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WIDECAST Sea Turtle Recovery Action Plan for the British Virgin Islands

UNEP

CARIBBEAN ENVIRONMENT PROGRAMME

WIDECAST

Wider Caribbean Sea Turtle Conservation Network

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PREFACE

Sea turtle stocks are declining throughout most of the Wider Caribbean region; in some areas the trends are dramatic and are likely to be irreversible during our lifetimes. According to the IUCN Conservation Monitoring Centre's *Red Data Book*, persistent over-exploitation, especially of adult females on the nesting beach, and the widespread collection of eggs are largely responsible for the Endangered status of five sea turtle species occurring in the region and the Vulnerable status of a sixth. In addition to direct harvest, sea turtles are accidentally captured in active or abandoned fishing gear, resulting in death to tens of thousands of turtles annually. Coral reef and sea grass degradation, oil spills, chemical waste, persistent plastic and other marine debris, high density coastal development, and an increase in ocean-based tourism have 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 third in a series of Sea Turtle Recovery Action Plans prepared by the Wider Caribbean Sea Turtle Recovery Team and Conservation Network (WIDECAST), an organization comprised of a regional team of sea turtle experts, local Country Co-ordinators, and an extensive network of interested citizens. The objective of the recovery action plan series is to assist Caribbean governments in the discharge of their obligations under the SPAW Protocol, and to promote a regional capability to implement scientifically sound sea turtle conservation programs by developing a technical understanding of sea turtle biology and management among local individuals and institutions. Each recovery action plan summarizes the known distribution of sea turtles, discusses major causes of mortality, evaluates the effectiveness of existing conservation laws, and prioritizes implementing measures for stock recovery. WIDECAST was founded in 1981 by Monitor International, in response to a recommendation by the IUCN/CCA Meeting of Non-Governmental Caribbean Organizations on Living Resources Conservation for Sustainable Development in the Wider Caribbean (Santo Domingo, 26-29 August 1981) that a "Wider Caribbean Sea Turtle Recovery Action Plan should be prepared ... consistent with the Action Plan for the Caribbean Environment Programme." WIDECAST is an autonomous NGO, partially supported by the Caribbean Environment Programme.

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LIST OF ACRONYMS

BVI	British Virgin Islands
CFD	Conservation and Fisheries Department
CIDA	Canadian International Development Agency
CITES	Convention on International Trade in Endangered Species
DOA	Dive Operators Association
ECNAMP	Eastern Caribbean Natural Areas Management Programme
IUCN	World Conservation Union
LDCA	Land Development Control Authority
MNRL	Ministry of Natural Resources and Labour
NPT	National Parks Trust
OECS	Organization of Eastern Caribbean States
TCP	Town and Country Planning
UK	United Kingdom
UNEP	United Nations Environment Programme
USVI	United States Virgin Islands
WATS	Western Atlantic Turtle Symposium
WIDECAST	Wider Caribbean Sea Turtle Recovery Team and Conservation Network

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DEDICATION

"Ways Turtles Die" [1]

People like turtles for their shell and taste
But you must not let turtles go to waste
There is something you must do, really must
That's to let turtles live just like us.

Turtles are intelligent creatures
And they have very talented features
Things that you throw in the sea like candy
Wrappers and grape vines will mess up turtles' lives
So listen to my advice and let turtles
Live their lives just like yours and mine.

Yachts throw out their anchors
Where the turtles' food grow
That is sea grass, as you know
Don't pollute the ocean blue
Please, let turtles live like you!

Akesha Smith (Age 9)
Isabella Morris Primary School
Carrot Bay, Tortola
July 1990

[1] Winning entry (3rd Place, Creative Writing, Class 3) from a Creative Writing Contest sponsored by the MNRL Conservation and Fisheries Department for primary school children in the British Virgin Islands.

