examined and implemented as a way of preventing damage to sea grass and coral reefs.

A five-year national Sea Turtle Conservation Programme is herein proposed. The goals of the programme are (1) to obtain comprehensive and accurate data on the distribution of turtle nesting and foraging habitat and (2) to promote the conservation and recovery of remaining sea turtle stocks. Activities, including habitat and market surveys, management planning, training, and environmental education, are fully described in the text. In addition to national efforts to conserve sea turtles, it is essential that Antigua and Barbuda support international initiatives to conserve these highly migratory reptiles. In this regard, Antigua and Barbuda is encouraged to ratify CITES, MARPOL, and the SPAW Protocol to the UNEP Cartagena Convention. In summary, an integrated approach to the continuing decline of sea turtles is needed, including strong domestic and regional legislation, habitat protection, population monitoring, and enhanced public awareness. Sea turtles are long-lived; most do not reach sexual maturity before 25-30 years of age. The extinction of local stocks will be guaranteed if we continue to harvest breeding-age adults and the eggs which are expected to produce the breeders of tomorrow. If we do not act soon to safeguard the turtles of Antigua and Barbuda, these ancient species will quietly and permanently disappear.

RESUMEN

La historia del aprovechamiento comercial y para la subsistencia, de las tortugas marinas en Antigua y Barbuda se remonta a la era precolombina. Una advertencia de que las tortugas, especialmente los grupos que anidan, estaban disminuyendo existe en la literatura desde hace casi veinte años. Algunas playas que contenían nidos ya no los tienen hoy; muchas otras reciben solamente unos pocos nidos por año. Varios pescadores indicaron que ya no cazan tortugas en las playas de anidación porque el número de hembras que llega ha bajado a tal punto en que el esfuerzo, raramente vale la pena. Una combinación de reservas agotadas y escasa demanda ha reducido el número de pescadores de tortugas activos a 2-3 personas. El número de tortugas que anidaron es probable que no excediera los 30 por año durante los años 90, un número que se redujo de varios centenares hace 50 años. Mientras que el aprovechamiento directo puede estar decayendo, la captura indirecta y el aprovechamiento opurtunista mediante harpones, parece estar en aumento. El robo de huevos se acerca a los varios miles por año. La tortuga Verde del Atlántico (Chelonia mydas) y la tortuga Carey (Eretmochelys imbricata) se alimentan en las aguas cercanas a la costa; las tortugas de Mar (Caretta caretta) se ven ocasionalmente, en particular en aguas de mar abierto. La tortuga Tora (Dermochelys coriacea) es una visitante de temporada. Todas, con excepción de la tortuga de Mar, anidan localmente. Estimamos que anidan menos de 130 hembras (combinadas) por año.

Este Plan de Acción resume la información conocida sobre el estado y la distribución de las tortugas marinas y ofrece una amplia variedad de soluciones a las sobrecargas actuales. Decretar una moratoria sobre el aprovechamiento de las tortugas y sus huevos es un primer paso esencial en un compromiso nacional para la conservación de esta especie en peligro. Tal moratoria debe permanecer en efecto hasta el momento en que haya una evidencia científica verosímil que haga posible un aprovechamiento sustentable. Los habitats esenciales también deben protegerse. Antes de que se desarrollen planes exhaustivos de ordenación, se debe dar prioridad a estudios diseñados para identificar terrenos de importancia local destinados a la anidación y la alimentación. Se recomienda como de alta prioridad un estudio integral de Barbuda y estudios de tres terrenos de importancia latente para la anidación en Antigua -- Sandy Island, el grupo de playas de Pearn's Bay, y la playa de Mill Reef. Se debiera designar un Indice de Playas como áreas focales para la investigación y el monitoreo a largo plazo. Se debiera considerar la designación de la isla de Barbuda como Refugio de la Tortuga Marina. También debería emprenderse un estudio sistemático de los habitats marinos utilizados por las tortugas, a la brevedad posible.

Las autoridades locales y las ONGs deben iniciar estudios dirigidos a contribuír a los planes de ordenación de habitats. Los planes de ordenación deberían incorporar soluciones a problemas que comprenden el minado de las arenas, la eliminación de desechos y de aguas residuales, la iluminación artificial, las edificaciones de blindaje como espolones y rompeolas, y el aprovechamiento ilegal de las tortugas y sus huevos. Las soluciones efectivas se describen en este Plan de Acción. En el mar, el dragado, las explosiones y el anclaje deben prohibirse en los arrecifes vivos y las áreas de pastizales marinos. La contaminación procedente de la industria, la agricultura, el petróleo, así como la eliminación indiscriminada de desechos, debe regularse y vigilarse atentamente con el objetivo de minimizar la posibilidad de degradación de los habitats costeros. Al desarrollar planes de ordenación de las costas o los parques marinos, debe tomarse

en cuenta la utilización de habitats de las tortugas marinas. El monitoreo de la actividad de anidación debería implementarse como parte de la dirección de manejo del parque Nelson Dockyard Park; se debiera emplear a un Guardia de Conservación. La creación de una División de Observancia Forzosa de las Leyes de la Conservación, permitir al Gobierno poner en vigor con mayor efectividad, un creciente número de regulaciones ambientales importantes, que abarcan la contaminación, las especies protegidas, las minas y los minerales, las pesquerías y los recursos marinos, la seguridad de los barcos, la recreación y la caza, y el manejo de las áreas costeras.

Las autoridades de las zonas costeras y la ciudadan¡a en general debieran participar plenamente en el manejo de habitats de anidación y de alimentación importantes. Debe establecerse un período mandatorio de 60 días para la revisión y el comentario público de proyectos de desarrollo que afectan los habitats de las tortugas marinas y de otras especies silvestres. Cuando se ha definido una área como de importancia para las tortugas marinas, las directrices reguladoras debieran apuntar a establecer un marco de trabajo dentro del cual puede ocurrir el desarrollo y la utilización apropiada de terrenos. El complejo turístico Jumby Bay Resort es un ejemplo excelente de una coexistencia planificada (y positiva) entre el desarrollo y la conservación de la tortuga marina. Las directrices aprobadas del Jumby Bay Club para salvaguardar la playa de anidación de la tortuga Carey en Pasture Bay, Long Island, deberían compartirse con otras comunidades similares. Los materiales educativos para alertar a residentes y turistas sobre la defensa de las tortugas marinas en peligro y los reglamentos en vigor que las protejen, deberían desarrollarse y distribuírse de manera amplia. Debería emprenderse una campaña para alertar a los usuarios marinos de la amenaza, sobre pesquerías y tortugas, de la eliminación indiscriminada de desechos en el mar. Otras amenazas, tales como harpones y captura incidental, deberían cuantificarse y desarrollar soluciones. Los sistemas de fondeo deben examinarse e implementarse como una forma de prevenir el daño de los pastizales marinos y los arrecifes de coral.

Se propone aquí un Programa de Conservación de la Tortuga Marina de cinco años de duración. Las metas del programa son (1) obtener información exhaustiva y precisa sobre la distribución de habitats de anidación y de alimentación y (2) fomentar la conservación el la recuperación de las reservas de tortugas restantes. Las actividades, que comprenden estudios de mercado y de habitat, planificación del manejo, capacitación, y educación ambiental, se hallan descritas completamente en el texto. Además de los esfuerzos nacionales para conservar las tortugas marinas, es fundamental que Antigua y Barbuda apoye iniciativas internacionales para conservar estos reptiles altamente migratorios. A este respecto, se anima a Antigua y Barbuda a ratificar CITES, MARPOL, y el Protocolo de SPAW al Convenio de Cartagena de PNUMA. En resumen, se necesita un enfoque integral al descenso continuo en el número de tortugas marinas, que comprenda una fuerte legislación nacional y regional, la protección de los habitats, el monitoreo de la población y un aumento en la concientización pública. Las tortugas marinas son de larga vida; la mayoría no alcanza la madurez sexual antes de los 25-30 años. Si continuamos aprovechando las adultas en edad reproductora y los huevos, que se convertirán en las reproductoras del mañana, estará garantizada la extinción de las reservas locales. Si no actuamos pronto para salvaguardar las tortugas de Antigua y Barbuda, esta especie antiquísima desaparecer discreta y permanentemente.

RESUME

L'histoire de la capture commerciale et de subsistance des tortues de mer à Antigua et Barbuda remonte á l'ère précolombienne. Cela fait vingt ans qu'on tire la sonnette d'alarme dans la littérature sur le fait que le nombre de tortues, surtout les groupes en nidation, étaient en diminution. Certaines plages qui accueillaient autrefois des tortues en nidation ne sont plus aptes à le faire aujourd'hui tandis que beaucoup d'autres ne reçoivent que quelques nids par an. Plusieurs pêcheurs ont indiqué qu'ils ne cherchent plus de tortues sur ces plages en raison du déclin dans le nombre de femelles, ce qui rend cette activité presque dérisoire. Le nombre de pêcheurs de tortues s'est réduit à 2 ou 3 en raison d'une combinaison de causes: des stocks limités et une demande réduite. Le nombre de tortues capturées n'a pas dépassé 30 au cours des années 90, un déclin par rapport aux milliers prises il y a 50 ans. Malgré la baisse de la récolte directe, les captures fortuites opportunistes et aux fusils à harpon semblent être en hausse. Le nombre d'oeufs volés chaque année s'élève à plusieurs milliers par an. La tortue verte (Chelonia mydas) et la tortue cahouanne (Eretmochelys imbricata) s'alimentent dans les eaux côtières tandis que la tortue à écailles (Caretta caretta) se remarquent de temps en temps, au large des côtes. La tortue cuir (Dermochelys coriacea) est plus saisonnière. Toutes ces tortues, à l'exception de la tortue á écaille, font leur nid sur le territoire national mais nous estimons que moins de 130 femelles (des quatre types de tortues) pondent chaque année.

Le présent Plan d'action de sauvegarde résume les informations connues sur la situation et la répartition des tortues de mer et offre plusieurs solutions aux pressions actuelles. La mise en place d'un moratoire sur la pêche des tortues de mer et la récolte de leurs oeufs est un premier pas important vers un engagement national à la préservation de ces espèces en danger. Ce moratoire devrait rester en vigueur jusqu' à ce que la preuve scientifique crédible de la possibilité d'une récolte durable soit faite. L'habitat essentiel devrait être également protégé. Avant l'élaboration de plans de gestion complexes des habitats, la priorité devrait être accordée à des études visant à identifier les terrains locaux importants pour la ponte et l'alimentation. Une priorité absolue doit être donnée à une étude sur tout le territoire de Barbuda ainsi que sur trois plages d'Antigua qui sont potentiellement importantes pour la ponte de la tortue cahouanne, à savoir, Sandy Island, le groupe des plages de La Baie de Pearn ainsi que la plage Mill Reef. Des plages-témoins devraient être identifiées pour servir de point de départ à la recherche et à la surveillance à long terme. On devrait penser à faire de l'île de Barbuda un Refuge pour les Tortues de Mer. L'étude systématique de l'utilisation des habitats marins par les tortues de mer devrait être entreprise le plus tôt possible.

Les autorités locales et les ONG devraient entamer des études visant à contribuer à l'élaboration de plans de gestion pour les habitats. Ces plans devraient comprendre des solutions à des problèmes, tels que l'exploitation de sable, l'évacuation des eaux usées et des déchets, la lumière artificielle, remparts de protection (digues, brise-lames) ainsi que la capture illégale des tortues et la récolte de leurs oeufs. Des solutions efficaces sont détaillées dans ce Plan d'action de sauvegarde. Le dragage, le minage et le mouillage devrait être interdits en mer dans des zones de coraux vivants et de bancs d'algues. La pollution provenant de l'industrie, de l'agriculture, du pétrole et de l'évacuation sans discrétion des déchets devrait être réglementée et surveillée de près afin de minimiser les risques pour l'habitat côtier. L'utilisation des habitats de la tortue de mer devrait être prise en considération lors de l'élaboration de plans de gestion pour

les parcs côtiers et marins. La surveillance de la ponte de la tortue de mer devrait faire partie du mandat de gestion du Parc National Nelson Dockyard et l'on devrait embaucher un responsable de la conservation. La création d'une section distincte pour la mise en application de la loi sur la protection de l'Environnement est nécessaire pour faire appliquer un nombre croissant de règles environnementales y compris la pollution, les espèces protégées, l'exploita-tion minière, les ressources halieutiques et marines, la sécurité des canotiers, la chasse et la gestion des zones côtières.

Les responsables de zones côtières aussi bien que les citoyens ordinaires devraient participer pleinement à la gestion des habitats qui sont importants pour la ponte et l'alimentation. Une période obligatoire de 60 jours devrait être prévue pour passer en revue et pour faire des commentaires sur les projets de développement qui touchent aux habitats des tortues et des autres espèces sauvages. Lorsqu'une zone est désignée comme importante pour la survie des tortues de mer, des directives devraient être formulées pour créer un cadre pour l'utilisation et le développement appropriés du terrain. Le complexe hôtelier de Jumby Bay est un excellent exemple de co-existence planifiée (et réussie) entre le développement économique et la protection des tortues de mer. Des exemplaires des directives élaborées par le Club de Jumby Bay, et qui ont été approuvées pour la sauvegarde de la plage à Pasture Bay, Long Island, utilisée pour la ponte par la tortue cahouanne, devrait être adoptée par d'autres communautés vivant près des plages. Du matériel éducatif publicitaire visant à sensibiliser les résidents et les touristes à la situation des tortues de mer en danger ainsi que des règlements pour les protéger devraient être élaborés et diffusés. On devrait également lancer une campagne pour sensibiliser les utilisateurs de la mer au danger qui se pose aux ressources halieutiques et aux tortues par l'évacuation irraisonnée des déchets en mer. D'autres menaces, telles que la pêche au harpon et la capture opportuniste doivent être évaluées et des solutions adoptées. Des systèmes d'ancrage devraient être étudiés et mis en place pour éviter d'endommager les bancs d'algues et les récifs coraliens.

Le présent document propose un Programme quinquennal pour la Sauvegarde des tortues de mer. Ce programme a pour objectifs (1) d'obtenir des données complètes et exactes sur les répartitions des lieux où les tortues pondent et s'alimentent et (2) d'encourager la protection et la sauvegarde des tortues de mer restantes. Le texte présente également en détail d'autres activités telles que des études d'habitats et de marché, la planification de la gestion, la formation et l'éducation à l'environnement. Antigua et Barbuda doivent non seulement déployer des efforts pour préserver les tortues de mer mais également appuyer les initiatives prises au niveau international visant à protéger ces reptiles très migrateurs. A cet égard, il est vivement recommandé au pays de ratifier les Protocoles CITES, MARPOL et SPAW à la Convention de Carthagène du PNUE. En bref, face au nombre décroissant de tortues de mers, une approche intégrée est nécessaire, y compris une législation nationale et régionale solide, la protection des habitats, la surveillance des populations et une plus grande sensibilisation du public. Les tortues de mer ont une espérance de vie très élevée; la plupart d'entre elles n'atteignent pas la maturité sexuelle avant l'âge de 25 à 30 ans. Une chose est certaine: la population locale de tortues sera complètement épuisée si nous continuons de capturer celles qui sont à l'âge de la reproduction et les oeufs qui contiennent des futures femelles. Si nous n'agissons pas maintenant pour sauvegarder les tortues d'Antigua et Barbuda, ces anciennes espèces disparaîtront pour toujours.

I. INTRODUCTION

Sea turtles are an integral part of the West Indies. They were here for countless centuries before man set foot on these islands. They were nesting on the beaches of what is now the nation of Antigua and Barbuda (Figure 1) during the time of the Arawaks and Caribs. The Indians were most appreciative of the sea turtles, which they perceived as a gift from their gods. Few sea turtle bones survived the millennia buried in kitchen middens in Antigua and Barbuda, but turtle idols have been found and pottery shards displaying sea turtle motifs are quite common. There is also evidence that seamen and fishermen wore turtle motif jewelry, presumably to bestow swimming prowess like the sea turtles (Desmond Nicholson, Museum of Antigua and Barbuda, pers. comm., 1992). In neighbouring St. Eustatius, a decapitated hawksbill sea turtle (dating from the period 200 BC - 400 AD) was excavated at Golden Rock Airport. The turtle was buried upside-down and identified based on the presence of sponge spicules found in the stomach (Versteeg and Effert, 1987; Versteeg, 1990). In general, eastern Caribbean kitchen middens show that early inhabitants depended mostly on reef fishes, but that diet was supplemented by sea turtles.

Many references to turtles appear in the works of missionaries sent out from Europe to spread the word of God amongst the newly discovered peoples of the Eastern Caribbean. Father Breton's French-Carib dictionary (1665) tells us that the Island Caribs used sea turtle oil medicinally. Turtle shell was *kararu-ora*, and used for making fish hooks. The Indians caught turtles by spearing them at night with a hard wooden pole tied with a rope. As soon as the shell was seen glistening in the moonlight, the paddle man was directed and a strike made. One method of capturing turtles alive was by slipping a noose over the flippers of a mating individual at the surface (Price, 1966). The Indians loved to watch the female lay her eggs, but afterwards would overturn and butcher her. Sometimes turtles were kept alive in corrals (*tona ita*, literally "water gardens") to be used in trade with the Europeans, in exchange for steel axes, bill hooks, cloth, beads and the like. From those prehistoric days, and throughout all of the rich chapters of Caribbean history, the sea turtle was an inseparable part of life in Antigua and Barbuda and elsewhere.

In the mid-nineteenth century, Lanaghan (1844) wrote that Testudo mydas, archaic for Chelonia mydas (green sea turtle), frequented the bays of Antigua. "The female is so very prolific, that she sometimes lays 1000 eggs, which are hatched by the sun, in about 25 days [N.B. modern research has shown that incubation generally lasts 55-70 days]. The merits of this amphibious animal are too well known to descant upon. The shell is very hard and strong, and it will carry as much as 700 or 800 lbs. upon its back. One was captured in these seas a few years ago which measured six feet across the back, and the shell formed a good boat for a boy to sail about the harbour in." A footnote reminds the reader that "it was the shell of a turtle which served that great monarch, Henry IV of France, for a cradle." Lanaghan continued, "Several very excellent kinds of fish, the produce both of sea and fresh water, and shell-fish, allure the eye of the epicure; and last, *not least*, the delicious turtle, which at certain seasons is vended weekly at 9d. sterling per pound! with all its rich green fat, its white and yellow eggs! What would a city alderman say to this? would not his imagination revel in all the delights of *calipash* and *calipee*, and *real* turtle soup? not made of beef and calf's head, with a few pieces of turtle floating in it . . . We are very soon to have the steam ships running, or rather galloping, between England and

these islands; and I really think it would well repay that very honourable body the "lord mayor, the sheriffs, and aldermen of London," to take a trip, if it was only to partake of turtle in perfection, and quaff a glass of Madeira beneath this burning sun."

Having stopped in Antigua to visit friends during the course of his Caribbean voyage in the 1880's, Paton (1901) wrote of sea turtle cuisine with similar rapture. "In these islands of iguana, groo-groo worms, edible apes and *crapauderies*, the foreign diner-out had best take whatever is set before him, asking no questions, as did I, in thankfulness of heart. There was one royal dish of which we had all seen many weak imitations and mock suggestions -- we were all familiar with it, just as the untraveled art amateur knows his old masters from having seen more or less clever copies and reproductions by various cheap and unsatisfying processes -- a giant dish of green-turtle fins and fat, with an abundance of delicate morsels all floating in the wonderful sauce, composing the like of which was never yet -- no, nor never will be -- furnished forth within a thousand miles of Guildhall. This dish, fit to set before the Lord Mayor, was served liberally with little ceremony; in fact, with no more pomp and circumstance than would have attended its coming had it been an Irish stew or a dish of Boston beans. Moreover, I noticed that our hostess passed it by, saying she preferred mutton. Verily green turtles, like prophets, are not without honor save in their own country." A century later, the very last words (circa 1982) of the last town crier in downtown St. John's were . . .

"Oyez! Oyez! Oyez! Get your fresh green turtle!
One dollar and fifty a pound.
Number four stall at the public market."

The town crier is now gone. The sea turtle may be next to go, if comprehensive conservation measures are not taken immediately.

Comparatively few turtles remain in Antigua and Barbuda today, certainly only a fraction of the numbers in years gone by. Rebel (1974) and Cato et al. (1978) both concluded that local sea turtle populations were declining steadily. Illegal harvest during the closed season and ineffective law enforcement were implicated as causal factors. Markets in recent decades have been both domestic and foreign; export destinations have included other eastern Caribbean islands and Japan (section 3.3). Catch records have never been kept, but the annual harvest over the last two decades has sometimes reached several hundred and some estimate several thousand animals. Turtles have traditionally been netted or taken from the nesting beaches, but increasingly they are speared by fishermen seeking lobster, reef fish and conch. Today the harvest probably does not exceed 50 turtles. Only 2-3 fishermen depend to any significant extent on income derived from the harvest. Several thousand eggs are collected each year, a situation which has no doubt contributed meaningfully to the present endangered status of local populations. Incidental take, particularly on longlines, appears to be a growing problem throughout the eastern Caribbean, and this is true in Antigua and Barbuda as well.

New threats to sea turtle survival seem to arise daily, the inevitable fallout of technology and an increasing human population. Nesting beaches are being consumed for development. Remote reefs and feeding areas are now within easy reach of modern power boats, spear guns, and SCUBA tanks. Eager tourists, unaware that they are part of the problem, purchase polished

carapaces and tortoiseshell jewelry for souvenirs of their visit. Unless action is taken very soon, the last remaining sea turtles may vanish from Antiguan beaches, much as they did from the Cayman Islands more than 150 years ago (see King, 1982). The most urgent needs are for the strengthening of national sea turtle conservation legislation, holistic coastal zone management planning, comprehensive surveys of important habitat, and enhanced public awareness. Integrated multinational efforts are also needed, for neither sea turtles nor people remain within national boundaries. Sea turtles nesting on one nation's shores will, at some point, feed or take refuge in the waters of another nation. A bold coalition of both national and international conservationists is needed to rescue the sea turtles from their progressive slide toward extinction. The WIDECAST project, with local coordinators in more than two dozen nations, is working to build just such a coalition.

This Sea Turtle Recovery Action Plan has several objectives, including (1) define a national sea turtle conservation agenda with precise recommendations for recovery action, (2) provide policy-makers and non-government groups with detailed information needed to make informed decisions regarding the conservation of depleted sea turtle populations, and (3) identify gaps in the existing knowledge base. This document, prepared by the Antigua and Barbuda Sea Turtle Conservation Network, is the first and most important step toward a national blueprint for action on behalf of sea turtles. The network is comprised of private individuals committed to assisting government with the conservation and recovery of sea turtles in this country. This network is but one of 39 in-country networks which together comprise the Wider Caribbean Sea Turtle Conservation Network (WIDECAST); each has prepared its own Recovery Action Plan for sea turtles. Together, the 39 Plans constitute a significant conservation initiative for Caribbean turtles. The WIDECAST approach to endangered species conservation is supported by the United Nations Environment Programme and by the constituent governments of the Caribbean Environment Programme.

II. STATUS AND DISTRIBUTION OF SEA TURTLES IN ANTIGUA/BARBUDA

In the Caribbean Sea, five species of sea turtle are recognized as *Endangered* and a sixth, the loggerhead turtle, as *Vulnerable* by the World Conservation Union (IUCN) (Groombridge, 1982). Sea turtles are harvested throughout the region for meat, shell, oil, and skins. They are accidentally captured in active or abandoned fishing gear, resulting in the deaths of tens of thousands of turtles each year. Oil spills, chemical waste and persistent plastic debris, as well as the ongoing degradation of important nesting beaches and feeding grounds, also threaten the continued existence of Caribbean populations. A recent report concluded that about half the world's nesting populations of hawksbill sea turtles are known or suspected to be in decline; in particular, the study found "the entire Western Atlantic-Caribbean region is greatly depleted" (Groombridge and Luxmoore, 1989).

In Antigua and Barbuda, three species of endangered sea turtle are known to nest: the hawksbill, the green, and the leatherback. In addition, foraging hawksbills and green turtles of varying sizes are present year-around. The giant leatherback turtle is a seasonal visitor. Gravid (=egg-bearing) females arrive in early summer to lay their eggs and presumably return to more temperate latitudes in June or July after egg-laying has been completed; foraging has not been

observed. The loggerhead is not known to nest, but is occasionally caught offshore. Neither the Kemp's ridley nor the olive ridley has ever been documented, although there are anecdotal accounts of the latter being caught in Barbuda. A general key to the identification of local species is found in Figure 2. Table 1 and Figures 3 and 4 summarize the distribution of nesting beaches.

2.1 Caretta caretta, Loggerhead Sea Turtle

The common name for this species is *mullato* in Barbuda; the animal does not appear to be known to the turtle fishermen of Antigua. The loggerhead is recognized by its large head, thick, somewhat tapered carapace (=shell), and characteristically heavy encrustation of invertebrate epifauna (especially barnacles). 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, plants, and a wide variety of invertebrates are also eaten (see Dodd, 1988). This turtle is also characterized by its colour, being usually reddish brown or even tinted with orange, and the five pair of lateral scutes (=carapace plates) on either side of the median, as opposed to four pair in other locally occurring turtles (Figure 2). Adults attain a carapace length of 120 cm (straight-line, nuchal notch to posterior tip) and weigh up to 200 kg (440 lb) (Pritchard et al., 1983).

The species has a wide oceanic distribution. In the Atlantic Ocean, loggerheads 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 along the Atlantic coast of Florida (USA) and Masirah Island (Oman). An estimated 14,150 females nest annually on the Atlantic coast of Florida (Murphy and Hopkins, 1984; Ehrhart, 1989), where the peak nesting season extends from mid-May to mid-July. Moderate nesting populations are also found in Mexico, where Gulf and Caribbean coasts support some 380-400 females per annum (Ehrhart, 1989). Low density nesting is reported from the West Indies (e.g., Bacon, 1981; Dodd, 1988; Sybesma and Hoetjes, 1992), but the species is not known to nest in Antigua or Barbuda.

Juvenile loggerheads are occasionally observed in both inshore and offshore waters, but adults have not been seen. Meylan (1983) reported: "Two informants were familiar with the loggerhead, but its occurrence at Antigua needs confirmation." There have since been several confirmed sightings in Antigua, particularly east of the island in deep water and most often in spring and early summer. A large juvenile loggerhead was found off the north side of Green Island in 1987, tangled in what appeared to be cargo netting and palm thatch. It was still alive, but butchered upon retrieval. Marks on the neck and flippers suggested rope burns. At about the same time, another large juvenile was found tangled in a "Japanese net" (heavy green fiber net) off the east coast of Barbuda. With respect to Barbuda, Meylan (1983) concluded: "Loggerheads are much less common than green turtles or hawksbills, but are well known to fishermen. Most are of intermediate size, weighing approximately 18-45 kg." The species appears to be most common around the northwestern end of Barbuda, this being an area of shallow water with large numbers of the conch Strombus gigas.

In March 1991, Antiguan longline fisherman Lucien Barreto caught nine juvenile loggerheads on lines set about 35 miles northeast of Antigua (see also section 3.5). The hooks were cut

and the turtles were released. The turtles were caught on longlines placed in deep oceanic water east of the Antigua/Barbuda continental shelf; baited hooks were set at approximately 200 ft (61.5 m) in depth. Ocean currents in this area of the Lesser Antilles represent the southwestern edge of the North Atlantic subtropical gyre, flowing from southeast to northwest as part of a vast clockwise spiral around the Sargasso Sea. All of the captured turtles were healthy juveniles, remarkably similar in size, with a carapace length "of about two feet."

Antigua loggerheads are of a size characteristic of most other juvenile loggerheads encountered on the Continental Shelf of the western North Atlantic. According to the existing paradigm, hatchlings leave U. S. beaches and are carried passively on the North Atlantic subtropical gyre in Sargassum seaweed rafts to areas of the eastern North Atlantic, including the Azores. After several years of pelagic existence, the growing juveniles (22-26 inches (56-66 cm) shell length) return or are returned by currents to the western North Atlantic to become resident benthic (=bottom) feeders on the Continental Shelf of North America, where they remain for the rest of their lives. Given that Barreto's loggerheads were apparently feeding normally in deep oceanic water at depths of several hundred feet and that juvenile loggerheads are rarely observed in shallow, near-shore Antiguan waters, it follows that Antiguan juveniles probably represent ordinary North Atlantic loggerheads returning from their pelagic years. They may have been moving north in March along the Atlantic side of the Lesser Antilles, toward the North American Continental Shelf, when they were caught on the longline hooks.

2.2 *Chelonia mydas*, Green Sea Turtle

The green turtle is the second most common species of sea turtle (after the hawksbill) reported from the waters of Antigua, and the most common species in the waters of Barbuda. The turtle is referred to as *green turtle* or *green-back*. The species is recognized by a round, blunt beak with serrated cutting edges, a single pair of large prefrontal scales between the eyes, and four pairs of lateral carapace scutes that do not overlap one another (cf. hawksbill, section 2.4) (Figure 2). The shell colour is light to dark brown, sometimes shaded with olive, with radiating wavy or mottled markings of darker colour or with large blotches of dark brown. The plastron (=belly plate) is whitish or light yellow (Carr, 1952). The carapace is generally devoid of barnacles. Adults can attain weights of 230 kg (500 lb) (Pritchard et al., 1983) and generally measure 95-120 cm in straight carapace length (nuchal notch to posterior tip). A mean size of 100.2 cm (n=2107) is reported from the Caribbean nesting beach at Tortuguero, Costa Rica (Bjorndal and Carr, 1989).