ABSTRACT

The British Virgin Islands lie between 18°20'N and 18°50'N latitude and 64°18'W and 64°51'W longitude in the northeastern Caribbean Sea, situated 100 km east and northeast of Puerto Rico. Sea turtles have played an important role in the cultural and socio-economic development of the BVI. It does not appear that there was ever an established commercial export of sea turtles, but locally occurring species have been extensively exploited at the subsistence level. Although there has been a considerable decline in the fishery, it continues to the present day and remains family or community oriented. Hawksbill (Eretmochelys imbricata) turtles and green (Chelonia mydas) turtles are primarily captured by the use of nets (but also by leaping on them from a boat and, increasingly, by spearing), while leatherbacks (Dermochelys coriacea) are taken on the beach during nesting. The hawksbill/green turtle fishery was widespread historically and concentrated in the major fishing villages on each island. The leatherback (trunk) fishery was concentrated in villages close to nesting beaches in Tortola and Virgin Gorda. This fishery has declined significantly; by 1986 when a closed season was established, fewer than 10 females (total) nested each year. The harvest of green and hawksbill turtles in 1991 was 10% what it was in 1981, partly because of depleted stocks and partly because of reduced demand. The total harvest of eggs is unquantified, but approaches 100% on some monitored beaches. Incidental catch in longline and net fisheries is a potential problem.

There must be two central components to any recovery programme: (1) protection of turtles and eggs and (2) protection of important feeding and nesting habitats. While some progress has been made, current legislation is inadequate to provide for the recovery of sea turtles. There is no protection for eggs and no size limit for turtles landed during the open season (1 December-31 March). The Ministry of Natural Resources and Labour is currently considering the Turtles Act of 1992 which will protect eggs and mandate a maximum size limit to protect large juveniles and breeding-age adults. A moratorium on the harvest of turtles and eggs is recommended by this Recovery Action Plan, as is passage of a strong Coast Conservation and Management Act. Additional law enforcement resources, including marine transportation, are needed. Several comprehensive workshops have been organized to familiarize enforcement officers and government personnel with conservation laws. Nevertheless, it is difficult to apprehend violators because the theft of eggs or the landing of a turtle out-of-season is easily accomplished clandestinely. An increased awareness on the part of the public has resulted in numerous reports to the Conservation and Fisheries Department (CFD) of illegal activity. One option for improving environmental law enforcement (e.g., mining, pollution, wildlife and fisheries, endangered species) is to create a Division of Enforcement under the aegis of CFD.

With regard to the protection of habitat, it is clear that the areas most important to sea turtles are sea grass meadows and coral reefs (food, shelter) and sandy beaches (nesting). These habitats are widespread in the BVI and support several important commercial enterprises, including fishing and tourism. A variety of regulatory guidelines are herein proposed for the protection of coastal and marine habitat. These involve waste disposal and pollution, construction set-backs, shoreline lighting, beach access, mooring, and the physical destruction of the sea bed. An expanded system of protected areas is also recommended. The BVI encompasses more than 40 islands and islets and dozens of pristine bays and sheltered anchorages. A national development plan is needed to protect the rich diversity of this community of islands for

residents and future generations. Public awareness programmes are an essential component of any effort to both develop and conserve the environment. CFD has a full-time Environmental Awareness Officer and has worked collaboratively with Department of Education personnel to design and present regular programmes to school children on mangroves, sea turtles, coral reefs, and beaches. These units will eventually become a standard part of the BVI curriculum. Efforts to educate the adult public and tourists are also underway.

In addition to protecting turtles and habitat, monitoring programmes are needed to determine population trends and to evaluate the success of conservation efforts. Because it is neither possible nor necessary to monitor all sea turtle nesting beaches in the BVI, the selection of Index Beaches for comprehensive study is recommended. Several important nesting areas suitable for Index Beach designation have already been identified. These include the northeast coast of Tortola from Trunk Bay east to Long Bay (Beef Island) for leatherbacks, the northern cays (Scrub Island, Great and Little Camanoe islands, Guana Island) for hawksbills, and the island Anegada for greens and hawksbills. Little is known of the distribution or timing of nesting in Virgin Gorda, Jost Van Dyke, or the southern cays. Even less is known of the residency, range, or behaviour patterns of juveniles foraging in BVI waters. Sea turtles are long-lived (most require 20-35 years to reach sexual maturity) and highly migratory. Local juvenile and adult (nesting) populations are not likely to be related. Nesting females are not residents. They arrive from distant feeding grounds to lay their eggs on BVI beaches, presumably because they were born in the BVI many years before. Hatchling turtles released from local beaches travel widely throughout the Caribbean prior to reaching maturity. Local-caught juveniles represent the future breeding stock for other Caribbean nations.

All Caribbean peoples must work together to conserve remaining sea turtles. Historical accounts confirm that sea turtles once swarmed throughout the region in numbers almost unimaginable today. They have been harvested for generations with no thought given to population size, rates of recruitment, or sustainable yield. The outcome is now clear. Nesting populations are declining; some have completely disappeared. If we are to safeguard what remains of this legacy, what remains of these mysterious and ancient reptiles, we must act without further delay to protect them. Few men are still involved in the sea turtle fishery. This is not to say, however, that their circumstances are unimportant. CFD should undertake a comprehensive Turtle Fishery Frame Survey to determine income derived from the turtle harvest. Technologies and programmes designed to enhance the harvest of fish may be all that is needed to compensate for income lost if turtles are protected year-around. The choice would appear an obvious one -- either explore alternatives to the turtle harvest now or be faced with the same challenge (that of finding alternatives) at a later date. In the second instance, the price may be the loss of sea turtles in the BVI. Since turtles return to their natal beaches, once nesting populations are exterminated, they cannot return. This Recovery Action Plan reviews a wide variety of solutions to contemporary stresses on sea turtles and outlines a detailed Sea Turtle Conservation Programme. A summary of recommendations is provided in Appendix I.

RESUMEN

Las Islas Vírgenes Británicas se encuentran entre los 18°20' y 18°50' de latitud Norte y los 64°18' y 64°51' de longitud Oeste en el Noroeste del Mar Caribe, situadas a 100 km al este y noroeste de Puerto Rico. Las tortugas marinas han desempeñado un papel importante en la cultura y el desarrollo socio económico de las Islas Vírgenes Británicas. No parece que haya habido nunca un comercio establecido de exportación de la tortuga marina, pero las especies que se encuentran localmente, han sido explotadas de manera frecuente a nivel de subsistencia. Aunque ha habido una disminución considerable en la pesca, esta continúa hasta el presente y permanece dentro de la familia o la comunidad. Las tortugas Carey (Eretmochelys imbricata) y las Verdes del Atlántico (Chelonia mydas), son capturadas, principalmente, utilizando redes (también, saltando sobre ellas desde un bote y, cada vez más, con harpón), mientras que las tortugas Toras (Dermochelys coriacea) son capturadas en las playas durante su anidación. La pesca de las tortugas Carey y Verde del Atlántico ha sido muy difundida históricamente y se ha concentrado en las mayores aldeas pesqueras de cada isla. La pesca (troncal) de la tortuga Tora se concentraba en las aldeas cercanas a las playas de anidación en Tórtola y Virgen Gorda. Esta pesca se ha reducido significativamente; para 1986, cuando se estableció una temporada cerrada, anidaban cada año menos de 10 hembras (total). El aprovechamiento de las tortugas Verde del Atlántico y Carey en 1991 fue 10% menor que en 1981, en parte a causa de las reservas agotadas y en parte a causa de una demanda reducida. El total de huevos aprovechados no se cuantifica, pero se aproxima al 100% en algunas playas monitoreadas. La captura incidental en hilos largos y redes de pesca constituye un problema latente.