Meylan (1983) concluded that green turtles and hawksbills were the "principal species" nesting on Barbuda, but that while "nesting density is probably higher on Barbuda than on any other island in the Leewards, absolute numbers are still very modest." Green turtles are reported to nest all along the shore from Billy Point to The River, Barbuda; nesting also occurs on several east coast beaches. Over the last several years, large green turtles have been caught during nesting at Rabbit's Beach, Two Feet Bay, Welch's Bay, Palmetto Point beach, Low Bay, and Cedar Tree Point beach. In Antigua, nesting has been reported on more than 20 beaches (Table 1). The nesting season is not precisely known, but informants contend that it spans August-October, with a September peak. Neither nest density nor nesting frequency are known. On the basis of information available from other areas, 2-6 clutches of eggs are probably laid by each fe-

male (at 12-14 day intervals during the nesting season) every 2-3 years. The number of eggs deposited per clutch most likely ranges from 125-150. Eggs hatch after about two months of incubation. An estimated 39 green turtles nested in 1982 (Joseph et al., 1984). Systematic beach surveys are required to determine more accurately the number of green turtles nesting each year (section 4.112).

Green turtles are herbivorous in Antigua and Barbuda, as they are throughout the Caribbean. They feed primarily on the sea grass Thalassia testudinum (Bjorndal, 1982). Recent studies indicate that individual turtles maintain feeding "scars" by returning to the same area of sea grass meadow to forage each day (Bjorndal, 1980; Ogden et al., 1980, 1983). The scars are maintained by regular cropping for several months, and the new growth, rich in nutrients and low in lignin, is preferred. When the cropped grasses show signs of stress (blade thinning, increased inter-nodal distance), the turtle abandons the scar and moves on to form another. In Antigua and Barbuda the green turtle occurs year-around in foraging habitats and is represented by a wide range of size classes. At the present time there are no data to indicate residency patterns; that is, it is not known how long juveniles in the various size classes remain in local waters before they move on through successive developmental habitats which may span several nations in area.

Meylan (1983) reported that the bays on the northern coast of Antigua "provide particularly good foraging habitat for green turtles, and for this reason most netting is carried out in this area. Nets are also set at feeding sites on the western and southern coast at Hawksbill Bay, Pinching Bay, Dark Wood, Urlings, and Mt. Carmel. Green turtles and a smaller number of hawksbills are captured at all localities." In addition, nets have traditionally been set in North Sound and Nonsuch Bay, although there are certainly many fewer nets set today than in the past (see section 3.3). Important foraging areas, based on persistent sightings of green turtles, are believed to occur in the shallows along the south coast and in the sheltered bays along the east and west coasts of Antigua. A fisherman recently reported "lots of little green turtles" caught in a gill net set for fish in Hanson's Bay on the west coast; they were released unharmed. Adults are sometimes seen in deeper waters, such as one very large individual routinely sighted off the south coast in about 15 fathoms of water. Foraging is also reported around the uninhabited island of Redonda, a small (2.6 km^2) island politically associated with Antigua and Barbuda.

Green turtles are also common in foraging habitats around Barbuda. Meylan (1983) reported "a fisherman who sets nets inside the reef at Welch Point catches only green turtles there. Hawksbills are more common on the reefs near Goat Point and Cedar Tree Point. Immature green turtles have been caught in mangrove areas inside the entrance to Codrington Lagoon. The Creek, as the entrance area is called, is a favorite netting location. A juvenile green turtle estimated to weigh less than a kilogram was reportedly seen resting on top of a net at this location." In August 1991, a local fisherman caught seven 30-40 lb green turtles in one hour in a 100-ft shark net set across the entrance of The Cove, the lagoon just north of the Creek mouth. All were released alive. This area is rich in sea grass, constituting a particularly good feeding area for the small and intermediate sized juveniles that are predictably found there. A "flotilla" of large green turtles is frequently seen agglomerating near Palmetto Point, Barbuda, in June; this phenomenon does not occur every year but with some regularity. Additional information is needed regarding the locations of favoured feeding areas.

It is likely that some of the adult green turtles observed in the waters of Antigua and Barbuda can be considered residents. These are turtles that predictably return to our waters after migrating to natal beaches in other countries to lay their eggs on multiple-year cycles. In contrast, juveniles may be resident for a time but are likely to move through several developmental habitats throughout the Wider Caribbean during their growth years. Green turtles may forage over vast distances during the decades prior to sexual maturity, which is estimated at 27-33 years of age in the U. S. Virgin Islands (Frazer and Ladner, 1986). Tagging and telemetry studies are necessary in Antigua and Barbuda to determine residency and behaviour patterns.

2.3 Dermochelys coriacea, Leatherback Sea Turtle

The leatherback is referred to in Antigua as *coffin back, river turtle* or *walava*, and in Barbuda as *bandora*. Leatherbacks are the largest of the sea turtles. Females nesting in the Caribbean typically weigh 300-500 kg (650-1100 lb). The largest leatherback on record is a male that stranded on the coast of Wales in 1988 and weighed 916 kg (Morgan, 1989). The species is easily distinguished from other sea turtles because it lacks a bony shell, having instead a slightly flexible skin-covered carapace. The smooth, black skin is spotted with pale yellow or white. The carapace is strongly tapered, measures 130-165 cm in total length (straight-line), and is raised into seven prominent ridges that streamline the body form (Figure 2). Powerful front flippers extend nearly the length of the body. Prominent cusps on the upper mandible provide a cutting and tearing edge for grasping jellyfish prey. Foraging has not been observed during the nesting or hatching season. Joseph et al. (1984) noted that "jellyfish swarm in July and August", coinciding with leatherback hatching.

Adult leatherbacks are observed in both inshore and offshore waters; juveniles have never been reported. Two adults were recently seen (March 1989) at the 100 fathom line due northeast of Jumby Bay. This observation was unusual in that leatherbacks are generally observed to be solitary at sea. There are also a few records of fishermen catching the species offshore, mostly on longlines baited with squid (L. Barreto, pers. comm., 1992). Two Antiguan longliners (*Stanley B, Jenny B*) occasionally capture leatherbacks whilst fishing along the 1000 fathom contour east, north and west of Antigua and Barbuda. They are also sometimes ensnared by trammel nets, but this is very rare. Meylan (1983) reported: "One caught in a net off Jolly Beach [Antigua] several years ago was believed to have been approaching to nest." Joseph et al. (1984) indicated that feeding occurred offshore Antigua from April to October, but there appears to be no documentation to support this contention, nor is it likely that leatherbacks remain in local waters in any numbers as late as October. Incidental catch records from the longline industry would be useful in clarifying the seasonality of leatherbacks in local waters. See section 4.27 for a discussion of incidental catch.

Leatherbacks are not resident in the waters of Antigua and Barbuda. They are seasonal visitors, migrating from temperate foraging grounds and arriving asynchronously to nest in the West Indies between February and July (Eckert and Eckert, 1988). Recent studies deploying time-depth recorders on gravid females have shown that individuals nesting on St. Croix, U. S. Virgin Islands, routinely spend the inter-nesting interval diving to an average depth of about 60 m and have attained maximum depths exceeding 1000 m (Eckert et al., 1986, 1989). Since leatherbacks feed predominantly on jellyfish and other soft-bodied prey (e.g., Den Hartog and

Van Nierop, 1984), the impetus behind the diving behaviour may be to feed on deep-water siphonophores in the deep scattering layer; that is, to feed within the strata of plankton that migrate to the ocean surface at night and descend just below the depth of light penetration during the day. The diving may also represent thermoregulatory behaviour or predator escape. Killer whales (Orcinus orca) are known to consume leatherbacks in the Caribbean (Caldwell and Caldwell, 1969) and large sharks undoubtedly take the turtles on an opportunistic basis.

Leatherback nesting is relatively rare in Antigua and Barbuda. The first known nesting report dates back to 1955 on Winthrops Bay beach on the north coast of Antigua. More recently, nesting has been reported at the Mill Reef Beaches, Big Rendezvous Bay, Carlisle Bay, Curtain Bluff, Morris Bay, Pearn's Point Beaches, the Five Islands Estate Beaches, Dickenson Bay, Jabberwock Beach (Ely's Bay), and Dutchman Bay (Table 1). The same female was observed nesting at Jabberwock Beach in 1981, 1984 and 1987, being readily recognizable by a distinct hole in her left rear flipper. One nesting occurred in mid-*day* on Morris Beach (June 1985). Another interesting record is a documented hatch at Bleaky Bay (Barbuda) on 2 November 1989, which is quite late for leatherback hatchlings. In Barbuda, leatherback nesting has been reported on Coco Point Beach (photos are available) and the Bleaky Bay Beaches, as well as on selected beaches from the River to Billy Point and from Pigeon Cliff to Griffin Point (Table 1). Meylan (1983) reported that "only a few leatherbacks nest on [Barbuda] each year. One that emerged at The River in 1979 became entrapped by debris and died of exposure."

Nesting is so infrequent that little is known of clutch size or frequency, nest density, or trends in abundance. In one case, 112 eggs were laid in one nest on a north coast (Antigua) beach on 7 April 1981 (Meylan, 1983). The nearest concentrated nesting to Antigua is at Sandy Point National Wildlife Refuge, St. Croix, U. S. Virgin Islands. At this beach, nesting commences in March (rarely February) and continues through July. Each female is tagged so that her reproductive history can be recorded (this type of intensive research is done with hawksbill turtles in Antigua; see section 2.4). On Sandy Point, an average of 5-6 clutches are deposited per female at 10-day intervals during the nesting season. Females generally return to nest every 2-3 years, but individuals occasionally nest in consecutive years and sometimes return after intervals longer than three years. Clutch size is typically 60-100 yolked eggs; a variable number of small, yolkless eggs is also deposited. The eggs incubate in the sand at a depth of 60-70 cm for about two months. The hatchlings break free of their eggs after 50-55 days and emerge from the sand, generally at dusk, several days later. As is the case with all species of sea turtle, sand temperature plays a large role in determining hatchling sex. Warmer temperatures produce females, whereas cooler temperatures produce males.

Leatherbacks have traditionally been killed whilst nesting, and to some extent this still occurs. In the mid-1970's, a leatherback was killed at Palmetto Point, Barbuda. In October 1984, a weathered nuchal bone was found in the grass far up behind the beach near Turtle Bay (south coast Antigua). In May 1985, a killing occurred at Big Rendezvous Bay, Antigua. A nester killed on Carlisle Beach in 1990 was reportedly tagged, but the carcass was burned before the tag could be retrieved. A leatherback was reportedly caught in a net offshore Parham in late September 1992 (during the closed season) and killed, but confirmation that the turtle was indeed a leatherback is not available. Eggs are also collected (section 3.3), despite the fact that this is illegal at all times of the year (section 4.21).

2.4 Eretmochelys imbricata, Hawksbill Sea Turtle

Hawksbill turtles, known locally as *'oxbills*, are distinguished by a narrow, pointed beak and two pairs of prefrontal scales between the eyes. The carapace is often posteriorly serrated and the carapace scutes overlap, like shingles on a roof (Figure 2). Adults rarely exceed 80 kg (175 lb) and a carapace length of about 90 cm (straight line, nuchal notch to posterior tip). Bright mottled colouration (brown, orange, gold) is common. Despite a wide variety of foods consumed (see Witzell, 1983), recent studies indicate that hawksbills may specialize on sponges in the Caribbean, and predominantly on two orders of Demospongea. Ten sponge species accounted for 79.1% of the dry mass of all sponges identified in the stomachs of hawksbills from seven Caribbean countries, suggesting a degree of dietary selectivity (Meylan, 1988). For this reason, healthy coral reef habitats are very important to the survival of hawksbill turtles.

This rare sea turtle is challenging to study. Little is known about Caribbean populations. Hawksbills are migratory, high-density nesting is rare, and the relatively few tagging programmes have not been in place long enough to generate a useful number of tag returns (that is, a sufficient number of recaptures to illustrate post-nesting movement). Principal nesting beaches in the West Indies are not easily identified, but one of the best known is Pasture Bay Beach (Jumby Bay Resort) on Long Island, Antigua. It should be noted that the rarely observed phenomenon of high-density nesting by hawksbills may reflect the rarity of nesting females left in the Caribbean today, rather than a propensity of the species to avoid high-density nesting as a behavioural trait. Hawksbills are presently endangered throughout their range (Groombridge, 1982) and both domestic and international markets are implicated in their demise. The largest (but not the exclusive) market has been Japan. Between 1970 and June 1989, Japan imported 368,318 kg of hawksbill shell (tortoiseshell) from the Wider Caribbean, the equivalent of more than a quarter million turtles; in 1988, Japan imported from the Wider Caribbean the tortoise-shell from nearly 12,000 adult hawksbills (Canin, 1989). Japanese imports from Antigua and Barbuda are summarized in section 4.31.

According to fishermen and other local residents, including the former owner of Jumby Bay Resort, Mr. Homer Williams, nesting was much more frequent in the past than it is today (see also section 3.3). We are fortunate that remnant populations have survived in Antigua and Barbuda. Hawksbills, though relatively few in number, are the most common turtle in the waters of Antigua and the second most common in Barbuda. Hawksbills are also the most common sea turtle to nest on Antigua and Barbuda. Nesting occurs throughout most of the year, but the primary season is from mid-June to mid-November (Corliss et al., 1989). Females routinely retreat into supralittoral vegetation, such as sea grape trees (Coccoloba uvifera), before egg-laying. To the untrained eye, there is little evidence of the nest aside from a faint asymmetrical crawl (about 0.7 m wide) leading to and from the sea. Pasture Bay beach has the largest concentration of nesting hawksbills in Antigua or Barbuda. A tagging programme begun there in 1987 has shown that this beach supports 20-40 nesters per year (Table 2). The turtles arrive at the nesting ground asynchronously and most nest 4-6 times at 14-15 day intervals during the nesting season. The peak of the season varies a little each year by virtue of the fact that the population is so small. Approximately 18,000 hatchlings are produced from Pasture Bay each year, now that a conservation programme is in place on this beach.

In addition to Long Island there is some nesting at Bird Island, as well as on several beaches in Antigua and Barbuda (see Table 1). Meylan (1983) cited Grape Bay on Guiana Island and Long Bay near Willikies; she reported that the species used to nest in Dutchman's Bay, but did so only rarely at the time of her writing. She also reported nesting on several beaches in the Five Islands Village area, including Galley Bay, Landing Bay, Hawksbill Bay, Pinchin Bay and Long Bay; of these, Pinchin Bay was believed to be the best, although even there nesting activity was attributed to only a few individuals per year (Meylan, 1983). In Barbuda, Meylan (1983) reported that hawksbills are the predominant nesters on a beach that extends from Span-ish Well Point to Coco Point; the shore from Billy Point to The River also supports nesting. Joseph et al. (1984) estimated that 76 hawksbills nested on Antigua and Barbuda in 1982, with fewer than 15 nests laid per annum on surveyed beaches. We now believe the 1982 estimate to be low, and suspect that perhaps 400-500 nests are laid on Antigua and Barbuda each year. Dividing this number by five (the average number of nests per female), we can estimate that 80-100 females nest each year. One-third of this nesting activity occurs at Pasture Bay on Long Island. Beach surveys are sorely needed to accurately determine the number of nests laid each year (section 4.112).

Hawksbill foraging and mating areas have not been precisely defined. Joseph et al. (1984) report foraging in local waters year-around. Neonate hawksbills 2-8 inches (5-20 cm) in shell length are apparently pelagic, feeding and developing within mats of Sargassum or floating debris found throughout offshore areas of the Caribbean; these very small hawksbills are not seen near Antigua or Barbuda after they leave the nesting beach. Small juveniles 8-25 inches (20-60 cm) in shell length can be observed in relatively shallow coral reef habitats, including reefs throughout the North Sound area, at virtually all times of the year. John Fuller and other recreation fishermen observe the larger individuals (adults and subadults with shell lengths >60 cm) in concentration along the 20-100 fathom drop-off of the Antigua/Barbuda continental shelf at all times of the year. This characteristic bi-distribution of smaller animals in nearshore shallow water and larger animals in offshore deep water is also reported in the USVI (Ralf Boulon, USVI Div. Fish Wildl., pers. comm., 1991) and Puerto Rico (Robert van Dam, pers. comm., 1992). Foraging hawksbills are common around the coral reefs which surround Redonda. Historically, turtle fishermen from Montserrat netted turtles at Redonda.

It is in the area of the 100 fathom drop-off that mating pairs of hawksbills are usually observed. Mating has also been observed on the outer edge of the reef near Urlings in May (Meylan, 1983), as well as in the Elsie Channel in Barbuda. There are no data to indicate residency patterns; that is, it is not known how long juveniles in the various size classes remain in a particular habitat before they move on through sequential developmental habitats which may be distributed among several nations. It is highly doubtful that an individual hawksbill (or any other sea turtle) lives its entire life, which may span 50-plus years, within the territorial waters of Antigua and Barbuda.

2.5 Lepidochelys kempii, Kemp's Ridley Sea Turtle

There are no records of Kemp's ridleys in Antigua and Barbuda, nor would the species be expected to occur. The diminutive Kemp's ridley is gray in colour as an immature and primarily olive green as an adult (Pritchard et al., 1983). The carapace is round, often as wide as it is long,

and carapace scutes do not overlap one another (cf. hawksbill sea turtle, section 2.4). According to Ross et al. (1989), adults weigh 60-90 lb (27-41 kg) and have a shell length of 23-30 inches (58-76 cm). The species is carnivorous and eats mostly crabs, but also preys upon other crustaceans, shellfish, jellyfish, sea urchins, starfish, and fish. With the exception of a single recapture from Caribbean Nicaragua of a "head-started" individual (Manzella et al., 1991), which may have displayed altered 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 world's most endangered sea turtle, the total adult population is thought to number no more than 900 females and an unknown number of males (Ross et al., 1989). The species nests almost exclusively in the state of Tamaulipas, Mexico.

2.6 Lepidochelys olivacea, Olive Ridley Sea Turtle

There are rare records of this species in the waters of Barbuda where older fishermen recall it to be a "wicked and nasty" turtle. It is referred to locally as *yellow-head*. There are two sightings in recent memory; both were caught on the south coast of Barbuda in nets about 20 years ago. There is no recent documentation, and there are no data to clarify seasonality, size classes present, distribution, or abundance. Olive ridleys are similar in appearance to Kemp's ridleys (section 2.5), having a nearly round carapace (width about 90% of the length) and an adult colour of olive green or brown dorsally and yellowish white ventrally. The turtle rarely exceeds 100 lb (45 kg) (Pritchard et al., 1983). Each front flipper bears a single claw, the horny beak may be finely serrated, and carapace scutes do not overlap one another. The lateral scutes (those to either side of the median on the shell) are divided into 5-9 pairs, considerably more than other sea turtles which typically have 4-5 pairs. The only significant nesting colony in the Western Atlantic is in Suriname, primarily at Eilanti Beach (Schulz, 1975). Olive ridleys nesting in Suriname have declined considerably in recent years, from about 3,000 nests per year in the late 1960's to fewer than 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 ANTIGUA/BARBUDA

3.1 Destruction or Modification of Habitat

Terrestrial habitat: Hawksbills are the most commonly observed species of sea turtle nesting on the shores of Antigua and Barbuda; an estimated 80-100 nest each year (section 2.4). Green turtles and leatherbacks are also known to nest, but in much lower numbers. Since all beaches taken together represent the combined nesting habitat for the local breeding populations, it is important that a national coalition of beach owners be developed to work throughout Antigua for the preservation of nesting habitat. Barbuda beaches are fewer but longer, and they are primarily government-owned (Table 1). Thus, the protection of Barbuda nesting habitat from destruction and modification remains largely with Government, the Development Control Authority, and the Barbuda Council, rather than with private owners.

Construction practices on or near beaches pose the greatest immediate threat to sea turtle nesting habitat, especially in Antigua. One example is Dickenson Bay which now supports four

hotels; nesting used to be common, but now it is rare. Houses and hotels are too often placed on or just behind the beach, without a sufficient buffer zone. They should be constructed on limestone, never on sand. Even when so-called "buffer zones" are allowed to remain, the intervening vegetation is usually cleared for patios, swimming pools, lawn, walkways, and other structures incompatible with hawksbill nesting requirements. Vegetation is also cleared for the ocean breeze, aesthetics (view), and/or insect control. Hawksbills prefer to nest within fairly dense woody vegetation, such as sea grape (Coccoloba) thickets. Thus, a mosaic of natural vegetation is needed in and around developments to provide suitable hawksbill habitat. A sandy beach alone is not sufficient, although an occasional green sea turtle or leatherback may nest there. It is important that buffer zones and setback limits be established and enforced with regard to development proximal to sandy beaches (section 4.122).

Coincident with coastal construction is a general increase in artificial lighting. Artificial light is one of the most destructive of man's influences on sea turtle nesting habitat. Lights that illuminate the beach seriously degrade the quality of nesting habitat. Lights deter some adult females from nesting; hatchlings are also negatively affected (e.g., Mrosovsky, 1978; Raymond, 1984; Witherington, 1990). As the hatchlings emerge from the nest and head for the sea, they are drawn irresistibly to the brightest illumination. If the brightest source of light is a landward development, the hatchlings are led away from the sea and either die in the burning morning sun or are consumed by predators. On virtually every beach where hawksbills nest in Antigua, hatchlings have been reported crawling inland toward artificial lights. Fortunately, this problem can oftentimes be minimized if not eliminated. Security lights and other illumination should take the form of low-pressure sodium (LPS) vapor lamps and should be situated behind screening vegetation or structural shades. In some cases, lights can be turned off during critical hours (see section 4.132).

Sand is a valuable economic commodity and natural resource in Antigua and Barbuda. The future of successful sea turtle reproduction in Antigua and Barbuda is inextricably tied to this economic reality, since sand mining can cause irreparable damage to important nesting beaches. While the mining of sand on beaches is currently banned, except in cases of special permit, it is a recommendation of this Recovery Action Plan that laws be developed to provide absolute protection to beaches from sand mining in perpetuity (section 4.131). The ideal approach to the protection of Antiguan beaches would be to preserve them, by government decree, as Sea Turtle Refuges. This option, however, appears to be neither politically nor economically feasible at the present time. Multiple use of beaches compatible with nesting sea turtles is the most realistic management option. Barbuda is arguably a different story, and we recommend that the island be declared a Sea Turtle Refuge (see section 4.12).

General pollution is another concern. According to the CCA (1991), the low priority assigned to pollution issues by the government is symptomatic of a larger related problem, for it reflects a lack of awareness – by the government, business community, and general population – about the importance of pollution control and the problems and costs associated with poor resource management, particularly in critical sectors such as tourism. One public official recently summed it up succinctly when he told an OECS audience that, "In our small countries of limited land and freshwater resources, indifference to the quality of solid waste management is a cavalier attitude and luxury we can ill-afford" (Michael, 1990). Pollution which most affects sea turtles

on nesting beaches includes oil and other potentially toxic runoff; glass, metal and other solid waste that may injure a nesting female or her young; and the disposal of large objects, such as construction waste, abandoned vehicles, or household appliances that may block a female's access to desirable nesting sites. Litter and contaminants also wash ashore from dumping or spills at sea. Virtually all windward beaches, including the important hawksbill nesting beach at Pasture Bay, are littered with tar balls, some quite large in size.

Other sources of degradation to nesting habitat include the planting of exotic vegetation, such as sea oats or coconut palm trees. Preliminary data suggest that sand temperatures at the depth of hawksbill sea turtle nests are significantly elevated under clumps of sea oats when compared to temperatures in the open beach or under the native sea grape tree (Michelle Zacks and Meg Hoyle, unpubl. data). Since temperature determines the sex of developing hatchlings, the introduction of exotic vegetation can have profound conservation implications. In the case of coconut palms, there is some evidence that their roots have obstructed nesting by hawksbills on Lord Nelson Beach (Dutchman's Bay). Livestock, such as donkeys and cattle, left unattended on sandy beaches have the potential to crush incubating eggs; this presents a greater problem in Barbuda than in Antigua. Further examples of destruction to sea turtle nesting habitat, such as excessive trash, sand replenishment (beach rebuilding), vehicle driving, and sea walls which are found in other areas of the Caribbean are not significant in Antigua or Barbuda at the present time. Vigilance must be maintained should such problems arise in the future. Solutions to stresses on important terrestrial sea turtle habitat are discussed in section 4.13.

Marine habitat: Pollution-related degradation of marine habitat important for sea turtles is not a widespread problem. The country lacks heavy industry and oil refineries; sugar processing factories are no longer operating. Selected areas, however, are being degraded at an alarming rate. The harbour at St. John's is grossly polluted with industrial and municipal effluents. Discharges from the storm sewers and streets of St. John's also contribute to pollution of the harbour. Fortunately, the affected area is small relative to greater Antigua and pollution leaving the harbour is swept westward, away from much of Antigua's coastal area which remains fairly clean. Barbuda's marine pollution problems are comparatively small, partly because of the low density of people there. This notwithstanding, it has been estimated by the senior author that about 50% of the living reef along the east coast of the island has died over the past two decades. "White line disease" and hurricane damage have been implicated (Oxenford, 1991).

Industrial effluent directly or indirectly discharged to the sea is particularly insidious because some of the most toxic components are invisible to human senses. Associated with industrial discharge are toxic materials such as heavy metals and persistent chemicals. These dangerous materials frequently accumulate in the food chain with increasing concentration in the higher order consumers such as humans. Thus, though they may not be obvious in the marine environment, their presence is nonetheless harmful. Contaminants are also found in the treated effluent of industrial and municipal sewage released to the ocean from discharge pipes located well offshore. Such out-of-sight, out-of-mind disposal practices can be extremely dangerous not only to sea turtles, but also to other marine organisms and to people who consume these organisms. The only way to control this problem is to control the quantity and chemical make-up of the effluent at the source where the effluent is produced. Strong environmental protection laws are needed and these laws should not be vulnerable to political pressures.

The effects of agricultural chemicals should be examined with regard to their effect on nearshore systems. There is very little control of the use of chemicals in agriculture and runoff in times of heavy rain is a particular problem. Soil erosion associated with road and home construction, upland deforestation, and marina construction is also a threat to coral and other sea life. Sedimentation derived from adjacent development can smother reefs and sea grass beds, rendering them lifeless and unable to support either sea turtles or commercially important fish or shellfish. Degradation to the marine environment from sedimentation on the leeward side of Antigua is now being observed, and a number of lagoons and semi-enclosed bays are viewed as vulnerable. Central sewage treatment is lacking in Antigua and Barbuda. Most domestic sewage is handled by individual septic tanks with drain fields to the porous limestone rock. Raw sewage is discharged from a nonfunctional private plant at McKinnons' swamp. High bacterial levels have already been documented in some areas. A recent study done by a local secondary school found very high levels of fecal coliform bacteria in Dickenson Bay. Finally, the potential for water pollution caused by seepage from the landfill (Union Dump) in Antigua, situated near The Flashes wetland west of St. John's Harbour, should be assessed.

The continuous flow of ocean currents past the islands is this country's great salvation. The minor nature of the marine pollution problems of Antigua and Barbuda is more the result of luck than of foresight. The Fisheries Act and the Dumping at Sea Act have yet to be tested by a severe environmental crisis. However, this country still has the rare opportunity to avoid the dreadful consequences of such a crisis by observing where other more industrialized countries have gone wrong. This opportunity must not be allowed to slip by. Antigua and Barbuda still have some of the most pristine marine habitat in the Leeward Islands, an environment which must be kept that way for the health and economic future of all. Vigilance is paramount. Unacceptable levels of degradation are sure to occur in Antigua and Barbuda if pollution and other threats to marine and coastal habitats are not met with an aggressive plan for maintaining a clean environment.

In addition to pollution, there has been some physical damage to marine habitats important to sea turtles. Dredging has been limited in the last 50 years to three major areas and has heavily modified at least one site, namely Jolly Harbour. The other two areas are St. John's Harbour, which was redredged in 1990-1992, and the new U. S. naval small boat facility at the eastern end of Ely Bay at the U. S. Naval Facility. The St. John's dredging has in itself had little impact on the ecology of the harbour but, as stated above, the harbour has been heavily polluted for some time. The run-off of sluice from the dredged material has considerably degraded the Flashes and the neighbouring leeward shallows in Five Islands Harbour because it has caused sedimentation of the coastal area and its environs; this is still occurring. The U. S. Naval dredging caused some downstream silting, but the damage to coastal reefs and sea grass is believed to have been minimal. This dredging was the subject of a minor dispute between the governments of the U. S. and Antigua and Barbuda, especially as it involved the only known underwater blasting to have occurred since 1978. The Historical, Conservation and Environmental Commission executed an EIA on the project and deemed the dredging and blasting to have caused little or no permanent substantive damage.

Physical damage to coral reefs as a result of anchoring by yachts and other vessels appears to be considerably less than in many other areas of the Eastern Caribbean. Several rea-

sons for this exist, but the main reason is that most anchoring sites are traditional and have been used as such for decades. These sites are mainly restricted to sand or mud bottom or to areas of sea grass. Little or no anchoring has been observed in coral. Similarly, anchor damage to sea grass appears neither widespread nor severe. Anchoring in coral or sea grass habitat should be actively discouraged, since these habitats are very important to the survival of sea turtles and to many species of commercially important fishes and shellfish. In contrast, the large number of fish pots in use by local fishermen have caused extensive damage to coral reefs in some areas. Pots are sometimes dropped directly on reefs, resulting in breakage and scarring. Damage of this type was observed during a SCUBA survey of the North Sound peripheral islands in October 1992 (William Alevizon, OAS consultant, pers. comm., 1992).

3.2 Disease or Predation

A potentially fatal tumor disease known as "fibropapilloma" has been observed in green sea turtles in local waters. The disease afflicts green turtles in many areas of the Wider Caribbean, notably Florida, although it has been observed as far south as Curaçao (Jacobson, 1990). The disease was first noted in Antigua and Barbuda in 1978, and approximately four local cases (adults and juveniles) have been observed since then (J. Fuller, pers. obsv.). The cause of this debilitating and often fatal sea turtle disease is unknown. It is important that turtles showing any sign of tumor-like growths, sometimes resembling large warts, be released immediately. Sick turtles should under no circumstances be marketed or eaten. WIDECAST has provided the Fisheries Office with photographs of afflicted turtles for reference.

In the absence of data to the contrary, natural (non-human) predation of sea turtles of all sizes is assumed to be normal and within acceptable limits. Knowledge of survivorship must become a high priority objective for future work, or the status and population trends of Antigua and Barbuda sea turtle populations can never be evaluated. Predation of eggs and hatchlings on the beach is expected, but has not been fully documented. Mongooses are known to consume turtle eggs on Guiana Island and Long Bay. Fishermen report that mongooses used to be a significant predator on hawksbill eggs laid at Windward Bay and Pigeon Point beaches (Veronica Michael, EAG, pers. comm., 1992). Ants, ghost crabs, and night herons are also a problem on some beaches. Dogs are potential egg and hatchling predators on both Antigua and Barbuda.

Juvenile and adult turtles are taken by sharks at sea. This is particularly obvious with hawksbills, which quite commonly are found inside large tiger sharks brought in by local fishermen (Joseph et al., 1984; Lucien Barreto, pers. comm., 1992). For example, Nicholas Fuller caught a 13-foot tiger shark in June 1975 which contained the shell from an adult hawksbill turtle. More recently, Archie Bailey caught an 800 lb tiger shark in August 1992 which contained the head of a hawksbill turtle. Lucien Barreto reports watching tiger sharks come into shallow water and grab hawksbills sleeping in the reef.

3.3 Over-utilization

Over-utilization is sometimes viewed as highly subjective; that is, it depends on the viewpoint of the observer. This subjectivity must be removed from the equation. Either sea turtles can maintain their population numbers at a given level when subjected to a certain level of

fishing pressure, or they cannot. If populations are declining below replacement levels, then over-utilization is occurring and regulation should be given high priority. While we lack precise data on historical and modern population levels, we know, based on the accounts of many long time residents and older fishermen who have watched the numbers of foraging and nesting turtles decrease over the years that sea turtles have declined over the course of the twentieth century in Antigua and Barbuda. It is therefore logical to conclude, especially lacking any evidence of widespread disease or excessive depredation, that sea turtle stocks have been over-exploited by man. The evidence available to us shows unequivocally that turtles have been harvested for centuries without regard to the size of their populations or their natural rates of replenishment. Eggs, juveniles, and adults have all been taken. The persistent loss of the latter is particularly damaging to the stability of wild populations (section 4.233).

Both resident and foreign fishermen have a long history of taking sea turtles from Antigua and Barbuda. Rebel (1974) wrote that sea turtles had declined "greatly", adding that "hawksbill and green turtles are caught in nets year around, and a few are turned when they nest. Eggs of these two species are also taken. All products are for local consumption." He listed the following figures for turtles landed in Antigua in the 1940's: 40 in 1943, 79 in 1944, 68 in 1945, 46 in 1946, 116 in 1947, and 53 in 1948. Sources later quoted in Cato et al. (1978) confirmed that "both greens and hawksbills nested in small numbers on Antigua, but that numbers were declining steadily." The decline was attributed to illegal harvest during the closed season (then June to September) and ineffective law enforcement. There was apparently no turtle export from Antigua at that time. All products were consumed locally, being sold primarily to hotels for about EC$ 2.00 per lb (viscera and red meat combined) [N.B. US$ 1.00 = EC$ 2.70 in October 1992]. The annual harvest in Antigua was not given, but the annual harvest in Barbuda was estimated at 150 turtles for export and as many as 3000 for domestic markets (in the latter case, 500 turtles was considered "more probable"). Hawksbill shell (tortoiseshell) buyers from Martinique, St. Lucia, and Guadeloupe visited Barbuda three times each year, "usually paying EC$ 7-8 per pound for the shell" (Cato et al., 1978).

Meylan (1983) reported that, in Barbuda, "heavy exploitation has continued, and possibly increased, since [Cato et al., 1978]. Turtles are captured to provide meat for hotel restaurants in Antigua and Guadeloupe, and to a lesser extent, in St. Thomas and Puerto Rico. During the winter season live green turtles are flown out several times a week on cargo planes that come to Barbuda to pick up lobsters. Most of these are subadult and adult green turtles; juvenile turtles are kept for local consumption. A resident who coordinates the export business reported that "several hundred" are exported annually. Turtle carapaces and tortoiseshell are also exported." She stated that turtles were caught by both net fishermen and lobster divers, and that a single fisherman may set as many as 11 nets. "Turtles are also chased with outboard-powered boats and captured by hand. … Turtles and eggs are routinely taken from nesting beaches. Surveillance for tracks is carried out by boat, incidental to other fishing activities." (Meylan, 1983).

As for Antigua, Meylan (1983) concluded that there were about 12 fishermen setting nets for turtles and that the number had been higher in the past. Catch records were not kept, but "in 1980 a turtle fisherman at Urlings reported catching 50 turtles in 1978, and a total of 20 (16 green turtles, 4 hawksbills) between October 1979 and late April 1980. As elsewhere in the region, turtles are caught to an increasing extent by spearfishermen who are diving for lobsters,

reef fish and conch. A large percentage of the turtle meat available on the island is sold under contract by the fishermen to hotel restaurants. Some meat is sold in the villages at US$ 0.80 per kg. Tortoiseshell is worked locally and is marketed in tourist shops in St. John's. It is also exported raw. In 1980 the price paid to fishermen for raw shell was US$ 12 per kg. Shell buyers go directly to the fishermen's homes to purchase it. Whole polished carapaces are sold to local souvenir shops. Because of the high value of turtle products, turtles are usually captured on the nesting beach whenever they are encountered. The meat and shell of an adult hawksbill that had been caught at Galley Bay in June 1979 brought the captor US$ 111. Residents of Five Islands Village used to hunt for turtles regularly on the beach, but they do so rarely today, presumably because so few turtles emerge."

The following year, Joseph et al. (1984) estimated that 150 green turtles, 250 hawksbills, and one leatherback were landed by local fishermen in 1982 (nation-wide) at St. John's, Parham, Valley Church Bay, Old Road and Codrington. The turtles were caught between August and April using nets. The report did not specify the number of fishermen involved. Today the number of professional fishermen who depend on sea turtle for a significant proportion of their annual income does not exceed three individuals. Turtles caught are generally not sold to the public, but rather to private contacts for personal consumption. Turtle meat is rarely available in the meat market. A few local restaurants in Antigua still offer sea turtle during the open season. In June 1992, WIDECAST sent a letter to the Mill Reef Club explaining the endangered status of Caribbean sea turtles and asking that turtles be removed from the menu selection. At a subsequent meeting, the Club's Board of Directors agreed to discontinue all turtle menu items. The Hawksbill Hotel has also agreed to remove sea turtle from its menu.

The number of turtles currently harvested each year is not known, but we estimate it does not exceed 50 turtles and probably does not exceed 30, greens and hawksbills combined. An unknown proportion of these are nesting females (we estimate that fewer than 100 hawksbills nest annually). Leatherbacks are rarely killed. The take, whether in nets or from the nesting beach, is probably largely opportunistic. Only two or three men target turtles with nets designed for this purpose. The meat sells for US$ 1.37/lb in the market (November 1992) and is occasionally announced on the radio when available. Turtle penis soaked in gin is readily available in some bars and turtle eggs are made into a popular rum drink (Meg Hoyle, pers. comm., 1992). In addition to direct harvest, turtles are sometimes speared, probably mostly by thoughtless tourists. Take incidental to longlining and other commercial fisheries is a continuing problem (see section 3.5). In an unusual case, a tagged female from the Pasture Bay nesting beach was captured in September 1992 by a construction crew on Long Island after she became trapped in a foundation hole. The crew reported that the turtle was dead when found and was butchered for her meat.

Veronica Michael (Environmental Awareness Group) spoke with fishermen in the English Harbour community on 18 October 1992 to clarify the current status of sea turtle harvest in that area. Interviewees were aware of and sensitive to the sea turtle's plight. In some cases, the men mentioned that they had caught tagged hawksbill turtles and, realizing that there was something special about these particular animals, had always released them. They were under the impression that these turtles had been tagged in Puerto Rico or the U. S. Virgin Islands. No supporting documentation for this contention is available. When asked how turtles used to be

caught in the English Harbour community, those interviewed said they rarely set nets for turtles at sea because nesting females (probably hawksbills) were predictable at nearby beaches and it was easier to hunt them there, usually during the half-moon in July and August. Four or more turtles could be had per night at Windward Bay, fewer at Pigeon Point. Occasionally a turtle would become entangled in a seine, or grabbed while resting under a ledge in shallow water.

Interviewees were aware of the nesting cycle and would plan their hunting trips with this information in mind. Some reported that visible "tracks in the sky" led them to the nesting turtles, a claim widely heard in the Caribbean. Eggs were also taken (and to some extent still are), but generally not the entire clutch. Sometimes a fish pot would be inverted over the nest to protect the remaining eggs from mongooses. The meat was shared within the community (not brought to market); shells were sometimes sold. The blood was drunk for medicinal reasons, usually in cases of asthma. Today the harvest has ended because the turtles are too rare on the beaches to make the effort worthwhile. There was a clear consensus that sea turtles, at least nesting hawksbill populations, had steeply declined in the English Harbour area. The fishermen were quite interested in supporting EAG conservation efforts, such as by reporting sightings. The EAG hopes to involve selected fishermen in EAG-sponsored surveys of English Harbour area beaches (see section 4.291). Unfortunately, the concern shown by the interviewees is not yet enough -- two hawksbills were netted and killed on 16 October 1992 in Falmouth Harbour.

Joseph et al. (1984) estimated that 2500 eggs were collected in 1982 (nation-wide) for "subsistence use". That number is now perceived to have been a gross underestimate. We believe that the number of eggs collected illegally each year exceeds 5000, the equivalent of some 40 clutches from all beaches combined. Informants estimate that roughly half of all eggs laid on Barbuda are stolen each year. Sea turtle eggs used to be available in the public market, but their possession and sale is now illegal. Eggs are consumed by the finder, shared amongst friends, or sold on the black market. Mr. Benjamin from Bolans village was selling leatherback eggs clandestinely for EC$ 3.00/dozen in mid-1992 ('Bushy' Gonzalez, pers. comm., 1992). As a result of the persistent take of both sea turtles, especially adult turtles and large juveniles, and their eggs, declines have been noted in both the number of turtles caught in Antigua (Rebel, 1974) and in the number of turtles nesting in general (Cato et al., 1978). There are several beaches where sea turtles once nested but do so no longer (Table 1). This fact represents a significant loss to the people of Antigua and Barbuda, for the reappearance of nesting females has never been observed anywhere in the world on beaches where the native population was exterminated.

The sale of tortoiseshell jewelry and trinkets is no longer as common as it was in the past. The few merchants who still offer these products are aiming at the tourist market. Items are small and include money clips, earrings, and bracelets. The turtles are captured locally and items are fashioned by local artisans. Shells are probably sold secondarily to the primary commodity which is meat. Karen Eckert visited 12 tourist-oriented boutiques (chosen more or less at random and encompassing a range of products and prices) in St. John's in October 1992 and found two stores selling tortoiseshell items. At Bailey's Treasure Cove two money clips were priced at EC$ 25 and 30, earrings (three pair) were EC$ 30/pair, and two bracelets sold for EC$ 25 each. The clerk was unaware that turtles were endangered and said that tourists buy the products quite regularly. Joannette's Boutique had eight pairs of earrings and one finger ring for sale at US$ 5

each. The Joannette's clerk was new and did not know whether the objects were purchased from local artisans or imported, nor whether they sold well to consumers.

In addition to retail sales in St. John's, a variety of jewelry was found offered for sale in October 1992 at the Galley Boutique in the Nelson Dockyard National Park. The items were all purchased 12-15 years ago from a local artisan (now deceased) and had sold extremely slowly. Prices (US$) were: 2 upper arm bangles $12 ea; 2 neck chokers $15 ea; 3 wide bracelets $16 ea; 1 medium bracelet $12; 1 slender bracelet $5; 1 child's bracelet $7; 4 hair combs $12-13 ea; several pairs of earrings $12 ea; numerous pendants, small charms, and miscellaneous items $6-12 ea. With the exception of the hair combs, all of the Galley Boutique items were graciously donated by owner Janie Easton at the request of WIDECAST to the Museum of Antigua and Barbuda for use in a display to educate residents and tourists about endangered sea turtles.

Retail sale of whole shells is relatively rare. In September 1990, two polished hawksbill shells were offered for sale by a St. Mary's Street sidewalk-vendor. They were approximately 8 and 10 inches (20-25 cm) in length and priced at US$ 20 and 30 (Carla Melucci, pers. comm., 1992). In July 1992, the wares of a sidewalk-vendor near Heritage Quay included the polished shell of a locally caught juvenile hawksbill for the price of US$ 15. The shell was about 30 cm (12 inches) in length (Wendi Webber and Ximena Prudencio, pers. comm., 1992). In November 1992, both the shells of juvenile hawksbills and their scutes were found for sale in St. John's; the latter sold for EC$ 40/lb (Meg Hoyle, pers. comm., 1992). Jerry Hazelwood, a local diver, reported seeing "recently" whole shells for sale to tourists, including at stores at the airport, for about US$ 100. This could not be corroborated by the authors.

In addition to domestic sales, the commercial export of large amounts of shell is a serious and continuing threat to hawksbill turtles throughout the Wider Caribbean. According to Japanese Customs Statistics, a significant proportion of shell received by importers in Japan originates from Antigua and Barbuda. Based on an average yield of 1.34 kg of shell scutes ('bekko') per turtle (Milliken and Tokunaga, 1987), exports from Antigua and Barbuda totalling 3,354 kg (1983-1986, 1990) represent some 2,500 hawksbills! We do not believe that this level of harvest actually occurs in national waters. We believe that because Antigua and Barbuda is not party to CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora), unscrupulous traders have occasionally indicated "Antigua/Barbuda" as the point of origin for hawksbills exported illegally from elsewhere (section 4.31). The number of locally caught turtles that enter into international commerce is not known.

It can safely be said that no Antiguan or Barbudan would, at the present time, consider sea turtle to be an important part of his/her diet; many would not notice its absence were it to become unavailable. Nor are residents likely to mourn the absence of trinkets made from turtle shell. Regarding fishermen still partially dependent on turtles, it is anticipated that the loss of income derived from turtles (should all harvest be banned) will be compensated by directing the effort previously allotted to turtles to catching fish. Those who take special pleasure in consuming sea turtles and their eggs are relatively few in number and could also be reached on a person to person basis. With this in mind, it is a recommendation of this Recovery Action Plan that the new fisheries regulations be immediately amended to provide protection to nesting turtles and large juveniles (section 4.23), and that a full moratorium be implemented as soon as possible.

The opportunity for a national moratorium on the taking of sea turtles in Antigua and Barbuda appears to be a real possibility. Many of the turtles harvested in Antigua and Barbuda are taken not by professional sea turtle fishermen but by divers in pursuit of a wide variety of game and by occasional individuals catching turtles for sport. These people earn their primary income from sources other than turtle. A ban on the harvest of sea turtles may injure their sense of personal choice, but not their livelihoods or their ability to feed their families. A moratorium has been recommended by the fisheries officer for the Organization of Eastern Caribbean States (OECS) as an emergency measure for recovering sea turtles in OECS waters. In addition, the recent adoption of the Annexes to the Protocol to the Cartagena Convention concerning Specially Protected Areas and Wildlife will ultimately require a moratorium on the capture and sale of turtles and their eggs since all six Caribbean sea turtles are listed on Annex II (see section 4.32).

3.4 Inadequate Regulatory Mechanisms

Regulatory mechanisms are inadequate and in certain cases nonexistent relative to the protection of sea turtles and their nesting and foraging habitats. The Fisheries Regulations of 1990 protect small juvenile turtles and establish a closed season, 1 March-31 August (section 4.21). There are three serious deficiencies in these regulations. First, the most important size classes to protect are the large juveniles and breeding adults, not the small turtles. Second, size limits should be expressed in shell length so that the legality of the catch can be evaluated prior to land fall. Third, the closed season does not encompass the entire breeding season. It is imperative that the adult turtles be protected at all times, on land and at sea. Breeding females are quite old (20-30 years) before they nest for the first time, and they are expected to lay eggs for decades. Their loss is sorely felt since they are difficult for the population to replace once they are gone. Because the majority of hawksbills are still nesting when the season opens on 1 September, some three-quarters of the entire breeding population in Antigua and Barbuda could be legally exterminated under the present law. This is clearly an unacceptable reality, and regulatory changes are needed (section 4.23).

Poaching is a serious regulatory problem for several reasons. First, fines for turtle violations have only recently become commensurate with the gravity of the offence (section 4.25). Second, no infraction of a wildlife protection law has ever been successfully prosecuted or even brought to court in Antigua or Barbuda. Therefore, there is no precedent in this country for enforcement of conservation laws, because the issues have never been raised. Third, the resources for effective law enforcement are not available. In addition to increasing the fines levied for violations of sea turtle protection laws, a willingness to prosecute illegal actions is needed, as well as a commitment of resources to do the job. There is a very small Fisheries Division; more wildlife law enforcement officers are needed. Currently there are insufficient funds to meet salaries for wardens and not a single boat or plane available for surveillance. Since wildlife and fisheries conservation is an expensive undertaking for the government, a financial commitment will be needed for this endeavour. Equally important is the cultivation of a sound conservation ethic on the part of the citizenry with regard to the protection of turtles and their eggs.

Regulatory mechanisms are also needed to protect critical habitat. It is important that sea turtles have adequate nesting beaches on which to lay their eggs, or all other efforts to protect them will be rendered superfluous. As previously stated (section 3.1), sandy beaches represent a

prominent and valuable natural resource in Antigua and Barbuda. Therefore, the only hope for protecting critical nesting habitat is to protect these beaches for economically understandable reasons and thereby achieve conservation goals as well. Unfortunately, there are no clear government directives for protecting wildlife habitat as part of larger development programmes. In the case of sandy beaches, there is some question concerning public versus private ownership. There is a widely held belief among Antiguans that all sandy beaches are public property, but, in reality, legal public access only extends to the mean high water mark. Rules of access and ownership of the beach above and below the water mark must be clarified before cooperative agreements for the conservation of sea turtles can be reached with concerned parties. An integrated and unambiguous national coastal zone management plan is long overdue.

In addition to establishing an integrated process for development planning at the government level which includes and encourages environmental input, the conservation and protection of sea turtle nesting habitat would be greatly assisted by building cooperative conservation programmes with private beachfront property owners and the building code authorities (i.e., the Development Control Authority for Antigua and the Local Council for Barbuda). Table 1 provides the specifics of ownership for property immediately behind nesting beaches. A very successful private initiative has already been established with the Jumby Bay Resort on Long Island, where a sea turtle conservation, research, and education programme based on a local colony of nesting hawksbills is underway. A detailed management plan for this regionally important nesting beach is being developed (see section 4.122).

Antigua and Barbuda's development control regulations (e.g., zoning) must be responsive to the conservation needs of its natural resources. Attached to all development approvals should be a set of conditions regarding ecological impacts of development that must be followed by the developer. This is particularly needed for projects that are financed with foreign capital, because plans drawn up in remote foreign countries are usually not responsive to the special needs of Antiguans and Barbudans to protect their vanishing natural resources. The involvement of all Antiguans and Barbudans, private individuals as well as government officials, is necessary to establish development plans and regulations. To facilitate this involvement, a mandatory period of public review should precede final consideration and decision by Government regarding coastal development projects. Local conservation groups and concerned individuals should be encouraged to comment on development proposals that affect sea turtle nesting beaches. This process stimulates conservation participation by the public, a process frequently missing.

The central government has recently established a Historical, Conservation and Environmental Commission whose role it is to advise the government on matters relating to government policy, including issues concerning the natural and cultural heritage of the islands. The Commission is a non-statutory body, and its recommendations are not binding. It is a recommendation of this Recovery Action Plan that the Commission be involved in decisions regarding major construction, especially coastal construction, prior to permission being granted to the developer. The recently completed Country Environmental Profile (CCA, 1991) suggests "providing the Commission with substantive coordination/integration responsibilities, both for recommending environmental policy across departmental lines and for establishing procedures for monitoring the environmental impacts of development activities". The resource management sector's regulatory framework would be strengthened considerably by improved coordination.

3.5 Other Natural or Man-made Factors

Additional problems, natural or man-made, include beach debris and obstacles, hurricanes and other violent storms, boat strikes, entanglement at sea, and incidental or accidental catch. An adult leatherback emerged to nest at The River (Barbuda) in 1979, became entrapped by debris, and died of exposure (Meylan, 1983). During Hurricanes Hugo and Gabriel (1989), seven hawksbill nests were affected on Pasture Bay, Long Island. Four were destroyed and three were partially destroyed (Lynn Corliss, 1989 Field Director, Jumby Bay Hawksbill Project, pers. comm.). Three hawksbills are known to have been struck by fast-moving boats in 1992. A wind surfer struck a sea turtle in nearshore water in June 1992. One of the nesters at Pasture Bay (Jumby Bay Resort) is characterized by an old wound that clearly resulted from a hard blow to the posterior of the carapace, perhaps a boat strike. Small hawksbills (5-10 lb) are occasionally found inside fish pots in the waters of Barbuda in 10 fathoms of water.

Incidents of entanglement are probably numerous, but documentation is scarce. A big green turtle, perhaps 100 lb, was recently found entangled in a buoy line on the north side of Barbuda. In 1979, a leatherback was entangled in the cable of a lobster-pot; the fishermen brought it back for exhibition, charging 25 cents per look before it died. In 1986, another leatherback was found entangled in the cable of a lobster-pot, this time east of Antigua. In February 1992, a leatherback became entangled in buoy lines delineating a swimming area at Dickenson Bay; she was released alive. Large loggerheads, larger than are observed in local waters (see section 2.1), are periodically found entangled and adrift, having presumably been transported from more distant waters. One such individual was found off the north side of Green Island, Antigua, in 1987 tangled up in what appeared to be cargo netting and palm thatch. Marks on the neck and flippers suggested rope burns. At about the same time, another large juvenile was found tangled in a "Japanese net" (heavy green fiber net) off the east coast of Barbuda. A decade ago, a local fisherman told Meylan (1983) that on several occasions he had found loggerheads floating at sea entangled in pieces of netting. He attributed it to the presence of Japanese fishing boats in the area.

Incidental catch is a persistent problem, especially with longlines but also occasionally in trammel nets in coastal waters. Loggerhead and leatherback turtles are the two species most commonly associated with incidental capture on longlines; hawksbills and green sea turtles are rarely caught. A leatherback was reported entangled in a fishing net in August 1992, although no further details are available. Lucien Barreto, a local Antiguan longliner, caught nine juvenile loggerheads in one set in March 1991 about 35 miles northeast of Antigua. Longlines are baited with squid and "Pacific pike", set at night, and retrieved in the morning. Turtles are typically recovered alive and cut loose with the hook still lodged in the throat or mouth. The nine turtles captured at one time was the most Barreto had ever seen, although he catches "a few" leatherbacks and loggerheads every year. The full extent of the incidental catch problem in Antigua and Barbuda is unknown. Barreto is one of only two longliners registered in Antigua, yet there are many other boats of various nationalities fishing in Antiguan waters without permission or supervision of any kind. Antiguan law enforcement is inadequate to cope with the problem. The annual incidental take of sea turtles in Antigua/Barbuda waters is estimated to be 100 or more (see section 4.27), but the actual number will not be known until on-board observers are provided to monitor the fishing activity of foreign boats in Antiguan waters.

IV. SOLUTIONS TO STRESSES ON SEA TURTLES IN ANTIGUA/BARBUDA

4.1 Manage and Protect Habitat

It is intuitive that enacting and enforcing a regulatory framework for the protection of sea turtles and their eggs is only the first step in our commitment to the survival of these gentle creatures. Important foraging and nesting habitats must also be afforded protection. Every effort should be made to minimize present and potential threats to nesting beaches, including sand mining and careless coastal development. Similarly, the sustainable management of foraging habitat entails the protection of coastal and offshore waters from industrial and agricultural pollution, solid waste disposal, and destructive practices such as anchoring and dredging. Maintaining the integrity of the marine environment, including coral, sea grasses, and mangroves, not only benefits turtles but also the commercial fishing industry. In addition, a pristine marine environment enhances tourism, which is a major source of income to Antigua/Barbuda, earning 80% of total foreign exchange (CCA, 1991). In the sections that follow, the identification of habitat important to turtles is discussed, as are recommendations and mechanisms for the longterm preservation of these habitats. Recommendations are underlined for ease of reference.

4.11 Identify essential habitat

No systematic surveys of sea turtle foraging or nesting habitats have been initiated at any of the three main islands (Antigua, Barbuda, Redonda) that comprise the nation of Antigua and Barbuda. Many sandy beaches are found on Antigua and Barbuda, and habitat suitable for sea turtle nesting is estimated to extend over 102 km of coastline (Joseph et al., 1984). In contrast, Redonda's coastline consists of vertical cliffs and is not conducive to sea turtle nesting. Sea turtles regularly feed in the sea grass meadows and coral reefs which surround, to varying degrees, all three islands. In order that effective conservation and management decisions can be made concerning endangered sea turtles, it is a recommendation of this Recovery Action Plan that priority be given to surveys undertaken specifically to identify locally important nesting and foraging habitats. The information currently available is summarized below.

4.111 Survey foraging areas

There are large areas of shelf habitat (7-50 fathoms) surrounding Antigua and Barbuda that are characterized by a coral reef/sponge ecosystem. This habitat should be considered very important for sea turtle foraging, particularly to hawksbills which feed primarily on reef-associated sponges (see section 2.3). Redonda is surrounded by deep water and provides nearshore rocky habitat and associated corals, also potentially useful for hawksbill foraging. In addition, healthy sea grass meadows virtually surround Antigua and Barbuda and are essential to the survival of green turtles (see section 2.2). Potentially important areas, especially for hawksbills, are indicated in Figures 5 and 6, which illustrate the approximate distribution of coral reefs around Antigua and Barbuda, respectively. There are no comparable maps of sea grass distribution. Resource atlases developed by the ECNAMP project (ECNAMP, 1980) significantly underestimate the extent of sea grass in the country, especially around Antigua.

Long-term planning for the protection of important habitat is not possible until such habitats have been identified. It is a recommendation of this Recovery Action Plan that systematic study of marine habitat use by turtles be undertaken as soon as possible. In the meantime, the continued support of fishermen and divers in reporting sightings and anecdotal information is appreciated and encouraged. At-sea sightings data should be cataloged and updated by a single organization, perhaps by the Museum of Antigua and Barbuda (the Museum is an active participant in the WIDECAST network), since the Museum is already involved in cataloging cetacean sightings data. Sea turtle data should be made available upon request to fisheries personnel, non-government groups, and other interested parties. Until more detailed knowledge is available, it should be assumed that all healthy sea grass meadows and coral reefs are potential foraging grounds for sea turtles and, as such, should be managed with care and foresight.

4.112 Survey nesting habitat

Antigua and Barbuda host a combined 102 km of available nesting beaches, 26 km on Antigua and 76 km on Barbuda. Of this, 73 km are undeveloped, mostly on Barbuda. The remaining 29 km are developed, heavily frequented by people, and located primarily on Antigua. The 26 km of Antigua's sandy shoreline is broken into numerous small beaches within protected bays because of the deeply indented nature of the Antiguan shoreline. These beaches are suitable for turtle nesting to various degrees, depending on substrate, supralittoral vegetation, the frequency and presence of people on the beach at night, the presence of artificial lighting, and shoreline development. Known or suspected nesting beaches are summarized in Table 1 and in Figures 3 and 4.

A well-orchestrated field survey of sandy beaches is necessary in order to test the accuracy of the often anecdotal data summarized in Table 1. Records should be cataloged, corrected and updated by a single organization. This clearing house has not yet been established, but may logically be either the WIDECAST County Coordinators (John and Sarah Fuller; see section 4.53), the Museum of Antigua and Barbuda, or the Fisheries Office. It would be very useful if an interested group, such as the Environmental Awareness Group, would sponsor ongoing surveys whereby members living on or near beaches agreed to conduct morning walks daily (or at least 3-4 times weekly) and document nesting crawls. Programmes of this type must be preceded by training workshops for participants so that no wildlife laws are violated and data are accurate with regard to species identification (species can usually be determined from crawl and nest characteristics; see section 4.291). WIDECAST personnel in the Wider Caribbean region are available to conduct training workshops upon request. Once important nesting areas have been identified, area-specific management plans should be developed (see section 4.12).

It is a recommendation of this Recovery Action Plan that, as a top priority, surveys of three potentially very important hawksbill nesting grounds be conducted; namely, Sandy Island, Pearn's Bay beach group, and the Mill Reef beaches on Antigua. Volunteers, student interns, or hired personnel should spend a minimum of three weeks on each beach conducting early morning daily surveys to count crawls, identify species (on the basis of crawl characteristics), and, if possible, make a judgment on whether or not eggs were laid. Full coverage during peak hawksbill season (June-December) is ideal, but not necessary for the time being. Because full-season (six month) nesting surveys are available for the last seven years (1986-1992) at Pasture

Bay, an accurate 18-day subsample in late July and another sample of similar length in early October would be sufficient to estimate the annual number of nests and nesting females at these three sites. Periodic follow-up patrols to record nest loss (e.g., predators, poaching, erosion) and, after 55-70 days, nest emergence success would also be desirable. For details concerning beach monitoring, see section 4.291.