Debe haber dos componentes centrales en cualquier programa de rescate: (1) protección de tortugas y de huevos y (2) protección de importantes habitats de anidación y de alimentación. Mientras se ha logrado algún progreso, la legislación actual resulta inadecuada para ocuparse del rescate de la tortuga marina. No existe protección para los huevos ni tamaño límite para las tortugas que llegan a las costas durante la temporada abierta (1 diciembre-31 marzo). El Ministerio de Trabajo y Recursos Naturales está actualmente considerando la Ley de las Tortugas de 1992 que protegerá los huevos y que ordena un límite máximo de tamaño para proteger a los juveniles grandes y a las adultas en edad de reproducción. Este Plan de Acción recomienda una moratoria en el aprovechamiento de tortugas y huevos, ya que es parte de una Ley de la Conservación y el Manejo de Costas. Se necesitan recursos adicionales para la observancia de la ley, que comprendan el transporte marítimo. Se han organizado varios talleres integrales para fami-liarizar a los oficiales encargados de la observancia de la ley y al personal del gobierno con las leyes de la conservación. Sin embargo es difícil arrestar a quienes violan la ley, porque el robo de huevos y la captura de tortugas fuera de temporada se logra fácilmente de forma clandestina. El aumento en la concientización por parte del público ha resultado en numerosos informes sobre actividades ilegales al Departamento de Conservación de Pesquerías (CFD). Una de las opciones para mejorar la observancia del derecho ambiental (ej. minería, contaminación, vida silvestre y pesquerías, especies en peligro) es crear una División de Observancia de la Ley bajo el eje de CFD.

Con respecto a la protección de habitats, queda claro que las áreas más importantes para las tortugas marinas son los pastizales marinos y los arrecifes de coral (alimento, protección) y

las playas arenosas (anidación). Estos habitats se encuentran diseminados por las IVB y apoyan varias empresas comerciales importantes, incluso la pesca y el turismo. Se proponen aquí una variedad de directrices regulatorias para la protección de habitats marinos y costeros. Estas comprenden, eliminación de desechos y contaminación, construcción de edificaciones de blindaje, iluminación de la fajas costeras, acceso a las playas, fondeo de embarcaciones, y la destrucción física del lecho marino. También se recomienda un sistema extendido de áreas protegidas. Las IVB abarcan más de 40 islas e islotes y docenas de bahías primitivas y ancladeros protegidos. Se precisa un plan de desarrollo nacional que proteja la rica diversidad de esta comunidad de islas para los residentes y las generaciones futuras. Los programas de concientización pública constituyen un componente esencial de cualquier esfuerzo, tanto para el desarrollo como para la conservación del medio ambiente. El CDF tiene un Oficial de Concientización Ambiental de tiempo completo, que ha trabajado en colaboración con personal del Departamento de Educación en el diseño y la presentación de programas regulares para los escolares sobre manglares, tortugas marinas, arrecifes de coral y playas. Estas unidades se convertirán finalmente en una parte corriente del programa de estudios de las IVB. Los esfuerzos por educar al público adulto y a los turistas se hallan también en camino.

Además de proteger las tortugas marinas y sus habitats, se necesitan programas de monitoreo para determinar las tendencias de la población y para evaluar el éxito de los esfuerzos conservacionistas. Como, no es posible ni tampoco es necesario monitorear todas las playas de anidación de tortugas marinas en las IVB, se recomienda la selección de un Indice de Playas para su estudio exhaustivo. Ya se han identificado varias áreas importantes adecuadas para integrar el Indice de Playas. Estas comprenden la costa nordeste de Tórtola desde Bay Trunk hacia el este de Log Bay (Beef Island) para las tortugas toras, los cayos del norte (Scrub Island, las islas Great y Little Camanoe, Guana Island) para la tortuga carey, y la isla Anegada para tortugas verdes del Atlántico y carey. Poco se sabe de la distribución o el tiempo de anidación en Virgen Gorda, Jost Van Dyke, o los cayos del sur. Se conoce aún menos sobre la residencia, el rango o los patrones de comportamiento de los juveniles que se alimentan en aguas de las IVB. Las tortugas marinas tienen larga vida (la mayoría requiere de 25-30 años para alcanzar la madurez sexual) y son altamente migratorias. La población de ejemplares locales jóvenes y adultos (anidando) tienden a no relacionarse. Las hembras en período de anidación no son residentes. Llegan desde terrenos distantes donde se alimentan, a poner sus huevos en las playas de las IVB, se presume que porque nacieron en las IVB hace muchos años. Los nuevos ejemplares que salen de las playas locales, viajan extensamente a lo largo del Caribe previo a alcanzar la madurez. Las juveniles capturadas localmente representan la futura reserva de reproductoras para otras naciones del Caribe.