Barbuda is a very important island for nesting sea turtles, both hawksbill and green. A one-day survey conducted by John Fuller on 8 August 1992 from Palmetto Point north to Billy Point revealed 30 hawksbill crawls. It is a recommendation of this Recovery Action Plan that nesting surveys of Barbuda beaches be a high priority, conducted either from the air or by ground transport. It is not clear at the present time which beaches are most important for hawksbills; it is very likely that the entire island provides essential nesting habitat. If surveys reveal concentrated nesting, an intensive nocturnal tagging and research programme similar to that ongoing at Pasture Bay, Long Island, should be considered. A half-dozen aerial surveys of the east coast in July and August should clarify which beaches are most important to green turtles. The best green turtle nesting beaches are expected to be in Two Feet and Welch's bays. Given the importance of Barbuda to sea turtles, we recommend that consideration be given to declaring Barbuda a Sea Turtle Refuge, as discussed in the following subsection.

4.12 Develop area-specific management plans

Once important foraging and nesting areas have been identified, the next step is to devise management plans that address site-specific threats and conservation needs. "Management" can involve a wide array of options, from simply enforcing existing regulations banning or restricting the take of turtles and eggs to manipulative options such as the establishment of a hatchery for eggs threatened by erosion or feral animals. It is a recommendation of this Recovery Action Plan that local authorities initiate studies designed to contribute to area-specific management plans for important foraging and nesting areas. Common problems that often need to be addressed are sand mining (section 4.131), pollution, sewage and garbage disposal (sections 4.143, 4.144, 4.146), artificial beachfront lighting (section 4.132), anchoring and dredging (section 4.147), and the construction of sea walls and jetties (section 4.133). These activities should be closely monitored and evaluated in important foraging and nesting areas. Guidelines for many management techniques, such as hatchery construction, are available in the Western Atlantic Turtle Symposium Manual of Sea Turtle Research and Conservation Techniques (Pritchard et al., 1983).

Jumby Bay Resort is currently developing the first management plan with regulatory guidelines for a sea turtle nesting beach in Antigua and Barbuda. Protection and management of nesting habitat, protection of the nesting turtles and their offspring, and control measures for beach lighting and disturbance by resort guests will be included in this plan (section 4.122). The success of the Pasture Bay beach management plan by Jumby Bay Resort will establish a precedent for other private initiatives. Several beachfront developments (e.g., Mill Reef) are potential candidates for a "Jumby Bay-style" management plan, but these beaches must first be surveyed to determine which would profit most from such a management plan. Area-specific plans for protecting nesting turtles on public beaches should also be considered, although threats will, to some extent, vary between public and private beaches. Legal and illegal take of nesting turtles and their eggs is the biggest challenge for public beaches, while lights, beachfront devel-

opment, and harassment pose the most serious threats on developed, private beaches. It would follow that surveillance and law enforcement are the actions most needed on public beaches. In all situations, care should be taken not to disrupt nesting and hatching turtles.

In view of the importance of Barbuda to nesting sea turtles, it is a recommendation of this Recovery Action Plan that the entire island of Barbuda be declared a Sea Turtle Refuge. The designation could be accomplished under the Barbuda Local Government Act of 1982, which gives the Barbuda Council power to declare protected areas and accompanying regulations. Refuge regulations should include all those summarized in section 4.122 (and expounded upon in more detail in subsequent sections) and should apply to all sandy beaches. Environmental impact assessments and a period of public review should be required prior to approval of coastal construction projects (as should be the case throughout the country). A conservation officer or warden should be appointed in order to ensure compliance with regulations. The residents of Barbuda live close to the land and have a strong conservation ethic. Care should be taken to discuss the idea openly with residents prior to any decision being made on the part of Government. The support of residents will be central to the success of the Refuge.

With regard to protecting marine habitat, there are two marine parks and both were established in 1973: the Diamond/Boone Reef complex in Antigua (Figure 7) and Palaster Reef in Barbuda (Figure 8). The first is formally known as "Diamond Reef Marine Park", or "Salt Fish Tail Marine Park" and covers the area of the northwest coast of Antigua, including Salt Fish Tail, Scone Reefs and Diamond Bank. Legislation defines the area to lie within a line connecting at a point at 17°11'06" N, 61°49'30" W and continuing northwards to 17°12'18" N, 61°49' 30" W, then continuing westwards to 17°12'18" N, 61°53'12" W, and finally southwards to 17°11'06" N, 61°53'12" W. Palaster Reef Park covers the area of the southern tip of Barbuda known as Palaster Reef due south of Cocoa Point and Guava Bay. The area is defined as that which lies within a line commencing at a point at 17°31'12" N, 61°44'24" W, continuing northwards to 17°31'54" N, 61°44'24" W, then continuing west-northwest to 17°32'06" N, 61°46' 18" W, then continuing southerly to 17°31'34" N, 61°46'18" W, and finally southeast back to the first mentioned point.

The marine parks were originally established as fish sanctuaries, with no boating or fishing allowed. However, there are no wardens and thus no mechanism for enforcement of Park regulations. It is a recommendation of this Recovery Action Plan that management plans be developed for these areas that provide for the enforcement of Park regulations, with special attention given to conserving endangered species such as sea turtles. The Parks should be surveyed carefully with regard to their importance as sea turtle foraging and refuge grounds and wardens should be employed as soon as possible in order to protect fisheries and turtle resources. In addition to the marine parks, Nelson Dockyard National Park (established under The National Parks Act, 1984) encompasses four important nesting beaches. Thus, we recommend that monitoring of sea turtle nesting activity be implemented as part of the Park's management authority and that a conservation plan be developed that takes into account the special needs of nesting and hatching sea turtles (see section 4.122). Since poaching is still a problem on Park beaches, a resident manager is needed.

4.121 Involve local coastal zone authorities

It is a recommendation of this Recovery Action Plan that (*i*) a communications network with property owners and developers be implemented, (*ii*) voluntary compliance with regulatory guidelines by owners and contractors be encouraged by fiscal incentives, government support, and/or promotional assistance, (*iii*) a liaison between building code authorities, most importantly between the DCA in Antigua and the Local Council in Barbuda, be encouraged, (*iv*) recommenddations for coastal zone ordinances be provided to the appropriate government authorities by the Historical, Conservation and Environmental Commission, and (*v*) a mandatory 60-day period be established for public review and comment of development projects that affect sea turtle and other wildlife habitat (see also section 4.23).

The Development Control Authority (DCA) has absolute authority over construction plans for housing and resort development. Beach lighting or landscaping regulations can be built into the DCA permit process without additional changes to the law. However, once the construction plans are approved, the DCA has no authority *post facto* to require compliance with sea turtle protective measures. Thus, in addition to requiring conservation measures to be integrated into new developments (ideally as a prerequisite for obtaining a construction permit), it is a recommendation of this Recovery Action Plan that there be a legal mechanism to implement mandatory lighting ordinances or other mitigative measures as the technology and understanding of sea turtle biology allows further refinements in management techniques.

When important habitats are privately owned, administrators and land owners should be intimately involved in the design and implementation of sea turtle conservation initiatives.

4.122 Develop regulatory guidelines

It is a recommendation of this Recovery Action Plan that when areas are defined as especially critical to remaining sea turtle stocks, regulatory guidelines should seek to establish a framework within which appropriate land use and development (commercial, recreational, residential) can occur. Development proximal to important nesting beaches should carry the requirement that beachfront lighting be designed in such a way as to prevent the disorientation of hatchlings or nesting adults, the construction of buildings on sand should be prohibited, and natural beach vegetation, woody shrubs, and trees should be preserved for hawksbill nesting habitat (see Ryder et al., 1989, for discussion). The construction of solid jetties and sea walls, and coastal activities such as sand mining and dredging should be regulated in such a way as not to result in the erosion of nesting habitat. We recommend that the following specific guidelines be implemented for nesting beaches and relevant coastal zones throughout Antigua and Barbuda. The recommendations, adapted from Orme (1989) and Eckert (1989), are further expanded in the section(s) referenced in each category.

Sand mining: Sand mining should be prohibited on all sandy beaches. The removal of beach sand disrupts stabilizing vegetation, often seriously exacerbates erosion, and has resulted in the nearly complete loss of some local beaches (section 4.131). Mining pits invite injury to humans and livestock and accumulate water which may serve as a breeding ground for mosquitoes and other unwanted insects.

Artificial lighting: Sea turtles, especially hatchlings, are profoundly influenced by light. Hatchlings depend largely on a visual response to natural seaward light to guide them to the ocean. In zones of coastal development, sources of artificial light distract the young turtles so that they turn away from the sea and crawl landward. It is essential that artificial light sources be positioned so that the source of light is not directly visible from the beach, does not directly illuminate the beach, and/or emits wavelengths (i.e., 560-620 nm) which are least attractive to sea turtles (section 4.132).

Beach stabilisation structures: No permanent impermeable engineering structures, including breakwaters, jetties, impermeable groynes and seawalls, should be placed on the beach or the nearshore zone if it is likely that such engineering structures will promote erosion or the loss of adjoining sandy beaches where sea turtles nest (section 4.133).

Design setbacks: Setbacks should provide for vegetated areas including native coastal vegetation, dunes, and/or lawns between hotels, homes and similar structures, and the beach proper. Setbacks not only help to protect coastal properties from storm damage, but also reduce overcrowding of the shorezone, lessen the likelihood that local residents will be excluded from the beach, and enhance the probability that artificial lighting will not shine directly on the beach (section 4.133).

Access: Access to beaches should be confined to specific locations and strictly regulated so as to minimize destruction of backshore vegetation and beaches by trampling and vehicle use. Motor vehicles should be prohibited on sandy beaches. Whenever possible, access should be provided by elevated walkways built over the primary dunes and positioned to direct foot traffic. Parking lots and roadways (including any paved or unpaved areas where vehicles will operate) should be positioned so that headlights do not cast light onto the beach at night.

Waste disposal: No dumping should be permitted within the nearshore, beach, dune, or coastal wetland (including mangrove) environments. On the beach, discarded glass and metal can injure sea turtles and larger objects obstructing the beach can prevent turtles from finding a nest site. Plastic can block the emergence of hatchlings; lightweight plastic blows out to sea and pollutes the ocean. Trash cans and regular pickup should be provided in all high-use areas. If beach cleanup is necessary, it should be done using hand tools (section 4.134).

Vegetation cover and fires: All attempts should be made to preserve vegetation above the mean high tide line. Creeping vines and other plants stabilize the beach and offer protection against destructive erosion by wind and waves. Larger vegetation can enhance nesting habitat for hawksbills, as well as offer natural shielding for the beach from the artificial lighting of shoreline development. Fires should be prohibited on sandy beaches. Fires are a hazard to the surrounding dry forest, create unsightly scars on the beach, may scorch sea turtle eggs and hatchlings beneath the surface of the sand, and can disorient hatchlings. Beach fires should be restricted to designated grill facilities.

In addition to aforementioned implementing measures for the conservation of nesting habitat, regulations are needed to safeguard important foraging grounds. When surveys determine that specific areas, most likely comprised of healthy coral reef and/or sea grass, are impor-

tant to sea turtles for feeding, it is a recommendation of this Recovery Action Plan that protected area or other conservation status be considered. The two areas designated as marine parks in 1973 (section 4.12) were created primarily as fish sanctuaries that prohibit boating and fishing. Boating need not be banned in sea turtle conservation areas but, at the very least, mooring must be confined to buoys provided for this purpose and enforced regulations should forbid pollution and waste disposal, the collection of plant or animal specimens, spearfishing, and the harassment of native wildlife. An area-specific management plan should be developed for each protected habitat; mechanisms for law enforcement should be clearly defined.

The following regulatory guidelines are recommended by this Recovery Action Plan in order to provide sustainable use of the marine environment by both sea turtles and human beings. These guidelines, adapted from Eckert (1989), are as follows:

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

Waste disposal and general pollution: Comprehensive legislation is needed in Antigua and Barbuda to regulate point and non-point sources of pollution. The Dumping at Sea Act of 1975 provides some protection against the indiscriminate disposal of waste and chemicals at sea (section 4.144). However, land-based sources of pollution, such as industrial facilities, agricultural lands, sewage, and ghauts and storm drains, are largely unregulated and wholly unmonitored (sections 4.143, 4.146). Some serious oil spills have already occurred, such as the April 1990 spill which came ashore in Barbuda, and tar balls are commonplace on the windward beaches of both Antigua and Barbuda (section 4.145). Pollution not only degrades sea turtle nesting and foraging habitats, but turtles ingest tar, plastic, rope, and other substances, presumably mistaking these for food.

Physical destruction of coral and sea grass: Living coral reefs should not be dynamited or dragged with chains. Anchoring should not occur in reef or sea grass areas (see above, and section 4.147). The practices of using chemicals or dynamite for the purpose of stunning fish for harvest should be prohibited at all times and under all circumstances (sections 4.141, 1.142). Specimen collecting and trampling of corals should be actively discouraged. The destruction of coral reefs resulting from these practices can be irreversible in our lifetime. In the absence of the sheltering influence of offshore reefs, shorelines are often severely altered, resulting in great economic losses. Sea grass, too, is profoundly important to coastal ecology, to water clarity, and to commercial and subsistence fisheries. Sea grass is easily degraded and even destroyed by sedimentation, anchoring, dredging, and explosives.

JUMBY BAY RESORT

In recognition that comprehensive guidelines are necessary in order to safeguard important habitat, regulations are currently being prepared at Jumby Bay Resort for the long-term protection of the nationally and regionally important Pasture Bay hawksbill nesting beach on Long Island. The Pasture Bay beach is approximately 200 m in length and supports about 30 nesting females (range 20-40) each year. About 150 nests (range 100-200) are produced annually by this population, with an average yield of 18,000 hatchlings. The nesting beach has been degraded by lights, people, vehicles, improper landscape management practices, and wind erosion. The Jumby Bay Hawksbill Sea Turtle Project, initiated by the Georgia Sea Turtle Cooperative Research and Education Program and WIDECAST-Antigua in 1986, includes research and population monitoring, habitat management, and education. Members of the Jumby Bay Club strongly support the Project and have written stringent requirements both for development in the vicinity of the nesting beach and for behaviour of family and guests on the beach. The *Rules and Regulations of Jumby Bay Club* state:

> The landscape of the Island is very fragile; there is a rich diversity of plant material and wildlife that can easily be disturbed or damaged. The salt air, the constant tradewinds, the lack of water, and the shallow soil depth make it difficult to repair or replace lost vegetation. Pasture Bay is one of the largest remaining breeding grounds for the Hawksbill Sea Turtle and the Island is home to a wide variety of birds. Conservation and protection of the existing landscape and wildlife will have the highest priority in the development of the Island.
>
> > 10. Turtle nesting area: During the Hawksbill Turtle breeding season of June to November, Owners of lots within the turtle nesting impact area may be required to take extraordinary measures to protect the hatching population. These may include turning all lights off at 11 pm or use of blackout curtains or shutters on villa openings toward the sea.
> >
> > Exterior lighting within the impact area will be limited to that which is necessary for safety reasons only, such as step or path lights. These lights must be indirect or concealed source type fixtures. No up-lighting of vegetation or building will be allowed.
> >
> > All Villa Owners must have the responsibility to protect the nesting turtles from being disturbed or molested by their children, guests, or staff.

In addition to concerns with house construction, the Jumby Bay Resort is working toward an aggressive beach management programme to recover degraded nesting habitat. Dr. Jim Richardson, Director of the Georgia Sea Turtle Cooperative Research and Education Program (Institute of Ecology, University of Georgia), Scientific Director of the Jumby Bay Hawksbill Sea Turtle Project, and founding member of the WIDECAST Wider Caribbean Sea Turtle Recovery Team, suggested the following management ideas to Club members at a 28 June 1992 meeting:

Landscape Management Design for Pasture Bay:
A Balance of Needs for Villa Owners and Hawksbill Nesting

Executive Summary:

1. Approximately 60% of hawksbill nesting is in front of private villas and future villa sites, while 40% is in the protected sea turtle nesting area. Important nesting habitat occurs in mixed shrub communities and beach forest, as well as in and under mature sea grape trees.

2. There is no biological or aesthetic reason to prevent the compatible use of Pasture Bay beach by Villa Owners, resort members/guests, and nesting hawksbill sea turtles. However, an aggressive hawksbill management programme is needed to mitigate continuing losses of sand, dwindling nesting habitat, people disturbance, and villa construction.

3. Natural beach vegetation is essential in maintaining the integrity of the sandy beach; note that such vegetation provided a very impressive anti-erosional mechanism against the powerful winds and waves of Hurricane Hugo.

4. Half of the protected sea turtle nesting area is now virtually unusable for nesting because of the extensive width of the beach. Landscape planting is needed to rectify this situation. The other half of this area is prime nesting habitat rapidly reaching carrying capacity for the limited area available for nests and the number turtles using the area.

5. Tidal sand deposited on the front beach and immediately offshore is in dynamic equilibrium with all parts of Pasture Bay beach. If sand-holding vegetation is altered at one location, re-deposition patterns will have repercussions on sand deposits at all other parts of the beach.

6. A net wind-carried loss of sand from the central cul-de-sac of the front beach to areas behind the beach is naturally replaced, in part, by sand brought by waves from the north and east ends of Pasture Bay. As a result, the beach extremities (the north and east ends) are now exposed ledge and cobble unsuitable for both turtle nesting and desirable beach recreation.

7. The overall depth of Pasture Bay beach is reduced from historical size, as evidenced by the pedestals of exposed roots supporting beach palm trees, and there has been a concomitant reduction and degradation of nesting habitat. Sand from the back beach could be relocated to the front beach to rectify this situation, as long as wind erosion has been stopped. Hydraulic or mechanical means are possible.

8. Recently planted sea oats, as an emergency measure, have been successful in stopping wind-eroded sand. However, this exotic grass needs to be replaced with native vegetation as soon as practical, to keep the original aspect of the beach.

9. Dead sea grasses raked from the water's edge should be used to mulch seed beds for native vegetation. The nursery beds should be located parallel with, and approximately 10 feet from, the high water line. A mosaic of beds is aesthetically pleasing and good for turtles.

10. Exposed "white" (full spectrum) light shining on the beach is disruptive and disorienting to hatchlings and nesting females. The use of low pressure sodium vapor lights is encouraged; their 590 nm wavelength is least harmful to sea turtles. In any event, resort lights should be low, indirect, and screened from the beach.

The efforts of the Jumby Bay Resort to not only take into account the sea turtles nesting on the beach at Pasture Bay, but to sponsor the most comprehensive study anywhere in the world of the nesting behaviour of hawksbills sets a high standard. The importance of this effort cannot be over-emphasized. One reason for the precarious global status of hawksbills is that it is so easy, given the value of beachfront property, to quietly exclude them from their breeding areas. The Jumby Bay Resort has pledged not to let this happen. Toward this end, the Resort is encouraged by this Recovery Action Plan to (*i*) replant native beach vegetation in order to retard beach erosion at Pasture Bay, (*ii*) extinguish outdoor lights within the turtle nesting impact area at 7 pm, rather than 11 pm (in 1992, a majority of nesting and hatching occurred prior to 11 pm), (*iii*) install LPS lighting when elevated outdoor lighting is essential for security or other purposes; shield other outdoor lighting within the turtle nesting impact area, (*iv*) uniformly and strictly enforce established guidelines, such as "no up-lighting of vegetation" within the turtle nesting impact area, (*v*) inform all parties, especially owners and architects, of conservation guidelines prior to construction or improvements, and (*vi*) provide finished regulatory guidelines for the Jumby Bay Resort *viz* sea turtle conservation as a model to other beach communities.

4.123 Provide for enforcement of guidelines

Consistent and fair law enforcement is crucial to the perpetuation of any conservation or management programme. Good laws that are ignored are useless. Thus, guidelines should be formulated with the community in mind so that a general acceptance of the guidelines will emerge on the part of residents and users. A particularly good example of this is the continuing involvement of the Jumby Bay Resort in the evolving regulations governing the sustained conservation of the important hawksbill turtle nesting beach at Pasture Bay, Long Island. Similarly, civic groups, proximal residents, and frequent commercial users (e.g., divers, fishermen) in other proposed protected areas should be made thoroughly familiar with the management programme and be responsible for reporting any violations that occur. In this way, limited enforcement personnel will not have additional burdens placed upon them. This does not lessen the importance, however, of familiarizing enforcement officers with regulations and making sure that all reports of violations are properly addressed by the appropriate enforcement entity.

It is a recommendation of this Recovery Action Plan that Wardens be hired (or citizen volunteer officers identified) for each management area, especially in the case of Parks or other formally protected areas, and that the financial and logistical support needed for effective law enforcement be secured. In most cases, legislation employed to designate a reserve or other protected area -- Marine Areas (Preservation and Enhancement) Act, 1972; Fisheries Act, 1983; National Parks Act, 1984; Barbuda Local Government Act, 1982 -- embodies provisions for enforcement, including designating authorized officers and levying fines and penalties. In instances where supporting legislation does not adequately provide for field enforcement, amendments or other suitable solutions must be sought in order to provide fully for the enforcement of area management guidelines.

4.124 Develop educational materials for each management area

Environmental education and public awareness is a fundamental first step toward the success of any sea turtle conservation initiative. The following actions are recommended:

1. Develop colourful and comprehensive materials (e.g., brochures, posters, sign boards) that explain clearly the regulations pertaining to the management area.

2. Provide managers of protected areas, management zones, and tourist facilities with educational materials describing the conservation programme for Antigua and Barbuda's sea turtles.

Materials should be readily available to the public and should include clear descriptions of what types of activities are permitted (and not permitted) in the management area. Permanent wooden sign boards at beach entrances are one way to educate users. For example, a sign board may explain that beach fires and littering are not permitted, pets should be leashed, vehicles must be parked in designated areas, and sea turtles not harassed or flash-photographed. If an important nesting beach is closed to the public at night, this should be indicated. A phone number to report violations should be provided. Other options include the distribution of informative pamphlets. The Jumby Bay resort has prepared a handout entitled "Jumby Bay Turtle Facts" for distribution to guests and Club members. The handout includes information on the biology and conservation of hawksbills, but does not discuss the history of the Jumby Bay Hawksbill Sea Turtle Project, management considerations, or guidelines for visitors on the nesting beach. We recommend that the Jumby Bay handout be revised to include specific information on the Pasture Bay study, particularly guidelines for visitor behaviour while on the nesting beach. General, national public awareness campaigns are discussed in section 4.4.

4.13 Prevent or mitigate degradation of nesting beaches

4.131 Sand mining

While it is important to remember that sand is needed for construction aggregate, it is equally important to keep in mind that mining can result in irreparable damage to beaches. The chronic removal of sand for construction or other purposes can accelerate beach erosion and degrade or destroy coastal vegetation by uprooting it or flooding it with seawater. In severe cases,

saline ponds are formed in unsightly pits left by mining operations, shoreline trees and other stabilizing vegetation are lost to the sea, and entire beach habitats are eliminated. Loss of beaches reduces the coast's potential to support recreation, tourism, commercial development, as well as reducing nesting habitat for endangered sea turtles.

There are no interior deposits of sufficient size to be mined commercially in Antigua. As a result, sand was, until recently, mined by the government from several Antiguan beaches. Today the demand for sand aggregate on both islands is largely met from interior sand deposits in Barbuda, although some mining continues on the beaches of Antigua. The Beach Protection Act gives the Director of Public Works authority to grant permission to mine sand. The problem is that Public Works is the largest user of sand, thus creating an inherent conflict of interest. Economic pressures to mine are powerful. The greatest defense against this threat is a citizenry knowledgeable about conservation priorities and self-governed by an environmental ethic, a citizenry that demands that wise conservation practices be followed by its government.

There are already several examples of beaches that have been mined virtually out of existence, including the Pearn's Point beaches and Valley Church Beach, Antigua. It is a recommendation of this Recovery Action Plan that the Government impose a ban on beach sand mining and that laws be developed soon that provide absolute protection to beaches from sand mining in perpetuity. Mining not only degrades sea turtle nesting habitat, but has the potential to completely eliminate shoreline sand deposits, thereby preventing residents and visitors alike from enjoying the recreational benefits of these beautiful coastal habitats. Offshore sand mining should be discouraged unless it can be shown that the activity will not result in net erosion of nearby beaches.

4.132 Lights

Sea turtle hatchlings orient to the sea using the brightness of the open ocean horizon as their primary cue. When artificial lights are present landward of the nesting beach, hatchlings orient toward bright artificial light sources instead of the ocean horizon. Under these circumstances they crawl toward security lights, street lights, private homes, recreational facilities, and other sources of night lighting. Disoriented hatchlings drawn away from the sea are crushed by passing vehicles, eaten by dogs and other domestic pets, or die from exposure in the morning sun. In Antigua there are countless reports of hatchlings crawling inland toward artificial lights. Artificial lighting, mostly from hotels, shines on the following beaches: Curtain Bluff, Morris Bay, Crabb Hill Bay, Runaway Bay, Dutchman's Bay, Long Bay, Jabberwock Beach, and Dickenson's Bay, among others. The problem is also obvious at Coco Point, Barbuda. On Long Island, hawksbill hatchlings have been disoriented by lights at Mariani's Point (Jumby Bay Resort), Pasture Bay. In 1989, an entire nest of disoriented hatchlings was rescued from lights at another owner's home and returned to the sea (L. Corliss, pers. comm., 1990). The Jumby Bay Resort is taking steps to prevent such incidents from recurring (section 4.122).

Nesting female sea turtles are also disoriented by artificial lighting. In 1990, a hawksbill nesting at Pasture Bay crawled inland across a resort lawn and was found the next day by grounds-keepers; she was carted back to the sea and released. In 1991, two females were disoriented inland by lights at Pasture Bay and guided back to the beach by on-site biologists. In 1992,

at least two females were similarly disoriented. Antigua and Barbuda is not alone with this problem. On Anegada (British Virgin Islands), a leatherback came ashore to nest in May 1988 and died in the morning sun after being disoriented by the security lights of a local business (Lettsome, 1988 *in* Eckert et al., 1992). The empirical and anecdotal evidence is supported by recent research projects designed to evaluate the effect of lighting on nesting sea turtles. Witherington (1992), examining the problem of artificial lighting on the beaches in Florida (USA) and Tortuguero (Costa Rica), found that the presence of mercury vapor lights all but eliminated nesting on affected beaches; nesting of green turtles and loggerheads on those beaches was 1/10 and 1/20 that observed on darkened beaches. With this in mind, some beachfront owners in Florida have switched to low pressure sodium (LPS) vapor lighting, which has little if any effect on nesting females.

In Antigua and Barbuda, it is important that developers and residents alike understand that nesting adult and newly emerged hatchling sea turtles are very sensitive to lights on the beach. Planners and developers must be encouraged to modify lighting plans so as not to disturb sea turtles. Elevated (>8 ft) lights should be required to be LPS lights. Soft white light can be used for low elevation lighting. In either case, lighting should be shielded from shining directly on the beach. A common and effective method for shielding is to leave (or plant) a vegetation buffer between the sea and shoreline developments. Alternatively, shields can be built into the lighting fixture, as has been done by Jumby Bay Resort at Pasture Bay. In some areas, the solution may lie in extinguishing lights for specified evening hours (e.g., 1900-0400 hr) during the hatching season (peak: August-January) so as to reduce hatchling disorientation. This is a requirement in some parts of Florida, USA. LPS lights do not wholly solve the problem, but they interfere with turtle orientation much less than do mercury vapor lights.

Based on the above information, it is a recommendation of this Recovery Action Plan that lighting restrictions be imposed on construction permits issued by DCA in areas important to nesting sea turtles. Restrictions should be developed after consulting the National Environmental and Historical Commission. An environmental consultant should monitor the construction process for permit compliance, as well as periodically inspecting the buildings for lighting and other environmental regulations.

While an absence of lighting is the best guarantee that hatchlings will safely find the sea, there are some "next-best" solutions proposed by Witherington (1990):

1. time restrictions (lights extinguished seasonally during evening hours when nesting/ hatching is most likely to occur; e.g., 1900-0400 hrs),

2. area restrictions (restrict beach lighting to areas of the beach where little or no nesting occurs; the effectiveness of this is diminished, however, because sources of light several kilometers away can disrupt hatchling orientation),

3. motion-sensitive lighting (sensor-activated lighting comes on only when a moving object, such as a person, approaches the light; this might be effective in low traffic areas),

4. shielding and lowering light sources (low intensity light at low elevations can be both attractive and adequate for most purposes; the glow can be shielded from the beach by flowering hedges or other barriers), and/or

5. alternative light sources, since LPS lighting is known to be less attractive to hatchlings than full-spectrum white light.

In the U. S. Virgin Islands, a book (Raymond, 1984) providing an overview of the problems posed by beachfront lighting and potential solutions is issued to all developers seeking permits for projects which may have an effect on sea turtle orientation due to lighting. Many developers now include this information in their environmental impact assessments and are designing appropriate lighting systems (R. Boulon, pers. comm.). In Barbados, Dr. Julia Horrocks (Bellairs Research Institute and WIDECAST Team Member) has sent a letter to hotels and restaurants built near the beach asking that (*i*) security personnel report incidents of sea turtle nesting on the beach, and (*ii*) lights shining on the beach be redirected or shaded during the breeding season. If the latter is impossible, she asks if personnel would examine the grounds each morning and "rescue" hatchlings that mistakenly crawled away from the sea. A similar notice is being prepared by WIDECAST in the British Virgin Islands. This kind of communication is encouraged in all countries of the Caribbean. Coastal developers, residents and hotel owners cannot be expected to be sensitive to an issue that they know nothing about.

4.133 Beach stabilization structures

Beach stabilization structures such as breakwaters, groynes, and solid jetties constructed perpendicular to the shoreline can actually exacerbate beach erosion, especially down-current. There are many local cases of severe erosion to beaches down-current of jetties and groynes; specific examples include Runaway Bay, Dutchman's Bay, and Jolly Beach in Antigua, and The River in Barbuda. Beach stabilization structures constructed parallel to the shore can also provoke erosion, especially if they armour the zone of fore dunes. Furthermore, seawalls and rip-rap (unconsolidated rock and boulders) can prevent access by female sea turtles to the nesting beach. It is a recommendation of this Recovery Action Plan that holistic coastal zone regulations be developed that mandate responsible coastal zone development, including setback limits, so that the loss of sandy beach (and the need for stabilizing structures) is minimized. Prior to any construction, an environmental impact statement (EIS) should be required by a competent consultant and construction permits granted based on the results of the EIS. A related discussion on beach rebuilding is presented in section 4.135.

Setback limits are especially important to the conservation of nesting beaches. If development of land adjoining a sandy beach is planned, it is a recommendation of this Recovery Action Plan that setback limits be defined that reflect the damage likely to be caused to the beach and backshore environment during a major storm, and that take into consideration beach and backshore characteristics. Setbacks should provide for vegetated areas, including lawns and dunes between hotels, homes and similar structures, and the beach proper. Setbacks of 30-40 m and 80-100 m from the line of permanent vegetation are reasonable guidelines for upland coast development and lowland beach coast development, respectively. Setbacks not only help to protect coastal properties from storm damage, but also reduce overcrowding of the shorezone,

lessen the likelihood that local residents will be excluded from the beach, and enhance the probability that artificial lighting will not shine directly on the beach.

4.134 Beach cleaning equipment

Mechanized beach cleaning equipment employed to remove accumulated seaweed or litter can crush incubating sea turtle eggs and accelerate erosion; its use should be avoided. While such equipment is not commonly used in Antigua or Barbuda, there have been exceptions. Bull-dozers were used at Pasture Bay to clear root debris after Hurricane Hugo in late 1989. As a result, two hawksbill turtle nests were crushed. Recognizing the importance of keeping recreational beaches clean, since litter is a serious problem in some areas, every effort should be made to provide means of waste disposal at beach areas -- or refuse should be returned home with its user. The Body Shop is commended for the provision of disposal cans at Jabberwock Beach. The National Parks Authority provides disposal facilities at the Dockyard National Park, which encompasses sandy beaches. When beach clean-up is necessary, it is a recommendation of this Recovery Action Plan that hand rakes be used. Beach clean-up should not include the removal of vegetative cover. Supralittoral trees and shrubbery provide hawksbills with nesting habitat (e.g., Ryder et al., 1989). Even raking and removal of leaves and grasses above the high tide line can increase the probability of wind erosion and degrade nesting habitat.

4.135 Beach rebuilding projects

Beaches are sometimes rebuilt or replenished with sand from adjacent areas when the erosion of beach areas, particularly those fronting resorts, becomes economically threatening. This expensive practice need not be detrimental to sea turtle nesting if the sand that is replaced is similar to the original material (e.g., organic content, grain size) and the rebuilding activities do not take place during the primary reproductive season. If rebuilding is necessary, replacement sand should be similar to that which was eroded, thereby maintaining the suitability of the beach for the incubation of sea turtle eggs. If beaches are rebuilt during the green/hawksbill turtle nesting season (peak: June to November) or hatching season (peak: August to January), heavy equipment and activity can deter nesting and crush eggs. In addition, the new overburden suffocates incubating eggs and prevents hatchlings from successfully digging their way out of the nest. If leatherbacks are known to nest on site, personnel should keep in mind that nesting begins in April (rarely March), peaks in May, and finishes in early July.

It is worth noting that there is an imbalance in the system somewhere when sand is lost from an otherwise predictable beach habitat and is not replaced by natural accretion processes. The underlying cause can be as direct as an up-current solid jetty or pier that is literally "starving" the down-current beaches by interrupting the constant longshore transport of sand and sediments. Or the impetus may be more subtle, as occurs with the removal of beach vegetation, or when nearshore pollution retards the productivity of calcareous (coralline) algae and other sand sources. In the case of Jolly Beach, which was recently replenished with sand dredged from a swamp nearby, the new sediments did not remain. This indicates that the underlying cause of the problem was not addressed. The linkages between development and the persistence of sandy beaches are complex and should be considered with great care before construction proximal to sandy beaches is permitted. If dunes are leveled, vegetation removed and/or jetties constructed,

the likelihood of committing the owners to repetitive and increasingly expensive rebuilding is heightened. In the case of Jolly Beach, the failed rebuilding effort will probably not be attempted again in the near future. Useful information regarding beach rebuilding in sea turtle nesting habitat can be obtained from the Florida Department of Natural Resources, 19100 SE Federal Hwy, Tequesta, Florida 33469-1712 USA.

4.14 Prevent or mitigate degradation of marine habitat

4.141 Dynamiting reefs

Dynamiting living coral reef as a fishing practice is highly destructive and unacceptable under any circumstances. The resulting explosion(s) can be lethal to many forms of marine life, including sea turtles, fishes, and prey items important to sea turtles and commercial fishes. The use of explosives to capture fish is prohibited in Antigua and Barbuda. It is a recommendation of this Recovery Action Plan that enforcement of the relevant Fisheries Act provisions be strict and consistent. Part II (Marine Reserves and Conservation Measures) section 24.(1) of the Fisheries Act, 1983, states: Any person who (a) permits to be used, uses or attempts to use any explosive, poison or other noxious substance for the purpose of killing, stunning, disabling or catching fish, or in any way rendering fish more easily caught; or (2) carries or has in his possession or control any explosive, poison or other noxious substance in circumstances indicating an intention of using such explosive, poison or other noxious substance for any of the purposes referred to in the preceding paragraph, is guilty of an offence and is liable on summary conviction to a fine not exceeding twenty thousand dollars (EC$ 20,000).

4.142 Chemical fishing

The use of chemicals, such as chlorine bleach, to stun reef fish or to catch lobster destroys coral and other forms of marine life associated with the reef. Chlorine is highly toxic to corals. Fishing with chemicals or other noxious substances is illegal in Antigua and Barbuda, but it reportedly occurs on rare occasions. It is a recommendation of this Recovery Action Plan that enforcement of the relevant Fisheries Act provisions (see section 4.141, above) be strict and consistent with regard to prosecuting fisherman employing chemicals whilst fishing.

4.143 Industrial discharges

Industrial discharges contaminate food chains, causing fish and other marine organisms to become toxic to sea turtles and man (see section 3.1, Marine Habitat, for discussion). Examples of industrial effluent in Antigua and Barbuda include such things as the Antigua Public Utilities Authority discharging oil into ghauts (stream valleys) that ultimately lead to the sea. Spills, including some which have resulted in oil on the beach, have been reported at the bunkering station at Crab's Peninsula. The West Indies Oil Company Terminal is another potential source of industrial waste. It is a recommendation of this Recovery Action Plan that (*i*) existing pollution laws be reviewed for completeness and enforceability, providing Government with recommendations for changes where needed, (*ii*) industries be monitored to confirm that discharges are duly registered with Government and properly identified as to content, and (*iii*) fish and other marine life in suspected polluted areas be tested for the presence of toxins.

The Dumping at Sea Act, 1975, makes it an offence to, amongst other things, "dump substances or articles in Antiguan waters [or] dump substances or articles in the sea outside Antiguan waters from an Antigua ship, aircraft, hovercraft or marine structure" [N.B. Since independence, Antigua is understood to refer to Antigua and Barbuda]. The law further provides that it is illegal to dispose of substances at sea "from a structure on land constructed or adapted wholly or mainly for the purpose of depositing solids in the sea." The penalty on summary conviction is a fine of EC$ 2,000 and imprisonment for 12 months; on conviction on indictment, a fine of EC$ 25,000 and imprisonment for five years. In some cases it may be possible to prosecute land-based, point-source polluters under this law, particularly if the offending industry or government facility can be shown to have constructed conduits specifically for the purpose of disposing effluent directly to the sea. This interpretation would have to be tested in court.

4.144 At-sea dumping of garbage

Garbage and other substances dumped at sea contaminates the environment and threatens the lives of sea turtles. Death to marine organisms as a result of ingestion or entanglement is widespread (e.g., O'Hara et al., 1986; Laist, 1987; CEE, 1987). Mrosovsky (1981) has summarized data showing that 44% of adult non-breeding leatherbacks have plastic in their stomachs (plastic bags are consumed by the turtles who mistake them for jellyfish). Styrofoam and other soft plastics also present a significant health hazard to sea turtles (Balazs, 1985). A great deal of debris discarded from cruise ships and merchant ships ultimately washes ashore on nesting beaches in Antigua and Barbuda (especially the windward beaches), as it does throughout most of the Eastern Caribbean, providing evidence of the magnitude of the problem. This is certainly true at Pasture Bay, an important hawksbill rookery, where a variety of ocean-borne debris collects on the north and west shores of the bay.

Dumping violations by the boating community are difficult to monitor and require a concentrated effort at public education, coupled with convenient places to safely dispose of refuse on shore and stiff penalties for offenders. As noted above (section 4.143), the Dumping at Sea Act (1975) includes stiff penalties upon conviction for disposing of "any substance or articles" from any marine vessel or structure at sea. Unfortunately, while the Act allows the Minister to appoint enforcement officers, such appointments have yet to be made. The government of Antigua and Barbuda should register its concern with cruise ship lines, merchant ships and military vessels that garbage not be thrown overboard, citing aesthetics and dangers to marine life. Warning should be made that offenders will be prosecuted to the full extent of the law.

There are efforts underway to solicit support from the yachting and fishing communities in the reduction of litter at sea. For example, the Port Authority provides facilities for cruise ships to dispose of their waste. This and other relevant information about regulations governing the marine environment of Antigua and Barbuda is provided to captains when they check-in with the Port Authority. It is a recommendation of this Recovery Action Plan that a campaign be undertaken to alert marine users of the threat to fisheries and turtles from the indiscriminate disposal of waste at sea. Relevant information should be provided at the Annual Charter Yacht Show (where the Museum of Antigua and Barbuda generally has a booth to solicit assistance from the yachting community in reporting whale sightings) and during Sailing Week each April. National media attention should be requested.

4.145 Oil exploration, production, refining, transport

Byproducts of oil and the oil industry pose a grave threat to sea turtles. Behavioural experiments indicate that green and loggerhead sea turtles possess limited ability to avoid oil slicks, and physiological experiments show that the respiration, skin, some aspects of blood chemistry and composition, and salt gland function of 15-18 month old loggerheads are significantly affected by exposure to crude oil preweathered for 48 hours (Vargo et al., 1986). There is some evidence to suggest that hawksbills are also vulnerable to oil pollution. Hawksbills (predominantly juveniles), were only 2.2% (34/1551) of the total sea turtle strandings in Florida between 1980-1984, yet comprised 28.0% of petroleum-related strandings. Oil and tar fouling was both external and internal. Chemical analysis of internal organs provided clear evidence that crude oil from tanker discharge had been ingested (Vargo et al., 1986). Carr (1987) reported juvenile hawksbills (to 20 cm) "stranded [in Florida] with tar-smeared sargassum"; some individuals had ingested tar. Aged crude oil turns to tar balls which float on the surface of the ocean and can cause turtles that ingest them to die for physical rather than chemical reasons. Fresh crude oil on nesting beaches can be highly toxic to incubating eggs.

Some serious spills have already come ashore from the Atlantic, such as in April 1990 when a slick some 10 ft (3 m) deep and several miles long came ashore in Barbuda. Several beaches were probably affected, but no immediate site inspection was done. An offshore spill in 1988 contaminated a segment of Pasture Bay beach with crude oil and tar. Several nesting hawksbills were physically contaminated by the soft tar, but no negative effects on health or nesting activity were noted by scientists studying the turtles that year. Most windward beaches on both Antigua and Barbuda, especially the latter, are littered with tar balls to varying degrees. Nesting beaches and incapacitated turtles should be routinely inspected for oil and tar damage. Evidence of contamination should be reported to the Historical, Conservation and Environmental Commission (Ministry of Economic Development), Coast Guard, and/or the Fisheries Division (Ministry of Agriculture). Preventative measures are urgently needed, including strong coastal zone regulations for land-based refineries, monitoring programmes for the municipal drainage of oil from fuel storage facilities, gas stations and motor vehicles, and centrally coordinated oil spill contingency plans in the case of a spill. Relevant topics and response protocol have been discussed by the Disaster Preparedness Committee and a National Oil Spill Contingency Plan is under development.

The danger always exists of an oil spill from tankers transporting or unloading oil. According to the CCA (1991), the proposal to relocate the West Indies oil bunkering and storage facility (now at Friar's Hill) to one of three possible sites -- Urlings, Fishers Point, or Crabbs -- "poses a serious threat of contamination and pollution of reefs and beaches in proximity to the [chosen] site. Leakages, which are almost inevitable, would degrade these areas over time; in the event of an oil spill, habitat destruction could be much quicker and more extensive. The absence of adequate oil spill contingency planning procedures and in-country capabilities for oil spill clean-up increase the necessity for a full environmental impact assessment and review" before the Government of Antigua and Barbuba moves ahead with plans for this proposed project. The most likely relocation site now appears to be Cades Estate, arguably the worst choice with regard to potential environmental calamity. Cades Reef complex is vulnerable to ruin from a serious oil spill, as is downstream habitat important to sea turtles for foraging, and the physical blight on

this pristine coastal landscape from the construction of a tank farm is seen by many as unacceptable. The whole concept of relocation should be reconsidered. If the move is inevitable, careful consideration should be given to selection of a site which will truly minimize potential environmental and aesthetic damage.

Ships in Antiguan and Barbudan waters should be warned that pumping an oil-contaminated bilge is illegal and will be punished severely. Governments of the countries of registry should receive similar warnings. The Dumping at Sea Act (see sections 4.143, 4.144) and the Fisheries Act should be fully enforced in regards to oil pollution. The Fisheries Act gives the Minister power to make regulations with respect to protection of all marine flora and fauna. This mechanism could be usefully adopted to promulgate more comprehensive oil discharge regulations, and the Minister is urged to explore this avenue. It is a recommendation of this Recovery Action Plan that a comprehensive National Oil Spill Contingency Plan be adopted and implemented as soon as possible. With regard to international cooperation in the event of a serious spill, Antigua and Barbuda ratified the Cartagena Convention (see section 4.32), as well as the Protocol Concerning Co-operation in Combating Oil Spills in the Wider Caribbean Region associated with this Convention, on 11 September 1986. Article 3 of the Protocol states:

a. The contracting Parties shall, within their capabilities, cooperate in taking all necessary measures, both preventive and remedial, for the protection of the marine and coastal environment of the Wider Caribbean, particularly the coastal areas of the islands of the region, from oil spill incidents.

b. The contracting Parties shall, within their capabilities, establish and maintain, or ensure the establishment and maintenance of, the means of responding to oil spill incidents and shall endeavor to reduce the risk thereof. Such means shall include the enactment, as necessary, of relevant legislation, the preparation of contingency plans, the identification and development of the capability to respond to an oil spill incident and the designation of an authority responsible for the implementation of this protocol.

4.146 Agricultural run-off and sewage

As explained in the recently published Country Environmental Profile (CCA, 1991), the landscape today is a result of land use patterns dating back to the early seventeenth century. In the space of a few decades, much of the natural vegetation was cleared for cultivation of tobacco, indigo, cotton and, later, sugar cane. Production of sugar cane in Antigua under the colonial plantation system was well established by the close of the eighteenth century. Only 5,500 acres (of a total land area of 69,120 acres) are reported to have been spared from cane production (Cater, 1944 *in* CCA, 1991). Much of the land that became available with the end of sugar production in the 1960's is used today by small-scale farmers; only 1.5% of operational farms exceed 10 acres and nearly 70% of all farmers pursue this occupation on a part-time basis. Despite the small-scale nature of modern agriculture (the contribution of agriculture to the national economy is <5%; CCA, 1991), Lausche (1986) refers to a study reporting Antigua/ Barbuda to be the largest importer of pesticides in the Lesser Antilles. Betz (1989), in her report on land-based sources of marine pollution in the Caribbean, cites Hammerton (1985 report to

CARDI and USAID) in which he lists seven types of fungicides, 17 types of herbicides, and 18 types of insecticides, acaricides, and nematicides available for use in Antigua and Barbuda.

Agricultural pesticides and herbicides frequently enter the natural environment as persistent toxins. These toxins accumulate in the food chain, and can present a significant threat to large predators (such as some fish and sea turtles) and to man when the contaminated species are consumed. Data are insufficient at the present time to evaluate the full extent to which agricultural run-off is affecting the productivity or viability of marine habitats important to sea turtles, but it is clear that deforestation has resulted in massive runoff of upland soil and its associated agricultural chemicals. Pesticide pollution was implicated in a recent fish-kill in the Potworks Dam (Fernandez and Williams, 1990). There is no list of pesticides approved for use in Antigua and Barbuda, no records or control of imports, and no controls on distribution or disposal (Lausche, 1986; DeGeorges, 1989). It is a recommendation of this Recovery Action Plan that the Pesticide Control Board established by the Pesticide Control Act of 1973 be reactivated, that chemicals used for commercial agricultural purposes be registered, and that their use be monitored for compliance with accepted safety standards. Antigua/Barbuda is one of the few places in the Wider Caribbean still lacking proper statutory management of these toxins.

Central sewage treatment is lacking in Antigua and Barbuda. There are no municipal sewage treatment plants on either island. Most domestic sewage is handled by individual septic tanks with drain fields to the porous limestone rock. Raw sewage is discharged from a nonfunctional private plant at McKinnons' swamp. High bacterial levels have already been documented in some areas, such as in Dickenson Bay. Contaminants are also found in the treated effluent of industrial and municipal sewage released to the ocean from discharge pipes located well offshore. Such out-of-sight, out-of-mind disposal practices are dangerous not only to sea turtles, but also to other marine organisms and to people who consume these organisms. The only way to control this problem is to control the quantity and chemical makeup of the effluent at its source. It is a recommendation of this Recovery Action Plan that strong environmental protection laws be developed to address the threat of coastal and ground water contamination resulting from untreated or incompletely treated sewage and that investment in infrastructure to treat and properly dispose of raw sewage be a priority for both Government and industry. Routine monitoring for compliance with environmental standards is essential.

4.147 Anchoring and dredging

Dredging (resulting in bottom disruption and widespread siltation) and indiscriminate anchoring severely degrade sea grass meadows and coral reefs. Sea grasses are essential in the diet of the green sea turtle (section 2.2), and the hawksbill feeds principally on sponges and other invertebrates associated with coral reefs (section 2.4). Thus, the effects of dredging and anchoring, both increasingly common in the West Indies (and increasing but still relatively infrequent in Antigua and Barbuda), will eventually have profoundly negative consequences for green and hawksbill turtles in nearshore waters. In addition to providing food for sea turtles, both of these habitat types serve as essential "nursery" and juvenile development habitat for commercially important fishes and contribute to SCUBA diving tourist dollars. For all these reasons, minimizing damage to these important and fragile ecosystems should be a priority. Widespread damage, especially to living coral, can be irreparable in our lifetime.

Traditional anchoring sites for yachts and other vessels in Antigua and Barbuda are mainly restricted to mud or sandy bottoms. Damage to living coral and sea grass is not widespread. Nevertheless, Boon's Reef in Antigua show signs of anchor damage and should be examined in order to determine the extent of the destruction. Sea grasses show anchor damage in the Green Island area, North Sound area, Dickenson Bay, Jolly Beach, Curtain Bluff, and Falmouth Harbour. It is a recommendation of this Recovery Action Plan that mooring systems be examined and implemented by local authorities as a way of mitigating severe damage to sea grass and coral reef habitats. Several islands, including Tortola and Virgin Gorda (British Virgin Islands) and Saba (Netherlands Antilles) have instituted comprehensive and very effective mooring systems to protect the long term integrity of slow-growing coral reefs. Technical information can be found in Halas (1985). Halas (1985) has designed a relatively inexpensive mooring system (US$ 100-200/mooring) which is adequate for holding yachts and live-aboard dive boats <55 ft in length and <36 tons.

With regard to dredging, the Jolly Harbour Project undoubtedly causes siltation downcurrent, as has been the case with the recent dredging of St. John's Harbour. Dynamiting and dredging the channel at the new U. S. Navy Marine Terminal Facility (SEAL training) has resulted at times in a silt plume stretching four-plus miles westward along the coast. It is a recommendation of this Recovery Action Plan that whenever possible, dredging sites be chosen or activities timed to cause the least amount of downstream silt and sedimentation.

4.2 Manage and Protect All Life Stages

In the previous subsections, a variety of solutions to contemporary assaults on sea turtle nesting and feeding habitats were presented and explained. The subsections which follow focus on managing and protecting the turtles themselves. Existing conservation legislation is reviewed and improvements are proposed. Other relevant topics are discussed, such as law enforcement, incidental catch, alternative livelihoods for turtle fishermen, population management, and population monitoring and trend analysis.

4.21 Review existing local laws and regulations

The Turtle Ordinance of 1927 granted partial protection to all species of sea turtle with the exception of the loggerhead, Caretta caretta. It established a closed season, 1 June-30 September, inclusive, during which time one could neither catch, attempt to catch, sell nor possess any sea turtle or its eggs. In addition, the Ordinance fully protected sea turtles less than 20 lb in weight. Upon conviction, any turtles or eggs in possession were to be forfeited and any net or other instrument used in the crime could be seized. A person found guilty of violating the Ordinance was liable to a fine not exceeding Ten Pounds. WIDECAST personnel in Antigua, realizing that the Ordinance was clearly antiquated and not responsive to the needs of diminishing sea turtle numbers in Antigua and Barbuda, recently petitioned the government to revise the law to provide full protection to large juveniles and adult size classes, as well as extend the closed season through the nesting season, a mandate which would reflect the gravity of the sea turtles' plight. The effort was partially successful in that the closed season was extended, the minimum size limit was raised to include a larger range of juvenile size classes, and the loggerhead turtle was included for the first time; however, breeding adults were not protected.

The Fisheries Regulations of 1990 (The Fisheries Act, 1983) state:

21.(1) The Minister shall by Notice published in the *Gazette* declare the close season for turtle which until otherwise declared shall commence from the 1st day of March and end on the 31st day of August of every year.

(2) No person shall:

(a) fish for, take, sell, purchase or have in his possession any turtle or part thereof, during the close season for that species of turtle;
(b) disturb, take, sell, purchase or have in his possession any turtle eggs; or
(c) interfere with any turtle nest;
(d) take, sell, purchase or have in his possession any undersized turtle;
(e) sell, purchase or have in his possession the shell of any undersized turtle. [N.B. Activities described in (2)(b)-(e) are prohibited at all times.]

(3) For the purposes of this regulation "undersize" means --

(a) Leatherback turtle (Dermochelys coriacea) less than 350 pounds (158.75 kg) in weight;
(b) Green turtle (Chelonia mydas) less than 180 pounds (81.65 kg) in weight;
(c) Hawksbill turtle (Eretmochelys imbricata) less than 85 pounds (38.50 kg) in weight;
(d) Loggerhead turtle (Caretta caretta) less than 160 pounds (72.57 kg) in weight.

The Regulations further prohibit the use of a speargun for fishing in Antigua and Barbuda without first having obtained written permission from the Chief Fisheries Officer. Any person contravening any of the provisions of these Regulations is guilty of an offence and is liable upon summary conviction to a fine of EC$ 5,000 or to imprisonment of twelve months. The Fisheries Act of 1983 also includes a mechanism for marine reserves and other habitat conservation measures. The Act reads, in part:

22.(1) The Minister may, by notice published in the *Gazette*, declare any area of Antigua and Barbuda waters and, as appropriate, any adjacent or surrounding land, to be a marine reserve where he considers that special measures are necessary --

(a) to afford special protection to the flora and fauna of such areas and to protect and preserve the natural breeding grounds and habitats of aquatic life, with particular regard to flora and fauna in danger of extinction;

(b) to allow for the natural regeneration of aquatic life in areas where such life has been depleted;
(c) to promote scientific study and research in respect of such areas; or
(d) to preserve and enhance the natural beauty of such areas.

The Act establishes that it is illegal (unless by permission of the Minister) within the boundaries of a marine reserve to fish, take or destroy any flora and fauna other than fish, dredge, extract sand or gravel, dispose of waste or other pollution, or construct any building; penalty for a convicted offence is not to exceed EC$ 10,000.

The Marine Areas Preservation and Enhancement Act of 1972 established (as of 1973) two marine protected areas, one at Diamond Reef and Salt Fish Tail Reef in Antigua and a second at Palaster Reef in Barbuda. These are more fully discussed in section 4.12 of this Recovery Action Plan. The Marine Areas Preservation and Enhancement Act gives the Minister responsible for Fisheries much the same power to designate protected areas as are granted by the revised Fisheries Act, but the 1972 Act also provides for acquiring adjacent lands important to the reserve, assigning management authority, regulating use, parking, concessions, licensing of boats and guides, fees, and enforcement.

Also relevant to the protection of specific life stages, in particular nesting females and eggs, is the Beach Protection Ordinance of 1957 which grants the Director of Public Works the ability to regulate the removal of sand from beaches. A permit is needed to, amongst other things, remove sand or other substrate from a beach or to "convey or move" for building or construction purposes any beach sand. The problem is that Public Works is the largest user of sand, thus exposing an inherent conflict of interest (section 4.131). Furthermore, penalties upon conviction of an offence include very minimal fines (not exceeding EC$ 50) and imprisonment for a term not exceeding three months. The Beach Control Ordinance of 1958 vests the "foreshore of the Colony and the floor of the sea" in the Crown and prohibits any use of the foreshore or the floor of the sea in connection with trade, business, or any commercial enterprise, but the Ordinance fails to define "foreshore".

4.22 Evaluate the effectiveness of law enforcement

Current law enforcement is inadequate to non-existent. Necessary improvements include encouraging Government to enforce laws and prosecute infractions, modifying penalties to include fines and imprisonment that reflect the gravity of the sea turtles' plight (see section 4.25), and seeking additional law enforcement agents and financial/logistical support for wildlife management departments. The Minister can designate authorized fisheries enforcement officers under Section 26 of the Fisheries Act; presently both Fisheries and Police personnel are involved with the enforcement of conservation provisions. Notwithstanding recent additions in Fisheries Division personnel, the nation has not yet come to terms with the idea that it can be a criminal offence of a serious nature to violate sea turtle or other conservation laws. Consequently, through-out the law enforcement system, there is a reluctance to take the law seriously. No arrests have ever been made for violations of turtle conservation regulations. It is likely that the judiciary system would prosecute such a case to the fullest extent of the law.

4.23 Propose new regulations where needed

Wildlife management laws and regulations pertaining to sea turtles must reflect the biological realities of sustainable harvest. Neither the Turtle Ordinance of 1927 nor the Fisheries Regulations of 1990 reflect a current understanding of sea turtle ecology, and neither responds to the needs of diminishing sea turtle numbers in Antigua and Barbuda. It is a recommendation of this Recovery Action Plan that a moratorium be implemented on the capture and sale of sea turtles and their products until such time as there is sufficient information to show that a regulated harvest will not compromise the sustainable recovery of depleted sea turtle stocks. Interim legislation, if needed, is described in section 4.232. In addition, regulations to conserve important breeding and feeding grounds are needed. It is recommended by this Recovery Action Plan that surveys be undertaken to identify important habitat (section 4.11), that area-specific management plans be developed (section 4.12), and that a 60-day public comment period be required for all development plans above a certain minimal size before approval may be received from the government. Contractors/owners who respond voluntarily to suggestions for greater environmental sensitivity in their developments should be rewarded with fiscal incentives. This could take the form of tax breaks, government support or promotional advertising by conservation groups, international publications, and the travel industry for cooperating resorts.

4.231 Eggs

The Fisheries Regulations of 1990 provide for the protection of sea turtle eggs, making it an offence to disturb, take, sell, purchase or possess any turtle eggs or interfere with any turtle nest at any time (section 4.21). Nevertheless, the illegal collection of eggs continues. An estimated one-half of all eggs laid in Barbuda are harvested, in addition to an unquantified proportion of those laid in Antigua (section 3.3). It is a recommendation of this Recovery Action Plan that a concentrated effort be made to inform the public that the harvest of sea turtle eggs (all species) is prohibited. Reports to the Fisheries Office or Police of violations should be encouraged. Penalties upon conviction should be strict in order to set an example for others who may consider contravening these regulations. It is an unambiguous biological reality that the continued harvest of eggs will guarantee the extinction of local nesting populations, regardless of any other conservation measures.

4.232 Immature turtles

Any continued harvest of the already depleted sea turtle resource is viewed as counterproductive to the objective of sustained recovery of local sea turtle populations. It is a recommendation of this Recovery Action Plan that an indefinite moratorium on the harvest of sea turtles of all sizes be enacted. If an interim period prior to the enforcement of a full moratorium is unavoidable, Regulation 21 (Turtles) of the Fisheries Regulations of 1990 (Fisheries Act, 1983) should be substantially revised and implemented during an interim period not to exceed one year. During this time, Fisheries personnel should be preparing the fishing community for a ban. It should be recognized that whilst the interim regulations described below represent a significant advancement over the present regulatory framework, they are in no way capable of realizing the objective of a sustained recovery of depleted sea turtle stocks. They are intended only to serve as a credible intermediate step toward full protection.

Any interim regulations should restrict harvest to juvenile green and loggerhead turtles, and further confine the legal harvest to green and loggerhead turtles with a curved carapace length *less than* 24 inches (60 cm). Small juvenile turtles are completing a period of rapid growth. If turtles must be harvested, this size class is more capable of being replaced than the adult class. The harvest of olive ridleys, hawksbills, and leatherbacks *of any size* should be forbidden immediately. Olive ridleys and hawksbills are seriously depleted in the Western Atlantic and no amount of harvest can be justified, even on an interim basis. Since only adult leatherbacks are encountered, there is no opportunity to harvest immatures of this species. With this in mind, Regulation 21 (Turtles) should be repealed and replaced with the following interim text:

21.(1) The close season for turtle until otherwise declared shall commence from the 1st day of March and end on the 30th day of November of every year.