Todos los pueblos del Caribe deben trabajar juntos para conservar las tortugas marinas que quedan. Descripciones históricas confirman que las tortugas marinas pulularon por las playas de la región en cantidades casi inimaginables hoy en día. Estas han sido aprovechadas por generaciones sin detenerse a pensar en el tamaño de la población, velocidad del abastecimiento, o crecimiento sustentable. El resultado es ahora claro. Las poblaciones que anidan están disminuyendo; algunas han desaparecido por completo. Si fuéramos a salvaguardar lo que resta de este legado, lo que resta de estos reptiles misteriosos y antiguos, deberíamos actuar sin más detenimiento para protegerlos. Hay pocos hombres todavía dedicados a la pesca de la tortuga. No queremos decir, sin embargo, que sus circunstancias carecen de importancia. La CDF debe emprender un exhaustivo Estudio de Marco de la Pesca de la Tortuga para deter-

minar el ingreso que se deriva del aprovechamiento de la tortuga. Las tecnologías y los programas diseñados para incrementar el aprovechamiento de peces tal vez sea todo lo que se necesita para compensar la pérdida de ingresos en caso de proteger las tortugas durante todo el año. La decisión parecería bastante obvia -- o se exploran alternativas al aprovechamiento de tortugas ahora, o se enfrenta el mismo reto (el de encontrar alternativas) en una fecha posterior. En segunda instancia, el precio puede ser la pérdida de la tortuga marina en las IVB. Ya que las tortugas regresan a sus playas natales, una vez que se exterminan las poblaciones que anidan, ya no se pueden recuperar. Este Plan de Acción para el Rescate de la Tortuga Marina contempla una variedad de soluciones a sobrecargas actuales a las tortugas marinas y destaca un Programa de Conservación de la Tortuga Marina. Se ofrece un sumario de recomendaciones en el Apéndice I.

RESUME

Les Iles Vierges britanniques sont situées entre les latitudes 18°20 N et 18°50 N et les longitudes 64°18 W et 64°51 W dans le nord-est de la Mer des Caraïbes, à 100 km à l'estnordest de Porto Rico. Les tortues de mer ont joué un rôle important dans le développement culturel et socio-économique de ces îles. Il n'y a aucune preuve d'une exportation commerciale organisée des tortues de mer, bien que cette espèce ait été exploitée au niveau de la subsistance. Malgré la baisse importante de la capture, celle-ci persiste aujourd'hui à l'échelle familiale et communautaire. La tortue cahouanne (Eretmochelys imbricata) et la tortue verte (Chelonia mydas) sont capturées le plus souvent à l'aide de filets; on leur saute également dessus et, de plus en plus souvent on les tue au harpon. La tortue cuir (Dermochelys coriacea) est capturée sur la plage pendant sa ponte. Dans le passé, la capture de la tortue cahouanne et de la tortue verte était répandue et se concentrait dans les principaux villages de pêche dans chaque île. La capture de la tortue cuir se limitait aux villages près des plages de nidation à Tortola et à Virgin Gorda. Cette capture a subi une baisse importante et en 1986, au moment de la déclaration de la fermeture d'une saison de pêche, moins de 10 femelles y pondaient chaque année. En 1991, la capture de la tortue verte et de la tortue cahouanne atteignait 10% de son niveau de 1981, dû en partie au nombre réduit et en partie à une demande moins importante. La récolte totale des oeufs ne peut pas être quantifiée, mais sur certaines plages surveillées, ceci pourrait s'élever à 100%. La capture fortuite à l'aide de lignes longues et de filets est un problème potentiel.