(2) No person shall:

(a) catch or take, or attempt to catch or take, or cause to be caught or taken any Green (Chelonia mydas) or Loggerhead turtle (Caretta caretta) during the close season; or
(b) notwithstanding the provisions of subsection (a), at anytime catch or take, or attempt to catch or take, or cause to be caught or taken any Green or Loggerhead turtle which is greater than 24 inches (60 cm) in carapace (shell) length; or
(c) catch or take any Green or Loggerhead turtle using a Spear Gun (Fish Gun); or
(d) buy, sell, offer or expose for sale, or have in his possession the whole or any part thereof of any Green or Loggerhead turtle during the close season; or
(e) notwithstanding subsection (a) take, capture or disturb or attempt to take, capture or disturb any Green or Loggerhead turtle or the eggs of same found on the shore or within one hundred yards thereof; or
(f) buy, sell, offer or expose for sale, or have in his possession eggs of any Green or Loggerhead turtle.

(3) No person shall:

(a) catch or take, or attempt to catch or take, or cause to be caught or taken at anytime or in any place any Hawksbill turtle (Eretmochelys imbricata), Olive Ridley turtle (Lepidochelys olivacea), or Leatherback turtle (Dermochelys coriacea) or the eggs of such turtles; or
(b) buy, sell, offer or expose for sale, or have in his possession the whole or any portion of Hawksbill, Olive Ridley, or Leather-back turtles, including the meat, oil, shell or eggs of such turtles.

(4) Any person contravening any of the provisions of these Regulations is guilty of an offence and shall be liable upon summary conviction to a fine of $5,000 or to imprisonment of twelve months; and, in addition thereto, any turtle parts, products or eggs and any boat, vehicle and/or equipment used in connection with the commission of an offence specified in Regulation 2 or 3 shall be forfeited to the Crown save and except that no such forfeiture shall take place in the event of the owner thereof satisfying the Court that he did not know of the use thereof in the commission of such offence.

Turtles must be landed alive in order that oversized turtles and protected species can be released unharmed. Consequently, the provision that turtles not be speared is an important one. Nets should be checked regularly to ensure that ensnared turtles do not drown or become vulnerable to predators. Turtles legally landed should be killed humanely prior to butchering.

4.233 Nesting females

Sea turtles are long-lived, and adult females will lay eggs for many years. Adult sea turtles represent decades of selective survival (sexual maturity is reached for most species in the Western Atlantic at 20-35 years), are the most difficult life stage for a population to replace, and are (along with subadults just entering their breeding years) the most important life stage for the survival of a sea turtle population (e.g., Crouse et al., 1987; Frazer, 1983, 1989). It is crucial to remember that, regardless of the expense and care taken to protect sea turtle habitat, eggs and juvenile life stages, it is inevitable that we will loose the sea turtle populations that nest in Antigua and Barbuda if we continue to eliminate our breeding animals. It is, therefore, an urgent recommendation of this Recovery Action Plan that adult turtles be protected at all times and under all circumstances. The majority of hawksbill sea turtles nesting in Antigua and Barbuda are still routinely visiting their nesting beaches when the season opens on 1 September. In 1991, for example, 26 of 34 (76%) hawksbills nesting at Pasture Bay, Long Island, could have been legally killed because they were still nesting after 1 September. No population, especially one characterized by delayed maturity and high natural adult survival, can withstand such pressure, which is why sea turtles are greatly depleted from their former abundance (section 3.3).

4.234 Unprotected species

It is important that all sea turtle species and their eggs are explicitly protected.

4.24 Augment existing law enforcement efforts

The law enforcement capability of Antigua/Barbuda is not sufficient to deal adequately with the problem of sea turtle protection. A cooperative private initiative is needed. The following actions are encouraged:

1. Private individuals (including fishermen, divers, and boaters) should assist governmental law enforcement efforts by reporting violations and may be appointed as authorized officers under the Fisheries Act.

2. Owners of nesting beaches or beachfront property should be urged to provide for regular patrols by trained personnel to protect nesting turtles and their eggs.

3. Research efforts should be encouraged that, by the nature of the presence of research personnel, serve also as a deterrent to illegal activities.

4. The names of individuals guilty of persistent infractions of sea turtle laws should be publicized in national media.

We recommend that the Minister appoint several additional authorized officers from amongst the civilian population who would be unpaid but have commitment to the natural resources of Antigua and Barbuda. Government (Fisheries Division) and/or non-government groups (Environmental Awareness Group) should place placards in selected public areas reminding people, residents and tourists alike, of the laws protecting sea turtles and requesting that violations be reported to the Fisheries Division. The media could also be used to greater advantage, publicizing the plight of sea turtles and encouraging residents to get involved. A separate Division of Conservation Law Enforcement would be highly desirable. Conservation Officers should be specifically trained in environmental law and enforcement procedures and be responsible for regulations concerning mining and minerals, pollution, protected species, fisheries and marine resources, boater safety, game and hunting, and coastal zone permits and compliance. Officers should be stationed in both Antigua and Barbuda and have reliable access to marine vessels and other essential transport.

4.25 Make fines commensurate with product value

Turtle meat was selling for up to EC$ 6.00 per lb in 1992 (comparable to fish), or about EC$ 100 for a whole turtle. Thus, current fines are commensurate with product value and with the gravity of the offence. Any person convicted of contravening any of the provisions of the 1990 Fisheries Regulations, including the sea turtle provisions (see section 4.21), is liable to a fine of EC$ 5,000 or to imprisonment of twelve months. In addition, any fishing vessel (together with its gear, stores and cargo) and any vehicle, fishing gear, net or other fishing appliance used in the commission of the offence can be forfeited (Section 33, Fisheries Act, 1983). A commitment on the part of the government to enforcing current regulations is needed, as well as to providing the resources necessary to carry out the job.

4.26 Investigate alternative livelihoods for turtle fishermen

The expert advice of Fisheries Officers, as well as from other government officials, the OECS, WIDECAST, the IUCN, and other organizations would be useful in order to identify alternative income sources for the 2-3 individuals that still rely on sea turtles for significant nutrition or income. These alternatives might include conservation livelihoods, enforcement duties, or enhanced fishing opportunities. Consideration need not be given to those who take sea turtles only for sport and are not tied to the resource for valid economic reasons.

4.27 Determine incidental catch and promote the use of TEDs

The incidental capture and death by drowning of sea turtles in shrimp trawl nets does not occur in Antigua/Barbuda. Thus there is no need for the implementation of turtle excluder devices (TEDs) which release trawl-caught turtles. However, the entanglement of sea turtles in fish pot lines and in longlines is perceived to be an increasingly serious problem. The numbers of turtles taken incidentally by a multi-national legal and illegal longline fishing industry within and adjacent to Antiguan/Barbudan waters and its economic zone are not precisely known, but we are in the process of estimating the take from ongoing interviews with fishermen. Preliminary evidence suggests that the toll approaches 100 or more turtles each year, mostly loggerheads and leatherbacks. Entanglement and incidental catch also occurs in trammel nets, seines, and gill nets. It is a recommendation of this Recovery Action Plan that incidents of entanglement be documented by the Chief Fisheries Officer, that the right to place on-board observers on foreign fishing vessels within the EEZ be established, and that the Government support the use of (TEDs) by shrimp trawlers throughout the Wider Caribbean.

It is further a recommendation of this Recovery Action Plan that the Government not license purse-seining vessels or other large-scale commercial fishing enterprises to fish in the waters of Antigua and Barbuda. Historically, it has been virtually impossible to monitor the activities of large-scale foreign fishing enterprises operating legally or illegally in the waters of Antigua and Barbuda. It is widely known that several of these fishing technologies, including purse-seines, longlines and driftnets, kill large numbers of non-target species, including marine turtles, throughout the world every year. In addition to serious incidental catch problems, large-scale indiscriminate fishing discourages local fishermen with regard to conservation methods.

4.28 Supplement reduced populations using management techniques

Identifying and protecting important foraging areas and natural beaches (section 4.11) and revising fisheries legislation to include an indefinite moratorium on the harvest of sea turtles and their eggs (section 4.23) are considered by this Recovery Action Plan to be the highest national management priorities. Second priority should be placed on identifying threatened nesting or foraging populations that would benefit from specific, hands-on management initiatives. Continuing support of ongoing monitoring and conservation programmes, such as that at Pasture Bay, Long Island, is essential. Implementing management options such as the establishment of a hatchery for eggs threatened by erosion or excessive depredation should be undertaken as needed using the advice of sea turtle experts and pursuant to management techniques described in Pritchard et al. (1983).

An individual sea turtle has the capacity to lay thousands of eggs in her lifetime, yet the probability that a given egg will lead to the production of a mature female is less than one percent. Many hundreds of hatchlings must enter the sea for each female that survives to adulthood. For all sea turtle nests not harvested but allowed to develop, it should be a conservation management goal to see that at least 50% of these hatch successfully. Recognizing that there will continue to be productivity losses to predators, erosion, natural levels of infertility, etc., it is important that Government take quick steps to protect eggs from human consumption. Where necessary to protect eggs from poachers or predators, fenced hatcheries may have to be considered.

But hatcheries should be used only if absolutely necessary. The artificial incubation of eggs and the improper handling of eggs and hatchlings can be disastrous. Incubation temperature is largely responsible for determining hatchling sex, so any attempt to artificially incubate eggs may skew the normal sex ratio of the nest.

The occasional erosion-prone nest should be relocated to a safe place on the natural beach. The decision to do so should be made at the time of egg-laying. If eggs are moved after the first 24 hr, the risk is high of dislodging the tiny embryo from the inner lining of the eggshell and killing it. Sometimes a compromise has to be made. If, for example, eggs are being washed away, such as by a storm surge, an attempt to salvage the clutch is prudent. There may be a steep decline in the hatch success of the rescued nest, but this would be preferable to a total loss. Eggs should always be handled with great care and reburied on a natural beach, preferably the one where the female made the original nest. The new nest should be dug to the same depth as the original nest and in the same type of habitat (open beach vs. beach forest) so that the temperature of incubation is not altered. Hatchlings should always be allowed to emerge from the nest naturally and traverse the beach unaided as soon as they emerge. Each hatchling is very important and contributes to the probability that enough turtles will mature to perpetuate the population. These hatchlings, when mature in about 20-30 years, will return to the beaches of Antigua and Barbuda to lay the eggs of the next generation.

4.29 Monitor stocks

A population of animals cannot be managed adequately until its numbers are counted with statistical accuracy. Standing stocks and changes in numbers that may reflect worsening conditions are impossible to identify without such accuracy. Existing statistics on the turtle populations of Antigua/Barbuda are virtually nonexistent. The following actions are recommended:

1. Designate Index Beaches for intensive monitoring.

2. Implement immediately a programme for the proper statistical evaluation of the existing numbers of sea turtles.

3. Establish a system of sub-sampling to ensure methods are comparable between different size classes, different locations, and different observers.

4. Implement a fisheries programme for gathering information on the numbers of turtles taken, and the number sold for either domestic use or international distribution.

5. Encourage research that will provide statistical estimates of stocks and develop a long-term stock assessment programme to identify trends over a period of decades.

6. Select one individual (*ex officio* or otherwise), either a government official (or office) or a member of the WIDECAST local network, to function as a repository for statistical data.

The following subsections articulate acceptable methodology regarding monitoring nests, hatchlings, and the larger size classes of turtles. A time-table and budget for the monitoring effort are presented in section 4.6.

4.291 Nests

Because it is neither possible nor necessary to monitor all sea turtle nesting beaches in Antigua and Barbuda, it is a recommendation of this Recovery Action Plan that Index Beaches be selected for comprehensive study. These areas should encompass important nesting habitat for leatherbacks, hawksbills, and green turtles and should be monitored on a daily basis during the breeding season for nest and hatch success. At least two major nesting beaches or areas on each of the two main islands should be selected as Index Beaches and protected from activities that compromise the suitability of the habitat to support sea turtle nesting. One Index Beach already fully monitored is Pasture Bay (Jumby Bay Hawksbill Sea Turtle Project) on Long Island, north of Antigua. This programme sets the standard for other beaches chosen for in-depth coverage. Whether monitoring efforts occur at night or during early morning hours, it is important to provide for a measurement of sampling efficiency, including nests missed, the ability to identify the age of a nesting crawl and the species responsible, and the ratio of nests to total crawls. The potential for aerial surveys should be investigated, in particular with regard to measuring nesting activity on remote beaches; aerial survey protocol is described in Pritchard et al. (1983).

The Jumby Bay Hawksbill Sea Turtle Project has already provided many important details necessary for the accurate interpretation of nesting monitoring data from other beaches. For example, the study has shown that hawksbills nest five times per season and that most females remigrate to the nesting beach on two- or three-year intervals. The approximate ratio of nests to crawls at Jumby Bay is 0.67, although this ratio *may vary* from beach to beach. The nest:crawl statistic is very important because it converts crawl counts to estimated nest counts. Having established an estimated nest count (which can be gleaned from early morning tallies of nesting beach crawls) and knowing that average fecundity is five nests/female/season, the number of females nesting during a particular year can be fairly estimated. As an example, if 30 crawls are counted during early morning patrols of a particular beach, an estimated 20 (30 x 0.67) would be considered nests. Dividing 20 by five nests per female shows that four turtles nested that year. Finally, using remigration indices (these have not been fully defined) converts average annual population size to total population size. [N.B. It should be noted that hawksbills may nest indiscriminately between adjacent beaches; thus, to gain an accurate picture of nesting activity, the full extent of the nesting area must first be defined.]

It is often difficult to confirm the deposition of eggs during early morning beach walks, but in some cases it is clear the turtle returned to the sea without ever attempting to dig. This is a "false crawl". Alternatively, when a poacher or predator has exposed eggs, or hatchlings are observed, nesting can be confirmed. In cases of an undisturbed crawl and potential nest site, distinguishing a true nest from an unsuccessful attempt is difficult even for an experienced worker. Gently probing for the eggs with a sharp stick will sometimes confirm the presence of a nest, but this is strongly discouraged because bacterial invasion of broken eggs may destroy the entire nest. In the case of hawksbills, even finding a site suitable for probing among dense vegetation can be difficult. Hence the logic that crawls (or tracks), rather than nests, be the basis

of reporting. When a crawl has been counted, it should be disguised with a palm frond or a gentle sweeping motion of hands or feet in order to dissuade possible poachers from finding the site and also to prevent the crawl from being counted twice.

Identifying a fresh crawl as to species is possible in many cases, since sea turtles leave either a symmetrical or an asymmetrical track in the sand. In the first case, the pattern is made by the simultaneous movement of the fore flippers. In the second case, the pattern alternates like a zipper, a result of the turtle moving her fore flippers in an alternating rhythm. Leatherbacks leave a deep, symmetrical crawl about 2 m in width. Green turtles also leave a symmetrical crawl, but only about 1 m in width; the nest site is often characterized by a deep, solitary pit 1 m or more in depth and breadth. Hawksbills and loggerheads leave an asymmetrical crawl, the hawksbill about 0.7 m in width and the loggerhead about 1.2 m in width. The hawksbill crawl is often very faint, however, since the animal averages a mere 54 kg (Caribbean Nicaragua: Nietschmann, 1972 *in* Witzell, 1983). Loggerheads are typically twice as massive, averaging about 116 kg in Florida (Ehrhart and Yoder, 1978 *in* Dodd, 1988). In addition, hawksbills will often make their nests deep within the shelter of Coccoloba or other beach vegetation.

As noted above, the nest:false crawl ratio for each beach is important. For hawksbills, the ratio can be approximated by using the Jumby Bay figure. Once the number of nests laid per species is known for a particular beach, a knowledge of the average number of clutches laid per female (estimated to be four for green turtles, five for hawksbills, six for leatherbacks) can be used to estimate the number of breeding females at that site. To obtain a more accurate assessment of the number of females nesting per year on a particular beach, as well as the return intervals both within and between seasons by individuals, all-night patrols must be undertaken by trained personnel and the tagging of nesting females initiated. Tagging is not something to be undertaken lightly. It is time-consuming and can be expensive. Most importantly, one does not learn much about nesting dynamics from tagging for a year or two. A long-term research commitment is requisite for knowledge gained beyond that obtained from daily crawl counts.

Beach surveys could be undertaken by volunteer groups, as suggested in section 4.112, if coordination (such as by the EAG) were available. The EAG youth group (EAG'ER) is encouraged to continue and expand its preliminary survey efforts in the English Harbour community under the supervision of Veronica Micheal, EAG Environmental Education Coordinator. The group has conducted periodic walking surveys of Pigeon Point and Freeman's Beach since 1991. Their objective has been to quantify reportedly significant losses of hawksbill nests to mongooses and to involve the community in sea turtle conservation. The EAG's concept of collaborating with one or two area fishermen and a small group of dedicated students is excellent. Using both EAG and community resources, we recommend expanding the survey effort to June-November morning patrols of Windward, Pigeon Point, Big Rendezvous, and Little Rendezvous bay beaches. Participants (and interested members of the community) should be required to attend a brief but comprehensive training seminar sponsored by the EAG and WIDECAST.

In addition to morning surveys, nocturnal patrols should be undertaken periodically throughout the season (e.g., one week of nights per month). These nightly efforts are not intended to gather systematic data, but rather to provide participants a chance to witness egg-laying and acquire a keener understanding of the turtles and their behaviour. This experience is

very useful when it comes to interpreting nesting crawls on the beach during the day. Participants should plan to spend a week with the Jumby Bay Hawksbill Turtle Project leaders learning proper beach etiquette and the techniques for measuring and tagging, if such activity is planned for the English Harbour area. As stated above, tagging should be not be undertaken lightly. Done incorrectly it can be painful and counter-productive. Done correctly, however, it can provide useful information on post-nesting movement if tagged turtles are captured by fishermen in distant countries and the tag returned (all tags are stamped with a return address).

4.292 Hatchlings

On beaches where sea turtle nesting occurs, it is necessary to identify causes of hatchling mortality. Choose an adequate sample of sea turtle nests from selected beaches and follow the fate of the eggs through hatching and emergence. Record losses to predators, erosion, wave-wash, crushing by vehicles, etc. Calculate hatching success by analysis of nest contents following the natural emergence of all the baby turtles. Estimate the number of hatchlings from the number of broken egg shells, then estimate total clutch size by factoring in the number of undeveloped eggs, pre-term embryos, hatchlings dead in the nest, etc.

4.293 Immature and adult turtles

The monitoring of juvenile and adult turtles requires special preparation and can be much more difficult than counting nests or evaluating hatchling mortality. For example, quantification of sea turtle numbers in the water by aerial survey has never been particularly successful. This technique probably should not be attempted here except with extreme caution as to conclusions reached. Instead, identify transects along reefs and grass beds for counting foraging sea turtles in a statistical manner suitable for replication. Solicit the assistance of divers and other private individuals to perform this task as a volunteer effort. Establish a network for reporting the presence of turtles found moribund or dead on beaches. Gather information from fishermen and boaters on sightings of sea turtles at sea. Prepare data forms that will function as guides for gathering all pertinent information. Again, select one individual, either a government official or a member of the WIDECAST local network to function as a repository for statistical data.

Beyond sightings and strandings data, specific and highly valuable information can be gained using bio-telemetry. Comprehensive monitoring of juvenile populations can only be accomplished using radio or other remote tracking technologies designed to document range and movement. Range and movement data are also necessary for the effective conservation of re-productively active adults. The monitoring of gravid females during the nesting season is particularly important. Without accurate information on inter-nesting behaviour and movement, at-sea conservation initiatives regarding incidental catch, pollution, habitat protection, etc. are far less likely to be successful. The assistance of qualified professionals should be solicited to design and implement a study to monitor stocks at sea using bio-telemetry.

4.3 Encourage and Support International Cooperation

Sea turtles are highly migratory throughout the Caribbean; no one nation can adequately protect them without the cooperation of other States. Antigua/Barbuda is strongly encouraged to

pursue international sea turtle conservation programmes with the OECS, CARICOM, the Caribbean Environment Programme of UNEP, and to participate in cooperative fisheries symposia such as the Western Atlantic Turtle Symposium (WATS). The fact that Antigua and Barbuda ratified the Cartagena Convention in 1986 (section 4.32) and was instrumental in the drafting and adoption of the new Protocol for Specially Protected Areas and Wildlife (SPAW) associated with this Convention, speaks highly for its willingness to participate in the international conservation community. It is a recommendation of this Recovery Action Plan that Government ratify the SPAW Protocol and the CITES treaty. International pollution control treaties are also important to Antigua and Barbuda; specifically, MARPOL 1973 (with Protocol 1978) and the London Dumping Convention 1972. These treaties are discussed in more detail below.

4.31 CITES

The 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is among the most powerful wildlife treaties in the world. With 118 member nations worldwide, the most recent being Barbados (USFWS, 1992), it has been very effective at reducing international commerce in endangered and depleted species, including their parts and products. Appendix I lists endangered species (including all species of sea turtle), trade in which is tightly controlled; Appendix II lists species that may become endangered unless trade is regulated; Appendix III lists species that any Party wishes to regulate and requires international cooperation to control trade; Appendix IV contains model permits. Permits are required for species listed in appendices I and II stating that export/import will not be detrimental to the survival of the species. It is an urgent recommendation of this Recovery Action Plan that Antigua and Barbuda, which is not yet a Party to this Convention, accede as soon as possible. This step is especially important because it appears that some wildlife traders are falsifying shipping documents to indicate "Antigua and Barbuda" as the point of origin for sea turtle products illegally exported from CITES countries to Japan.

According to Japanese Customs Statistics, 849 kg of 'bekko' (hawksbill shell scutes) was exported to Japan between 1983-1986 from Antigua/Barbuda (Milliken and Tokunaga, 1987). Based on a calculated average yield of 1.34 kg of bekko per turtle imported into Japan from the Caribbean region (Milliken and Tokunaga, 1987), this trade represents about 630 endangered hawksbill turtles. Japanese dealer's data indicate an even higher level of export, equal to some 1,089 kg (813 turtles) between 1984-1986. The authors of this Recovery Action Plan consider it impossible that these turtles were exported from Antigua/Barbuda (there is no evidence that the harvest is high enough to support such trade and no evidence of stockpiling of shell). This conclusion is supported by Milliken and Tokunaga (1987) who suggested that shipments of shell obtained elsewhere in the Caribbean had been deliberately labeled "Antigua/Barbuda" because of our non-Party status with regard to CITES. Canin (1991), in a review of the international aspects of Japanese hawksbill shell industry, also considered it unlikely that the shell exported to Japan from Antigua and Barbuda (which, in 1990, was 2,505 kg -- *among the highest volume of bekko export in the world*) had been obtained locally. Antiguan authorities deny any knowledge of the export, further suggesting foul play on the part of unscrupulous dealers.

In order to eliminate such abuse on the sovereignty of Antigua and Barbuda by smugglers, it is essential that Antigua and Barbuda ratify CITES. It is encouraging that Adrian

Brown (Customs Officer, Ministry of Finance) and Everette Williams (Forestry Assistant Officer, Ministry of Agriculture) attended the Caribbean CITES Implementation Training Seminar held in Trinidad, 14-18 September 1992. This comprehensive seminar, hosted by the Government of Trinidad and Tobago and the CITES Secretariat, was convened to familiarize Eastern Caribbean governments, especially non-CITES parties, with the Convention.

4.32 Regional treaties

In 1940, the Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere was negotiated under the auspices of the Pan American Union. Twelve of the parties to the Western Hemisphere Convention are in the wider Caribbean region (Antigua and Barbuda is not a party). The Convention has not been as effective as it might have been, however, since it contains no mechanism for reaching decisions binding upon the parties but leaves each party to implement the treaty's provisions as it find "appropriate". The Bonn Convention for the Conservation of Migratory Wild Animals, if ratified by enough nations in the wider Caribbean, could be an effective tool in the conservation of migratory species, such as sea turtles. It was developed to deal with all threats to migratory species, including habitat destruction and taking for domestic consumption. Unfortunately, only France, the Netherlands and the United Kingdom, among nations of the wider Caribbean, have signed this Convention.

The 1973 International Convention for the Prevention of Pollution from Ships, known as the MARPOL Convention, is an important treaty for the conservation of marine habitat. Its objective is "to preserve the marine environment by achieving the complete elimination of international pollution by oil and other harmful substances" (UNEP, 1989). Antigua and Barbuda deposited its instrument of ratification on 9 February 1987. The Convention has five Annexes that give detailed technical specifications regarding the way in which a ship must be built and equipped to prevent major pollution of the marine environment in case of accidents, as well as technical requirements to minimize operational discharges. The five Annexes are for oil, chemicals in bulk, packaged chemicals, liquid sewage, and garbage. Regarding Annex 5 (garbage), it has been proposed to the International Maritime Organization (IMO) by the nations of the Caribbean that the Caribbean Region be declared a "Special Area". This proposal has been accepted, but will only come into force when nations install facilities to receive garbage on shore.

The most promising regional environmental treaty with regard to the protection of sea turtles and their habitats is the United Nations Environment Programme's (UNEP) Regional Seas Convention in the Caribbean, known as the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (the "Cartagena Convention"). The Convention is coupled with an Action Plan, known as the Action Plan for the Caribbean Environment Programme (APCEP). The First Intergovernmental Meeting on APCEP was convened by UNEP in cooperation with the Economic Commission for Latin America in Montego Bay, Jamaica, 6-8 April 1981. The representatives of Governments from 22 States in the region adopted APCEP at this meeting and established the Caribbean Trust Fund to support common costs and activities associated with the implementation of the Action Plan.

In March 1983, a Conference of Plenipotentiaries met in Cartagena, Colombia to negotiate the Cartagena Convention and ultimately adopted both the Convention and a Protocol

Concerning Co-operation in Combating Oil Spills in the Wider Caribbean Region. The Convention describes the responsibilities of Contracting Parties to "prevent, reduce and control" pollution from a variety of sources (i.e., pollution from ships, from at-sea dumping of waste, from land-based sources, from sea-bed activities, and from airborne sources). Article 10 is of special interest in that it addresses the responsibilities of Contracting Parties to "individually or jointly, take all appropriate measures to protect and preserve rare or fragile ecosystems, as well as the habitat of depleted, threatened or endangered species, in the Convention area." Antigua and Barbuda ratified the Convention on 11 September 1986.

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

On 11 June 1991, Plenipotentiaries again met in Kingston, Jamaica, to formally adopt the Annexes. The Conference voted unanimously to include all six species of sea turtle inhabiting the Wider Caribbean (i.e., Caretta caretta, Chelonia mydas, Eretmochelys imbricata, Dermochelys coriacea, Lepidochelys kempii, and L. olivacea) in Annex II (Eckert 1991; UNEP, 1991). The unanimous vote on this issue is a clear statement on the part of Caribbean governments that the protection of regionally depleted species, including sea turtles, is a priority. Antigua/Barbuda 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 the government has not yet ratified the Protocol. It is a strong recommendation of this Recovery Action Plan that Antigua and Barbuda ratify the SPAW Protocol with its Annexes at the earliest possible opportunity.

4.33 Subregional sea turtle management

It is a recommendation of this Recovery Action Plan that the Antigua/Barbuda Fisheries Officer work closely with regional groups such as the WIDECAST, OECS, CARICOM, CCA, UNEP, and others on cooperative sea turtle recovery and management programmes. The OECS/FAO Draft Report of the Workshop on the Review of the Harmonized Fisheries Legislation (March 30 - April 2, 1992) recommends a moratorium on the taking of sea turtles in member countries. This decision meaningfully strengthens the recent decision by Parties to the UNEP Cartagena Convention to ban the direct and incidental harvest of marine turtles throughout the Wider Caribbean. Representatives of Antigua and Barbuda should actively support OECS-wide (and regional) protection for sea turtles. Sea turtles are migratory marine animals and unilateral conservation, while important, is insufficient without equal protection in neighbouring states. In

the case of Antigua and Barbuda, cooperative programmes to monitor stocks and enforce regulations should be established with Anguilla, St. Martin/Maarten, and St. Barthelemy to the north, Saba, St. Eustatius, and St. Kitts and Nevis to the west, and Montserrat and Guadeloupe to the southwest. Full regional efforts are also needed, as clearly shown by the capture in Barbuda of a green turtle tagged earlier at Aves Island (Cato et al., 1978) and the more recent capture in Dominica of a hawksbill tagged on Long Island, Antigua.

Since sea turtle tagging is new to Antigua and Barbuda and is only being done at Pasture Bay, Long Island, it is not surprising that little direct evidence is currently available regarding the international movements of Antigua and Barbuda turtles. There has been only one recapture, and that was of a hawksbill tagged while nesting at Pasture Bay, Long Island, on 18 June 1991. The same turtle was captured by a fisherman in Dominica during the first week of November 1991. Recognizing that tag returns can provide valuable information on the range of sea turtles, it is a recommendation of this Recovery Action Plan that the Jumby Bay Hawksbill Turtle Project continue to tag the females nesting at Pasture Bay, and that trained personnel in Antigua do whatever they can to promote responsible, long-term tagging efforts in neighbouring countries. Furthermore, fishermen should be made aware of turtle tagging efforts and should be encouraged to participate in sea turtle conservation by returning tags removed from dead turtles to the address engraved on the tag. An observer should never remove a tag from a living turtle, but should a live tagged turtle be captured accidentally in a net, for example, the tag *number* should be recorded prior to the turtle being released back to the sea. This information should be sent to the tag address.