Tout programme de sauvegarde doit comprendre deux principaux composants: (1) la protection des tortues et de leurs oeufs et (2) la protection des habitats importants pour l'alimentation et la réproduction. En dépit des progrès réalisés, la législation nationale actuellement en vigueur n'est pas adéquate pour faire face au problème de la sauvegarde des tortues de mer. Il n'y a aucune protection pour les oeufs et aucune limitation en ce qui concerne des tortues capturées au cours de la saison de pêche qui s'étend du 1er décembre au 31 mars. Le Ministère des ressources naturelles et du travail étudie actuellement la Loi de 1992 sur les Tortues de 1992 qui porte sur la protection des oeufs et la fixation d'une taille maximale pour la capture des jeunes adultes et de ceux qui sont en âge de se reproduire. Un moratoire sur la capture des tortues et sur la prise de leurs oeufs ainsi que l'adoption d'une Loi solide sur la protection et la gestion des côtes. D'autres mécanismes pour l'application de la loi, y compris le transport maritime seront nécessaires. Plusieurs ateliers détaillés ont été organisés afin de mettre les écologistes ainsi que les responsables gouvernementaux au courant des lois sur la préservation. Néanmoins, il est difficile de saisir les contrevenants car le vol des oeufs ou la capture des tortues en dehors de la saison de chasse peut facilement se faire clandestinement. Grâce à une plus grande sensibilisation du public, le Département pour la protection de l'environnement et de la pêche (DPEP) a été averti de nombreuses activités illégales. Une option pour améliorer l'application de la loi environnementale (par exemple, l'exploitation minière, la pollution, la vie sauvage et les ressources halieutiques ainsi que les espèces menacées) est de créer une Section d'application de la loi sur l'environnement sous l'égide du DPEP.

En ce qui concerne la protection de l'habitat, il est évident que les zones les plus importantes pour les tortues de mer sont les bancs d'algues et les récifs coralliens (pour l'alimentation et l'habitat) et les plages sableuses (pour la reproduction). Ces habitats s'étendent dans les Iles Vierges britanniques et abritent plusieurs entreprises commerciales importantes, y

compris la pêche et le tourisme. Plusieurs directives pour la protection de l'habitat côtier et marin sont proposées dans le présent document. Elles concernent l'évacuation des déchets et la pollution, la construction de remparts, l'éclairage public des côtes, l'ancrage et la destruction physique des fonds marins. Une extension du nombre des zones protégées est également recommandé. Les Iles Vierges britanniques comprennent plus de 40 îles et îlots et des douzaines de baies vierges et de mouillages protégés. Un plan national de développement est nécessaire pour protéger la diversité de ce groupe d'îles pour les résidents et les générations futures. Les programmes de sensibilisation du public sont des éléments essentiels à tout effort pour protéger l'environnement et le mettre en valeur. Le DPEP a un Responsable de la sensibilisation du public qui travaille à plein temps et qui a collaboré étroitement avec le personnel du Département de l'éducation pour concevoir et présenter régulièrement aux écoliers des programmes sur les mangroves, les tortues de mer les récifs coralliens et les plages. A la longue, ces unités feront partie intégrante des programmes dans les écoles des Iles Vierges britanniques. Des efforts sont en cours pour sensibiliser la population adulte et les touristes.