4.4 Develop Public Education

4.41 Residents

It is important that residents have access to sea turtle information so that informed decisions can be made regarding the management and conservation of these endangered species. Fortunately, there is a growing effort on the part of several groups in Antigua and Barbuda to design and implement public awareness programmes that include sea turtles. Such efforts, which often are accompanied by national media coverage, have been made by the Fisheries Division, EAG, Body Shop, Cable and Wireless, and C-TV (local cable "superstation"). The EAG is presently building a library of natural resource materials and WIDECAST is actively involved in providing scientific papers and other references, as well as posters, brochures, videos, and slides. In addition, EAG and WIDECAST personnel are working together to design two colour brochures to share with schools, community groups, museums, and selected places of business, as well as with tourists and other visitors. One will provide a general explanation of sea turtle biology, why turtles are endangered, and what regulations protect them in Antigua and Barbuda. The other will have more local flavour, focusing on the history and future of local sea turtles and what is being done by EAG and others to promote sea turtle conservation.

WIDECAST has developed several information packets about hawksbills nesting at Pasture Bay for Jumby Bay Resort home owners, as well as given public presentations to home owners and their guests both on the beach during turtle patrol and in more formal settings. We encourage sea turtle research and programme leaders at Jumby Bay Resort to provide copies of

their approved guidelines to safeguard the hawksbill nesting beach at Pasture Bay, Long Island, to other beach communities (see section 4.122). The Jumby Bay Hawksbill Turtle Project also includes programmes and slide shows in the public schools of Antigua, sometimes with live turtle hatchlings. These programmes, conducted by the Jumby Bay research biologists and in collaboration with the EAG, are in much demand by Antiguan teachers. School programmes such as these should be a high priority in Antigua and Barbuda, for the roots of a conservation ethic are nurtured at a young age. These programmes should treat more than the biology and conservation of sea turtles. Children should be taught that the continued presence of sea turtles in our waters is a necessary part of our national pride and important for the quality of life in Antigua and Barbuda. In addition, and also relating to children, the Jumby Bay program is assisting with the development of a children's book focusing on hawksbill sea turtles. This book is expected to be available for distribution in 1993 or 1994.

Since 1991, the EAG has been active in providing lectures and slide shows about sea turtles to the public schools, mainly primary schools. Programme expansion into the secondary schools has begun; Science Clubs are being targeted as a priority. A video of the Jumby Bay Resort hawksbill research programme has been provided to the EAG and this has been a popular school presentation. Unfortunately, only two schools have the equipment necessary to view videos. The EAG is presently seeking a grant to purchase its own video and slide viewing equipment in order to expand its community outreach capacity. The EAG has done remarkable job of public awareness and creative programming, despite the fact that the Group has no paid or full-time staff. Full advantage should be taken of the print and electronic media in getting the sea turtle conservation message across to the citizenry of Antigua and Barbuda.

Informative programmes on the conservation and biology of Antiguan sea turtles have also been given to local dive clubs and to the staff of the Jumby Bay Resort. These programmes are very popular and much appreciated by the audiences. SCUBA dive clubs should be encouraged to become involved with cooperative research efforts by keeping records of sightings on standard forms provided for this purpose. A central clearing-house for the data is essential.

4.42 Fishermen

Fishermen who specialize in the taking of sea turtles should be encouraged to explore alternative fishing targets, in order that sea turtles might have a chance to recover their numbers. Work with "opportunistic fishermen", those that take lobster and reef fish with spear-guns, is necessary to heighten the probability that they will leave the occasional sea turtle alone. The possibility of utilizing some of the fishermen as paid research assistants should be considered; this has worked well in other areas and works particularly well where researchers use tangle nets for mark-recapture studies of growth and habitat use. The Fisheries Division, in cooperation with the Antigua and Barbuda Sport Fishing Club and the Antigua and Barbuda Fisherman's Association, has undertaken an intensive data-gathering project in order to obtain data essential to the sustainable management of local fisheries resources. This effort provides an excellent opportunity to emphasize that the Fisheries Regulations regarding sea turtles were recently revised (section 4.21) and that a regional moratorium will soon be enacted, pending Antigua/ Barbuda ratification of the SPAW Protocol to the Cartagena Convention (section 4.32).

4.43 Tourists

All major resorts constructed on or adjacent to sea turtle nesting habitat should be provided with sea turtle awareness materials, perhaps based on materials already developed for Jumby Bay Resort owners and guests, and including the *Sea Turtles of Antigua and Barbuda* brochure currently under development by WIDECAST and the EAG (section 4.41). In addition, a brochure should be designed specifically for visitors that explains local regulations and international law, the latter so that tourists are aware that sea turtle products cannot legally be returned to most countries. A display planned for the Museum of Antigua and Barbuda, a joint project of WIDECAST and museum staff, will provide an excellent opportunity to educate both visitors and residents about endangered sea turtles. An additional display at the international airport would be highly desirable, as well as attractive displays at selected hotels, dive shops, and other tourist-oriented places of business. It would be useful to integrate these efforts into the larger context of encouraging travelers not to collect coral or other marine creatures, not to anchor sailboats and yachts on local reefs, and to practice appropriate "beach etiquette" (no driving on beaches, no bonfires, no litter). Funding for such a programme could be solicited from businesses in tourist districts, such as St. John's.

4.44 Non-consumptive uses of sea turtles to generate revenue

Tourism is appreciated and understood as a primary source of revenue. SCUBA dive clubs could perhaps be rewarded with free promotional help if they feature non-consumptive experiences with sea turtles, such as photography. It should be stressed whenever possible that the value of accessible, visible sea turtles on natural coral reefs is a good investment! We recommend that SCUBA dive operators, clubs, and retail shops be fully integrated into ongoing public awareness efforts on the part of EAG and others. Lynn Corliss, former Field Director for the Jumby Bay Hawksbill Project, has designed and distributed data sheets to local dive operators in order to encourage their participation in reporting sea turtle sightings. "Turtle Walks" may at some future time be offered under the aegis of the EAG. Participants would pay a fee to accompany a trained Guide to a sea turtle nesting beach to quietly and non-obtrusively observe the nesting process. Guidelines developed for the Jumby Bay Resort could serve as a blueprint for such an endeavour. In addition, WIDECAST is preparing a Sea Turtle Ecotourism Manual for use throughout the region.

4.5 Increase Information Exchange

4.51 Marine Turtle Newsletter

The Marine Turtle Newsletter (MTN) is a scholarly publication that provides timely information regarding the conservation status of sea turtles around the world, as well as new research techniques and a listing of current scientific publications about sea turtles. English and Spanish editions of the MTN are distributed quarterly, free of charge, to readers in more than 100 countries. At the present time, the Newsletter is received in Antigua/Barbuda only by John Fuller, a member of the WIDECAST regional Sea Turtle Recovery Team. We recommend that local readership be broadened to include Fisheries personnel, the Environmental Awareness Group, interested members of the Jumby Bay Club, and public libraries in the country. To sub-

scribe, notify the Marine Turtle Newsletter Editors, Hubbs-Sea World Research Institute, 1700 South Shores Road, San Diego, California 92109 USA.

4.52 Western Atlantic Turtle Symposium (WATS)

The nation of Antigua and Barbuda has supported this important regional data base in the past and is encouraged to continue to support and participate in the efforts of this Symposium in the future. A National Report for Antigua and Barbuda was drafted by Joseph et al. (1984) for the first Western Atlantic Turtle Symposium (WATS I) convened in 1983 in Costa Rica. At WATS II, convened in 1987 in Puerto Rico, Antigua and Barbuda was represented, but a National Report was not presented. An important resource book, the Manual of Sea Turtle Research and Conservation Techniques (Pritchard et al., 1983), was a product of WATS I.

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 that 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 Antigua and Barbuda, in the Wider Caribbean. Each STRAP is tailored specifically to local circumstances and provides the following information:

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

The short-term objectives of WIDECAST are to provide Wider Caribbean governments with updated information on the status of sea turtles in the region, to provide specific recommendations for the management and recovery of endangered, threatened, and vulnerable sea turtle stocks, and to assist Wider Caribbean governments in the discharge of their obligations under the Protocol Concerning Specially Protected Areas and Wildlife (SPAW) in the Wider Caribbean Region (see section 4.32). The longer-term objectives are to promote a regional capability to implement scientifically sound sea turtle conservation programmes. 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. Utilising local network participants to collect information and draft, under the supervision of regional sea turtle experts, locally appropriate sea turtle management recommendations.

3. Providing or assisting in the development of educational materials (slides, brochures, posters, pamphlets).
4. Sponsoring or supporting local or subregional workshops on sea turtle biology and management.
5. Assisting governments and non-government groups with the implementation of effective management and conservation programmes for 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 Caribbean Trust Fund of the UNEP Caribbean Environment Programme, as well as by government and non-government agencies and groups. Government and non-government personnel, biologists, fishermen, educators, developers, and other interested persons are encouraged to join in WIDECAST's efforts in Antigua and Barbuda. The Country Coordinators in Antigua and Barbuda are John and Sarah Fuller, Hodges Bay, P. O. Box 1168, St. John's, Antigua. John Fuller is also a member of the WIDECAST regional Sea Turtle Recovery Team.

4.54 IUCN/SSC Marine Turtle Specialist Group

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

4.55 Workshops on research and management

Prior to the implementation of field surveys or other sea turtle conservation projects, participants should be educated concerning basic sea turtle ecology. This training should include the identification of sea turtle species, whether the evidence available is a live turtle, a hatchling, an egg, or a crawl on the beach. Additional detail, provided as needed, could include proper methods to tag turtles, to conduct beach patrols, move eggs, survey by air, etc. Informal on-site workshops can be arranged by WIDECAST upon request. More formal field instruction is available from the Caribbean Conservation Corporation (P. O. Box 2866, Gainesville, Florida 32602) at their annual sea turtle training course in Tortuguero, Costa Rica. A Manual of Sea Turtle Research and Conservation Techniques, produced by the Western Atlantic Turtle Symposium (Pritchard et al., 1983), provides instruction and background for many sea turtle research and management techniques. Programme managers are encouraged to follow it to the fullest extent when research and conservation projects are designed and implemented.

4.56 Exchange of information among local groups

Almost any endeavour, especially conservation, benefits from the free exchange of information. Both the Environmental Awareness Group and the Historical and Archaeological Society produce and distribute informative newsletters to their memberships. Full advantage

should be taken of all opportunities to communicate the conservation message to residents and visitors alike.

4.6 Implement a National Sea Turtle Conservation Programme

4.61 Rationale

Sea turtles have always been and continue to be an inseparable part of life in Antigua and Barbuda. The full extent of their historical relationships with and importance to coral reefs, sea grass, and sandy beaches can only be guessed, for the vast numbers of turtles once present in our waters have been reduced to relatively few individuals. The last surviving animals provide a treasured link with an historical heritage now largely gone. They are part of our quality of life. Our children deserve the right to observe a hawksbill turtle laying her eggs beneath a sea grape tree, witness a fleet of green turtles foraging upon meadows of sea grass in coastal waters, or be awed by an encounter with a 1000 lb leatherback. No other rationale should be needed for a sea turtle conservation programme. There must be a personal obligation on the part of all Antiguans and Barbudans to preserve and recover for future generations what we have so nearly destroyed. Further, we have a responsibility to our fellow Caribbean citizens, since sea turtles are a shared heritage amongst our many nations.

Sea turtles are also a valuable economic resource. They once provided an important source of food and raw materials for our island forebears, from pre-Columbian days to the mid-twentieth century. Having now decimated our sea turtle stocks through indiscriminate harvest, it is no longer reasonable to expect to earn a livelihood from the killing and eating of turtles. Today, the economic value of *living* sea turtles for non-consumptive "ecotourism" far outweighs the cash value of the turtle fishery. Living sea turtles mean jobs. Conservation of sea turtles is in the best economic interest of all Antiguans and Barbudans. Perhaps someday we can sufficiently recover our sea turtle population numbers to again share in the harvest of turtles, but we must first prove our wildlife management skills before that day can arrive. We must focus our management efforts on the three species of sea turtle, all classified as Endangered (Groombridge, 1982; Groombridge and Luxmoore, 1989), that still nest in Antigua/Barbuda. These are the hawksbill, leatherback, and green turtle (Figure 2).

A sea turtle conservation programme is needed for Antigua and Barbuda, and it must be implemented immediately. Relatively small nesting populations remain of hawksbills, green turtles, and leatherbacks (we estimate <130 nesters/yr, combined). They must be protected at all costs, for we know that sea turtles return to nest where they were born. Beaches stripped of their resident nesting turtles may not be recolonized in less than hundreds of years. Existing fisheries legislation is inadequate to promote full recovery of remaining stocks and illegal harvest continues, despite conservation laws currently in place. Nesting and feeding habitat is being destroyed at an alarming rate. Our citizens continue to believe that sea turtles are forever, that the ocean will always provide, and that the responsibility for our disappearing turtles must lie far away and not with us. This is denial of responsibility. There is still time for a meaningful sea turtle conservation programme in Antigua and Barbuda, but not much time.

4.62 Goals and objectives

The broad goals and objectives of the proposed Sea Turtle Conservation Programme (STCP) are to obtain comprehensive and accurate data on the distribution of sea turtle nesting and foraging habitats and to promote the conservation and recovery of remaining sea turtle stocks. The specific objectives of the Programme are as follows:

1. Establish a Sea Turtle Conservation Programme (STCP) with a full-time Programme Director, an office, and a Board of Directors.

2. Ground survey (at least weekly, 1 April-30 November) all potential nesting beaches (see Table 1) during Years 1 and 2. During Years 3-5, determine nest density and nest success at at least four important rookeries (defined based on the initial 2-year survey), two each in Barbuda and Antigua, in addition to Pasture Bay (Long Island).

3. Collect information relative to the distribution and abundance of turtles at sea during Years 1-5, based on sightings from volunteer network participants and data gathered during any ongoing or planned coral reef and/or sea grass monitoring programmes.

4. Quantify critical nesting and feeding habitats based on the results of field surveys undertaken as described in 2 and 3 above, and develop holistic management plans for these habitats as soon as possible.

5. Define residency patterns and movements of local sea turtles and evaluate the extent to which sea turtles are shared with neighbouring political jurisdictions (use tagging programmes and bio-telemetry).

6. Quantify the exploitation (direct harvest) of sea turtles on an annual basis, based on user and market surveys.

7. Quantify the incidental take of sea turtles in Antigua/Barbuda waters by local and foreign-operated longline and net fisheries.

8. Enact and enforce a moratorium on the capture of sea turtles (all species) and the collection of sea turtle eggs.

9. Promote community support of (and participation in) sea turtle conservation; increase public awareness through ongoing education programmes in schools, public presentations, brochures and posters, and the media.

10. Solicit assistance from the public in documenting sea turtle nests and at-sea sightings, reporting illegal activities, and safeguarding turtles and eggs from poachers by providing informal surveillance.

4.63 Activities

The following activities are proposed to meet the goals and objectives outlined above:

1. Organize a STCP Board of Directors, keeping the Board non-governmental but with invited participation from government officials involved with sea turtles and coast conservation. Hire a Programme Director by Year

2. Establish a list of action initiatives. Distribute itemized responsibilities to specific individuals and organizations.

3. Identify and involve in the STCP pertinent Government (national and island) ministries and offices, non-governmental groups (e.g., the EAG, Georgia Sea Turtle Cooperative Research and Education Program, Museum of Antigua and Barbuda), local fishing and development representatives, U. S. military commands, hotels, private community organizations (e.g., Mill Reef Club, Jumby Bay Club), social clubs and children's groups, concerned citizens, and international organizations.

3. Maintain an active WIDECAST network in Antigua/Barbuda to sustain and support the STCP.

4. Undertake at least weekly ground surveys of all sandy beaches where sea turtles are believed to lay their eggs (see Table 1, Figures 3 and 4) for two consecutive years (1 April-30 November).

5. Based on data collected during Years 1 and 2 (see activity no. 4), at least two Index Beaches will be identified on Antigua and two on Barbuda for comprehensive study. These beaches will be patrolled daily, preferably at night, in order to quantify population size and reproductive success. We predict that the following areas will emerge as important habitat, and thus good candidates for Index Beach designation: Antigua -- Green Island and the Mill Reef beaches, Pearn's Point beaches; Barbuda -- western coast from Billy Point to The River, northeast coast in the vicinity of Two Feet Bay, south coast from Spanish Well Point to Coco Point and around to Spanish Point.

6. On secondary hawksbill nesting beaches where trend data are desired, an alternative to continuous daily surveys (June to November) will be employed. Specifically, at least two surveys covering 18 consecutive nights each will be undertaken (one in August, one in October). Then, using the Jumby Bay Hawksbill Sea Turtle Project data base, the resulting data will be extrapolated to describe the entire season.

7. Collect information relative to the distribution and abundance of turtles at sea over five consecutive years based on sightings from volunteer networks and data gathered during any ongoing coral reef and/or sea grass monitoring

programmes. Focus on sport fishermen, commercial long-line fishermen, and diving clubs for this purpose.

8. Support continuation of the long-term hawksbill population study at Pasture Bay, Long Island. Initiate additional long-term tagging studies on the main islands if surveys indicate that nesting densities are sufficient to reward such an effort. Request the existing expertise of the Jumby Bay Hawksbill Project and the participation of its scientific adviser (Georgia Sea Turtle Cooperative Research and Education Program) for assistance with initiation of any new tagging programmes.

9. Develop site-specific management plans for critical nesting and foraging habitats, including Index Beaches, taking into account the recommendations of this Recovery Action Plan. For nesting beaches, include provision for nightly protection against harassment of nesting females and adequate protection for incubating eggs throughout the hatching season. At sea, pollution and destruction of the seabed should be addressed.

10. Provide for the long-term protection of critical habitats. Hire and train wardens to oversee these areas and enforce compliance with regulations.

11. Solicit the assistance of professionals to design at-sea monitoring programmes to determine residency patterns and movements of sea turtles.

12. Conduct interview and market surveys in order to determine or estimate the number of sea turtles caught during the annual 1 September - 28 February open season. The number of turtles involved, as well as size species, place and method of capture, and fate (market) will be recorded. The number of fishermen involved will be determined. This is particularly important in Barbuda where a small turtle fishery continues.

13. Quantify the incidental take of sea turtles. Determine the types of fishing gear used in Antigua/Barbuda and determine the relative proportion of annual incidental catch attributable to each gear type. Collaborate with local Industries to have incidentally captured turtles brought to an authorised receiving station for rehabilitation (if alive and treatment is called for) or scientific study (if dead). Place observers and/or cameras on-board cooperative vessels. Work with Government and international conservation organizations to require on-board observers on foreign vessels fishing in Antigua/Barbuda waters.

14. Lobby Government with specific requests for improved national legislation and enforcement (see section 4.23) and international agreements. Encourage the Ministry of Foreign Affairs to sign CITES, MARPOL, and the SPAW Protocol to the Cartagena Convention.

15. Acquire field and camping equipment for sea turtle surveys, as well as data collection materials (e.g., measuring tapes, tags and pliers, flashlights, clipboards, tents, sleeping bags, cooking utensils, a small dinghy). These may be obtained by direct purchase, as well as by soliciting the donations of items. A 4-wheel ATV vehicle, such as a Honda 350, would be particularly useful for Barbuda.

16. Provide training opportunities (local workshops) for field personnel in data collection techniques. Whenever possible, encourage persons to attend relevant training programmes overseas (e.g., Tortuguero, Costa Rica) and to visit long-term research projects elsewhere in the region (e.g., Sandy Point National Wildlife Refuge, St. Croix).

17. Host workshops for volunteers, SCUBA operators, yacht and charterboat crews, etc. to provide training in sea turtle identification and record-keeping. This will enhance accurate reporting of sea turtle nesting and at-sea sightings, as well as public awareness of endangered sea turtles. Provide volunteers with log books, data sheets, etc.

18. Gather data opportunistically on the distribution and abundance of turtles at sea. Focus on sport fishermen; commercial longline fishermen; turtle, fish pot, and hook-and-line fishermen; and SCUBA dive clubs. Should sea grass and coral reef monitoring programmes be established, ensure that sea turtle sightings become part of the recorded data base. Determine species, size, and behaviour of the animal when sighted. Develop a confidence index for the accuracy of the observations. Correlate sightings with sea state, date, weather patterns, depth of water, bottom type, and proximity to other significant marine features.

19. Build a library of published scientific literature and environmental education materials for national use; house the collection at the National Sea Turtle Conservation Programme office.

20. Expand existing environmental education programmes for schools and the general public by purchasing or otherwise acquiring audiovisual materials and literature on sea turtle biology and conservation, distributing the WIDECAST sea turtle identification mini-poster, and working with WIDECAST to develop posters and leaflets for national display. Coordinate the EAG, Jumby Bay Hawksbill Project, and the Ministry of Education, Office of Science Education, to provide national sea turtle conservation programmes to local elementary schools.

A suggested time chart for these activities is the following:

	Activity	Year 1	2	3	4	5	Ongoing
1.	STCP Board of Directors	X					
	Hire STCP Programme Director		X				
	List/distribute action initiatives		X				
2.	Establish STCP partners	X					X
3.	Maintain WIDECAST network						X
4.	Preliminary beach surveys	X	X				
5.	Intense survey of Index Beaches			X	X	X	X
6.	Subsample secondary beaches			X	X	X	X
7.	Distribution/abundance at sea	X	X	X	X	X	X
8.	Continue Jumby Bay Project	X	X	X	X	X	X
9.	Site-specific mgmt plans			X	X		X
10.	Long-term protection of habitat						X
11.	Movements/behaviour at sea	X	X	X			
12.	Interviews and market surveys	X	X				
13.	Determine incidental take	X	X				X
14.	Lobbying initiatives	X	X				X
15.	Acquire survey equipment	X	X				X
16.	Training	X	X				X
17.	Workshops	X	X				X
18.	Involve marine users	X	X	X	X	X	X
19.	Build a sea turtle library	X	X				X
20.	Environmental education	X	X	X	X	X	X

4.64 Budget

The STCP will not function without financial and material support from Government and non-government sources. The following budget, except for Warden's salaries, is expected to be solicited from private sources, grants, donations, etc. Amounts are US$ in multiples of $1000.

Item	**Year**	**1**	**2**	**3**	**4**	**5**
STCP Director		-0-	12	12	12	12
STCP Office (equipment)		5	4	3	2	2
STCP Office (supplies)		1	1	1	1	1
Transportation (auto)		3	6	6	6	6
Transportation (boat)		2	2	2	2	2
Training Workshops (supplies)		1	1	1	1	1
School Programmes (supplies)		1	1	1	1	1
Environmental Education		3	3	3	3	3
Antigua Beach Surveys (wages)		3	3	3	3	3
Barbuda Beach Surveys (wages)		3	3	3	3	3
Survey Scientific Equipment		1	0.5	0.5	0.5	0.5
Survey Camping Gear		2	0.5	0.5	0.5	0.5
CB Radios		1.5	1.0	1.0	-0-	-0-
Intensive Tagging (wages, expenses)		15	15	25	35	35
Food and Housing for Field Biologists		7.5	7.5	15	25	25
2 Wardens (wages)		-0-	24	24	24	24
Contingencies (10%)		5	8.5	10	12	12
TOTAL		54	93	111	131	131

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Table 1. The distribution of sea turtle nesting beaches and beach ownership in Antigua and Barbuda. At some sites, nesting populations are thought to have already been lost; where this is believed to be the case, the species has been placed in brackets. Important and very important nesting beaches are indicated by a single (*) or double (**) asterisk, respectively. There are three species of sea turtle known to nest in Antigua and Barbuda -- the hawksbill (H), Eretmochelys imbricata; the green turtle (G), Chelonia mydas; and the leatherback (L), Dermochelys coriacea. Field surveys designed to corroborate and, as necessary, correct the following preliminary data are considered by this Recovery Action Plan to be an urgent priority. Beach length is given in kilometers.

	Beach	**Length**	**Owner**	**Species**
ANTIGUA				
1.	Pasture Bay, Long Is. **	0.7	Arawak Co.	H
2.	Sandy Island **	--	Government	H, G
3.	Great Bird Island (two beaches)	--	John Fuller	H
4.	Guiana Island	--	Guiana Isl. Farms Ltd.	H
5.	Pelican Island	--	Albertino Paravano, California USA	[??]
6.	Long Bay	--	Long Bay Hotel Pineapple Beach Hotel	H
7.	Devil's Bridge Beach	--	Government (Nat'l Park)	H
8.	Green Island * (several beaches)	--	Leased by government to Mill Reef Club	H, G
9.	Mill Reef Beaches ** (several beaches)	--	Mill Reef Club	H, G, L
10.	Half Moon Bay	--	Government H.M.B. Holdings, Ltd. (c/o Half Moon Bay Hotel)	H, G, L
11.	Crawl Bay	--	Government	??
12.	Mamora Bay	--	St. James Club	[??]
13.	Indian Creek Beach *	0.05	Ralph Camacho	H, G
14.	Freeman's Bay	--	Galleon Beach Hotel	[??]
15.	Windward Bay	--	New Century Develop. Co.	H, G
16.	Pigeon Point Beach	--	Government	H
17.	Dieppe Bay	--	Dieppe Bay, Ltd.	H, G
18.	Turtle Bay *	--	Mr. Jeff Pidduck	H, G?
19.	Little Rendezvous Bay	--	c/o Jack Henderson	H, G
20.	Big Rendezvous Bay *	--	c/o Estate of J. Rowan Henry	H, G, L
21.	Tuck's Beach	--	Mrs. Erskine	H, G
22.	Carlisle Bay	0.3	Carlisle Bay Develop. Co.	H, G, L
23.	Curtain Bluff Beach	0.3	Mr. Howard Hulford	H, G, L

Table 1, *continued*.

Beach		Length	Owner	Species
24.	Morris Bay *	0.5	Nicholas A. Fuller Government	H, G, L
25.	Johnson's Point	--	Mr. Daryl Belizaire Blue Heron Hotel	H
26.	Crabb Hill Beach	0.6	Government	--
27.	Darkwood Beach	0.6	Government	H, G
28.	Fryes Bay (two beaches)	0.4	Government	H, G
29.	Jolly Beach (=Lignumvitae Bay)	--	Jolly Beach Universal Caribbean Establishment	H
30.	Pearn's Point Beaches ** (5 beaches, 1 sand mined by the government)	0.6	Lawrence Nilsen, Ltd.	H, G, L
31.	Hermitage Bay (=Two Foot Bay, Royal Bay)	--	Pewee Francis	G
32.	Five Islands Estate Beaches *	--	Mr. Keith Edwards	G, H, L
33.	Hawksbill Bay (4 beaches, 1 important)	--	c/o Hawksbill Hotel	G
34.	Galley Bay	--	Galley Bay Hotel	H, G
35.	Deep Bay	--	Government	H
36.	Hog John Bay	--	Government	[H, G]
37.	Ft. James Beach	--	Government	[H]
38.	Runaway Bay *	1.0	Multiple owners	H
39.	Dickenson Bay	--	Multiple owners	H, L
40.	Soldier Bay (and 2 smaller beaches)	--	Mrs. Lee Schaffler	H
41.	White Sands Beach	--	Point Pleasant, Ltd.	H
42.	Jabberwock Beach *	--	Government	H, L
43.	Dutchman Bay	0.3	Mrs. Nicholas Fuller Government	H, L
BARBUDA				
1.	Spanish Point Beach *	0.2	Government	H
2.	Coco Point East	0.1	Mr. Frank Delisle	H
3.	Coco Point Beach *	4.8	Coco Point Hotel (USA) William Cody Kelly III Government, K Club	H, G, L

Table 1, *continued*.

Beach		Length	Owner	Species
4.	Coral Group Beaches *	1.7	Government	H
5.	Continuous Beach from River to Billy Point * (Palmetto Point, Low Bay, Palm Beach, Cedar Tree Point)	22.1	Government	H, G, L
6.	North Beach * (to Cobb Cove)	4.8	Government	H, G
7.	Kid Island Beach *	0.8	Government	H, G
8.	Fishing Creek Beach *	0.6	Government	H, G
9.	Hog Point to Sea View	4.0	Government	H
10.	Two Feet Bay	0.5	Government	H, G
11.	Ghaut to Pigeon Cliff	2.4	Government	H, G
12.	Pigeon Cliff to Griffin Pt **	2.4	Government	H, G, L
13.	Bleaky Bay Beaches	0.8	Government	H, L

Table 2. Selected reproductive data for hawksbill sea turtles (Eretmochelys imbricata) nesting at Pasture Bay (Jumby Bay Resort) on Long Island, Antigua, 1987-1992 (15 June-15 November). Nests per turtle, clutch size (=eggs per nest), and hatch success represent average annual values; ranges in parentheses.

Year	Total Turtles	Total Crawls	Total Nests	Nests/ Turtle *	Clutch Size	Hatch Success
1987	21	164	99	4.8	157 (62-215)	79%
1988	39	227	156	4.4	147 (70-203)	85%
1989	30	202	129	4.7	151 (96-196)	84%
1990	21	116	78	4.3	150 (68-202)	74%
1991	34	226	137	4.3	148 (94-225)	79%
1992	31	189	114	**	153 (124-229)	90%

* For maximum accuracy, annual clutch frequency (=nests per turtle) was calculated only for those turtles nesting completely within the survey period; that is, turtles that began nesting after 5 July and deposited their last clutch of eggs prior to 25 October. Since turtles do not normally display inter-nesting intervals exceeding 20 days, we can be confident that these individuals did not nest prior to the initiation of all-night patrol and likewise did not continue nesting after all-night patrol had ceased.

** Not calculated.

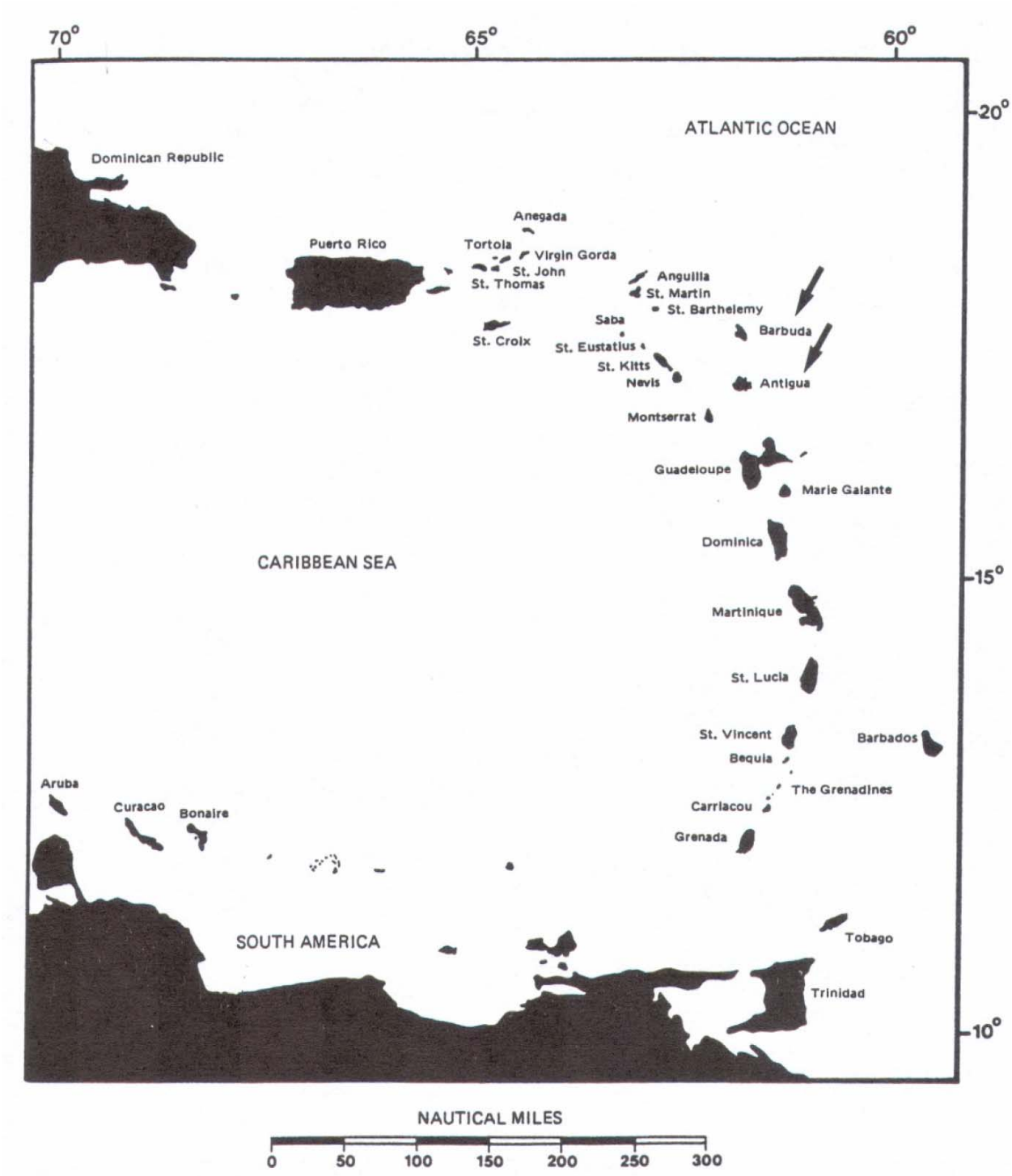

Figure 1. The two island nation of Antigua and Barbuda, West Indies.

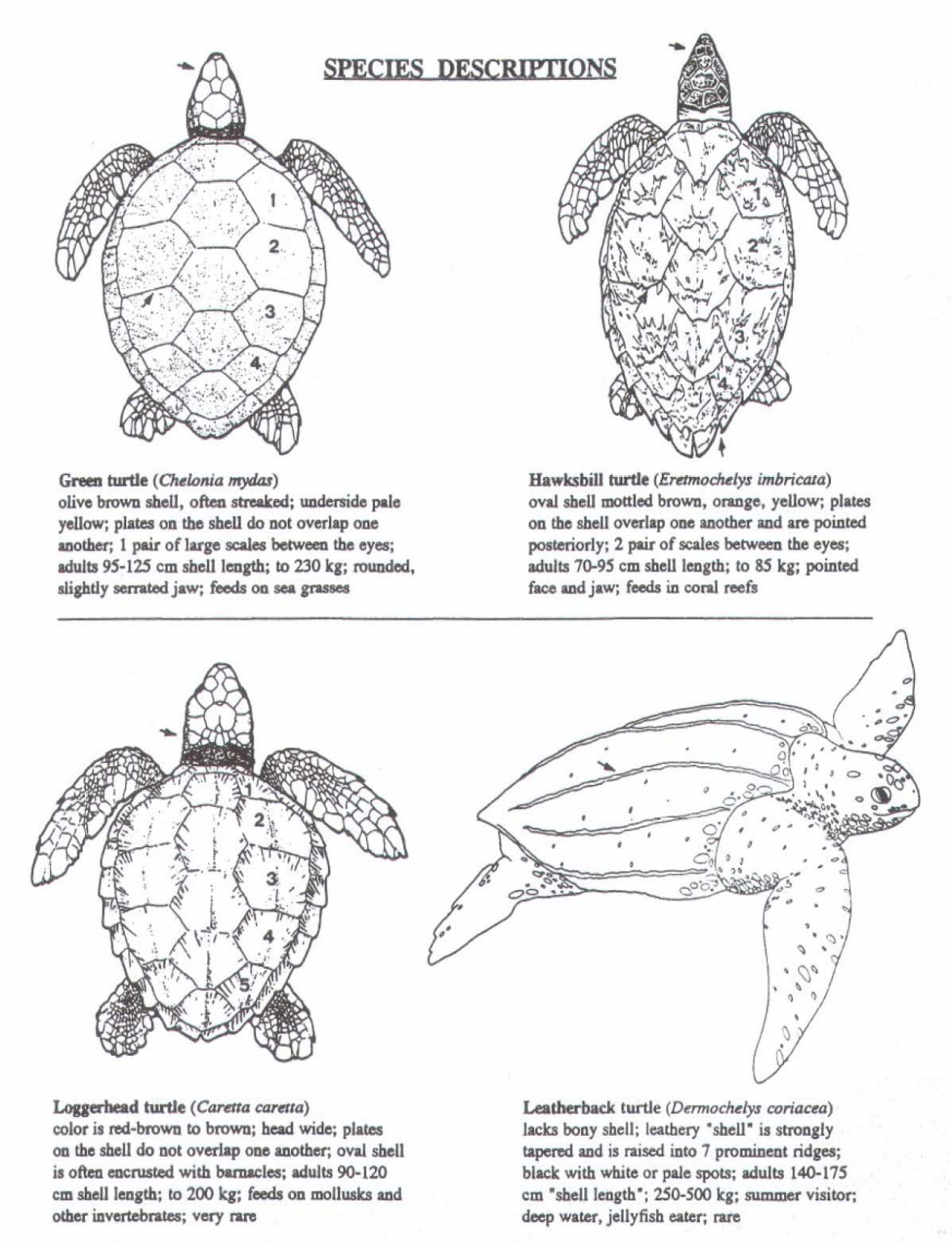

Figure 2. Four species of sea turtle are found in Antigua and Barbuda. Hawksbills (Eretmochelys imbricata) are most common, followed by green turtles (Chelonia mydas); loggerheads (Caretta caretta) and leatherbacks (Dermochelys coriacea) are much less common.

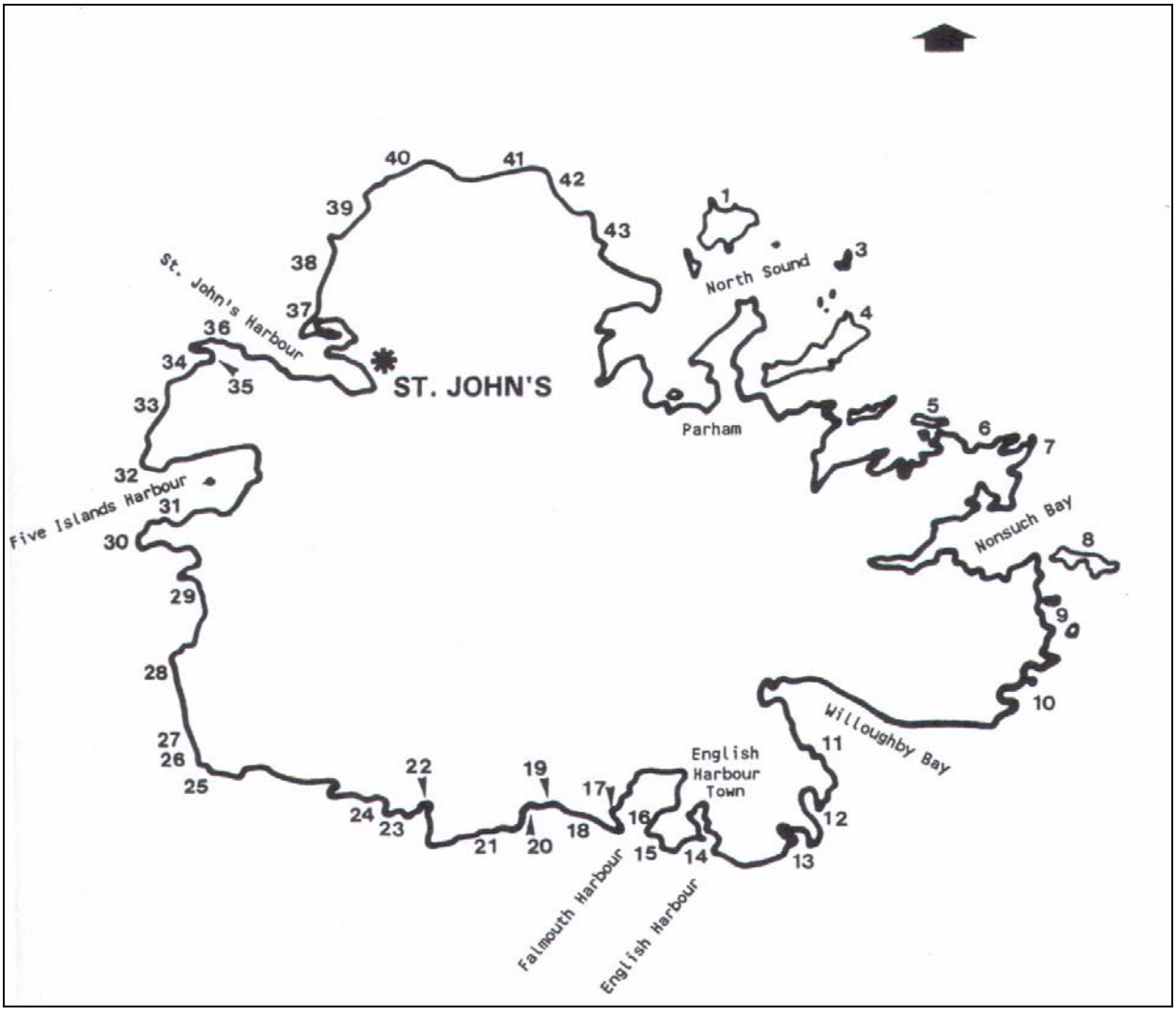

Figure 3. Known or suspected sea turtle nesting beaches in Antigua, West Indies. Numbers refer to locations listed in Table 1 (Sandy Island located northeast of Antigua is not shown).

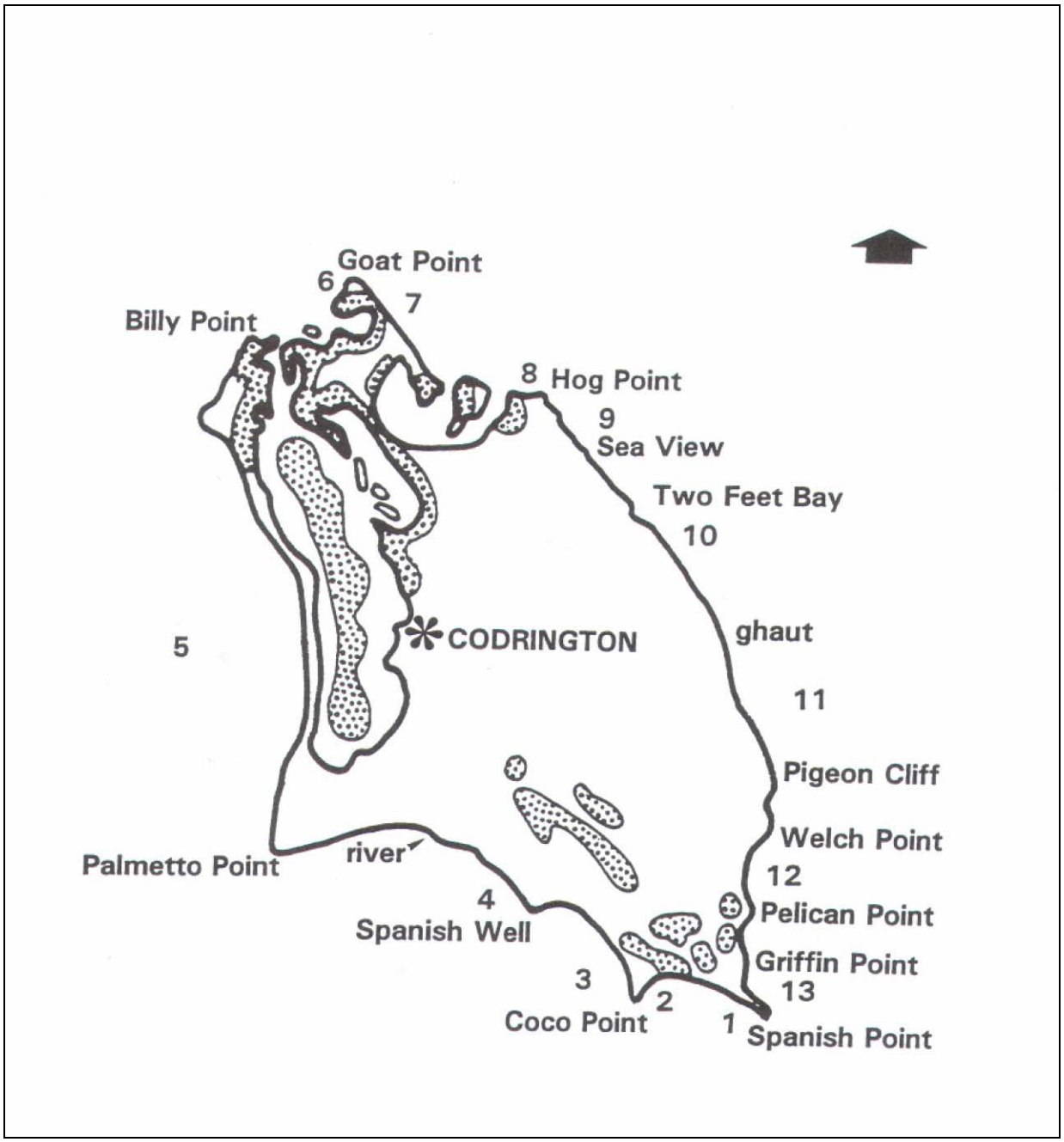

Figure 4. Known or suspected sea turtle nesting beaches in Barbuda, West Indies. Numbers refer to locations listed in Table 1.

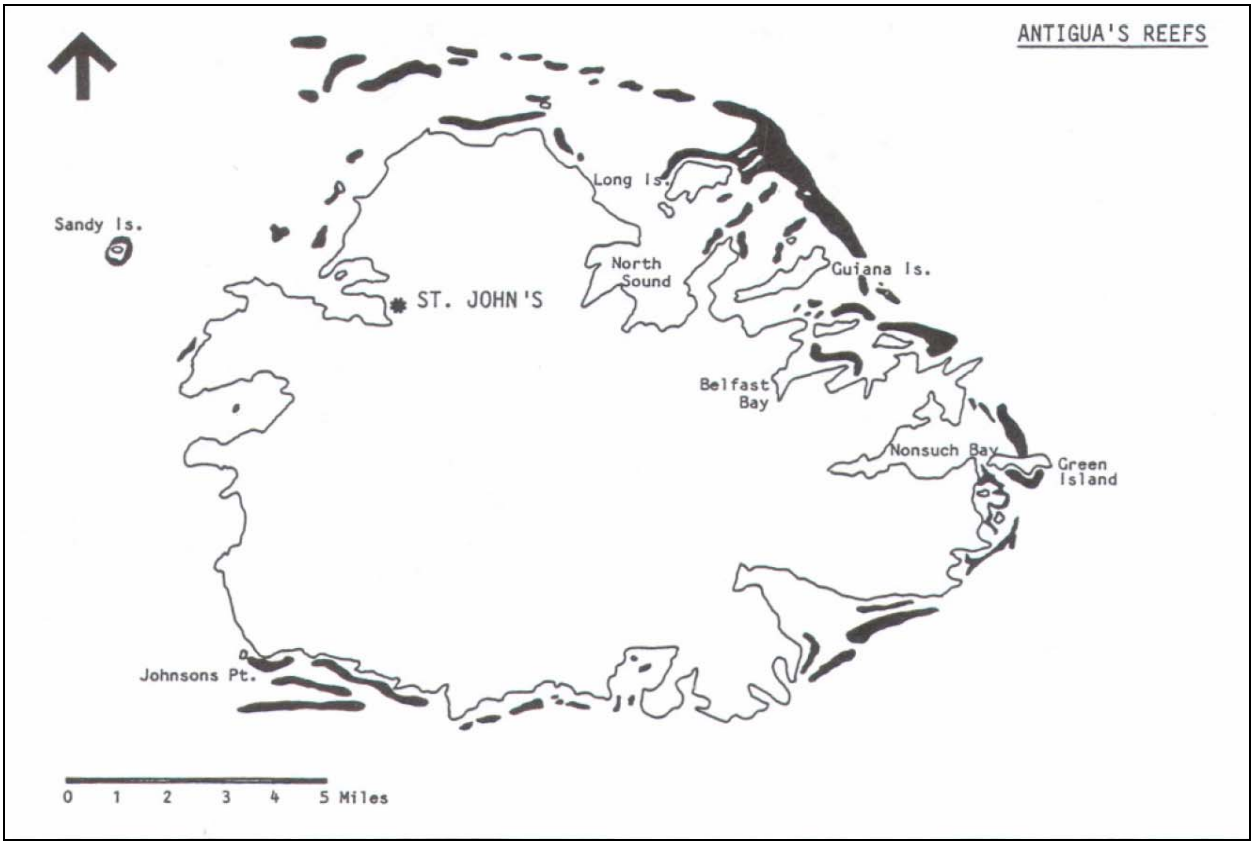

Figure 5. Important coral reef areas of Antigua (source: Reefwatch, 1989 *in* CCA, 1991).

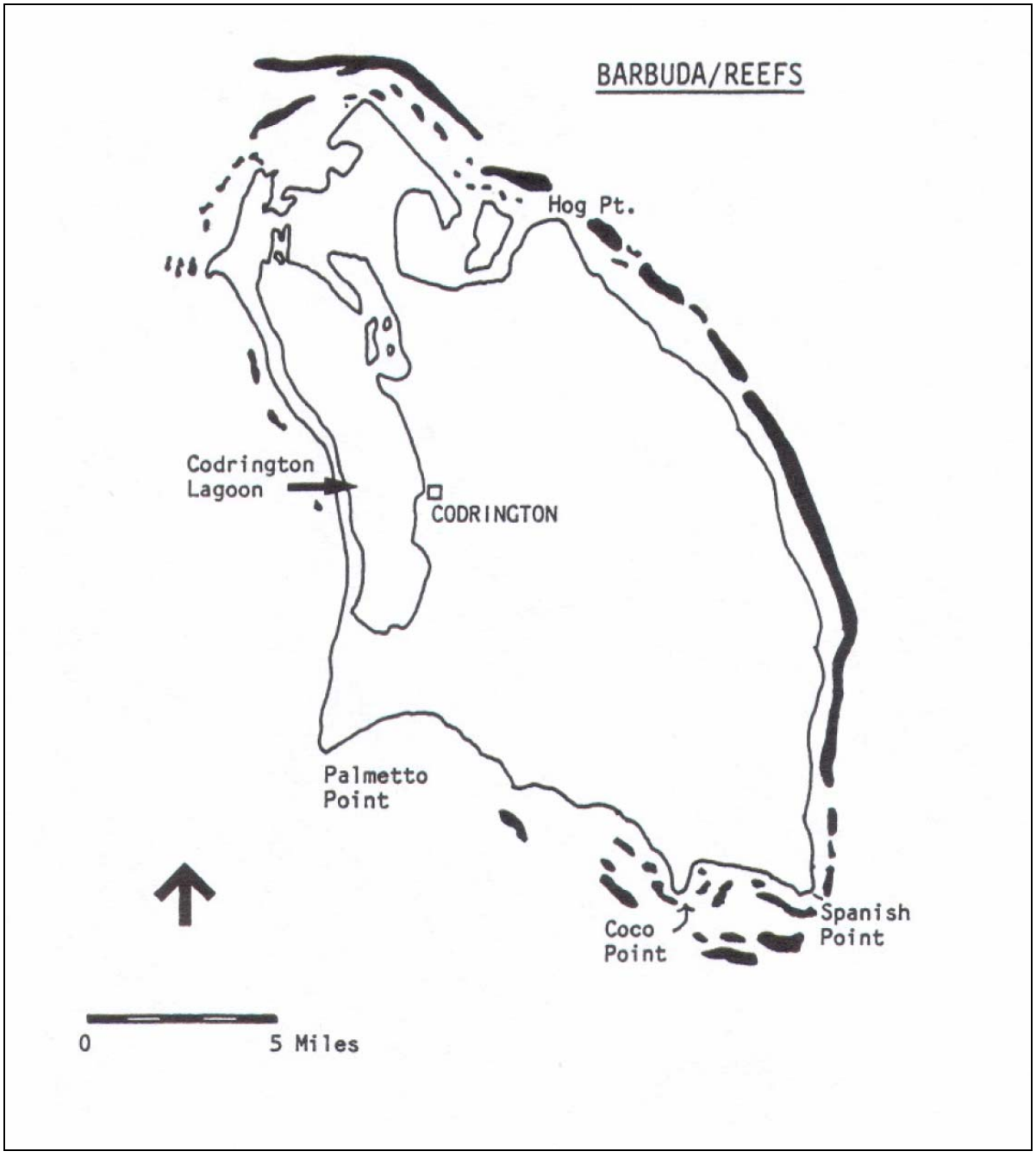

Figure 6. Important coral reef areas of Barbuda (source: Wells, 1987 *in* CCA, 1991).

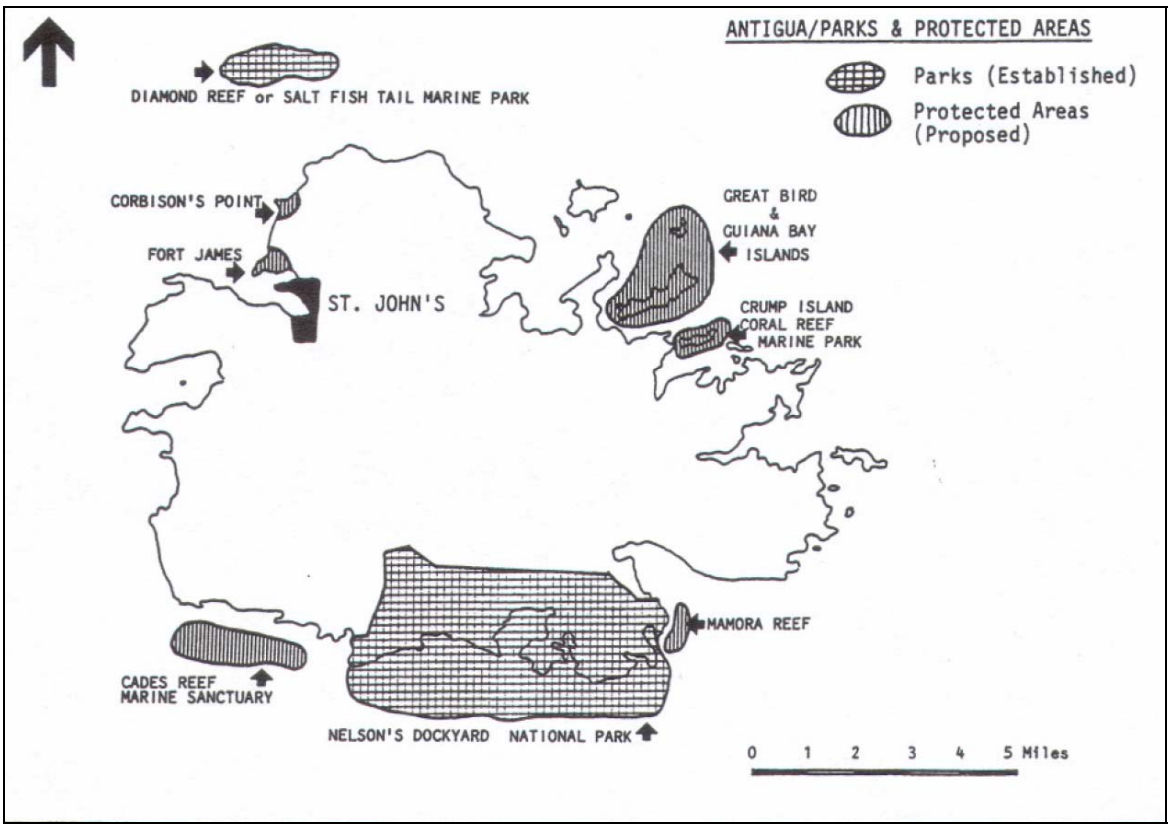

Figure 7. Existing and proposed Antigua parks and protected areas (source: CCA, 1991).

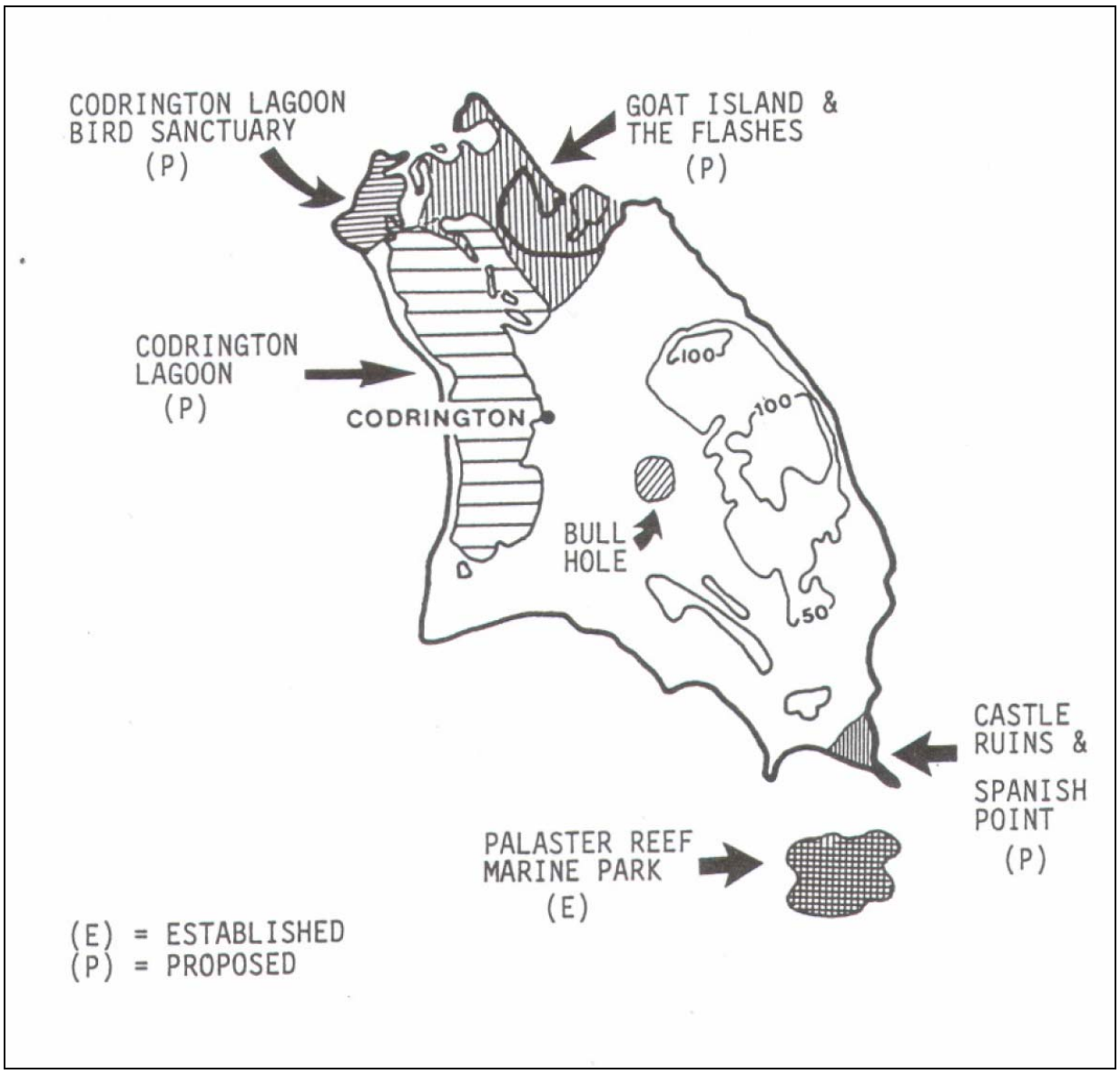

Figure 8. Existing and proposed Barbuda parks and protected areas (source: CCA, 1991).

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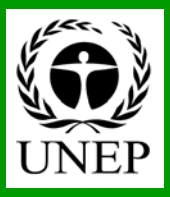

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The series of CEP Technical Reports contains selected information resulting from the various activities performed within the framework of the UNEP Caribbean Environment Programme (CEP). CEP was initiated in 1976 by UNEP with the assistance of ECLAC,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

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