En plus des programmes visant la protection des tortues et des habitats, des programmes de surveillance sont nécessaires pour déterminer la croissance de la population et pour évaluer la réussite des programmes de conservation. Etant donné qu'il n'est ni possible ni nécessaire de surveiller toutes les plages où se reproduisent les tortues de mer dans les Iles Vierges britanniques, il est recommandé de choisir des plages-témoins pour mener des études détaillées. Plusieurs endroits importants pour la réproduction ont été déjà identifiés comme pouvant servir de plagestémoins. Il s'agit de la côte nord-est de Tortola, de la Baie Trunk à la Baie Long (sur l'Ile Beef) pour les tortues cuir, les récifs du nord (l'Ile Scrub, les Grandes et les Petites Iles Camanoe, l'Ile Guana) pour les tortues cahouannes et l'île Anegada pour les tortues cuir et les tortues cahouannes. On en sait très peu sur la distribution et la période de ponte à Virgin Gorda, Jost Van Dyke ou dans les récifs du sud. On en sait encore moins sur les habitats, l'étendue du territoire ou le comportement des jeunes qui s'alimentent dans les eaux des Iles Vierges britanniques. Les tortues de mer ont une espérance de vie très élevée (la plupart d'entre elles atteignent la maturité sexuelle entre l'âge de 20 et 35 ans) et sont très migratrices. Il y a peu de chance que les populations locales de jeunes et les populations adultes (en reproduction) appartiennent aux même familles. Les femelles en reproduction ne vivent pas dans des eaux côtières des Iles Vierges britanniques; elles y arrivent des zones de forage lointaines pour pondre leurs oeufs sur les plages, car elles y étaient nées beaucoup d'années auparavant. Des nouveauxnés voyagent beaucoup dans les Caraïbes avant d'atteindre l'âge adulte. Les jeunes capturés dans les eaux d'une île constituent la future population reproductrice d'autres pays des Caraïbes.

Tous les peuples des Caraïbes sont appelés à travailler ensemble pour protéger les tortues de mer restantes. D'après les documents historiques, les tortues de mer étaient présentes dans la région dans des quantités qu'on peut imaginer guère aujourd'hui. Elles ont été capturées pendant des générations sans qu'on se préoccupe de la taille de leurs populations, du taux d'exploitation ou d'un rendement durable. Le résultat en est évident. Les populations susceptibles de se reproduire sont en baisse et certaines ont complètement disparu. Nous devons agir immédiatement pour sauvegarder ce qui reste de cet héritage et de ces reptiles anciens et mystérieux. Il y a peu d'individus qui se livrent actuellement à la chasse aux tortues. Néanmoins, cela ne diminue pas la gravité de la situation de ces dernières. Le DPEP devrait entreprendre une Etude détaillée sur l'exploitaion des tortues afin d'évaluer les revenus découlant

de leur capture. De meilleurs techniques et programmes dans le domaine de la pêche pourraient se substituer aux revenus qui seront perdus par la protection des tortues toute l'année. Le choix paraît évident - chercher aujourd'hui des options à la capture des tortues ou bien devoir faire face plus tard à ce même défi. Dans le deuxième cas, on risque d'avoir à payer la perte de tortues de mer dans les Iles Vierges britanniques. Puisque les tortues de mer retournent à leur plage natale pour se reproduire, l'extinction des populations en âge de reproduction signifie qu'elles ne pourraient pas le faire. Le Plan d'action de sauvegarde étudie plusieurs solutions aux pressions actuelles exercées sur les tortues de mer et présente en détail un Programme pour la sauvegarde des tortues de mer. Un résumé de ces recommandations figure à l'Annexe 1 du présent document.

I. INTRODUCTION

The British Virgin Islands (BVI) lie between 18°20'N and 18°50'N latitude and 64°18' W and 64°51'W longitude in the northeastern Caribbean Sea (Figure 1). The Territory's more than 40 islands, islets and rocks are situated 100 km east and northeast of Puerto Rico and lie with the U. S. Virgin Islands (USVI) on a common submerged platform known as the Puerto Rican Plateau on the Greater Antillean submarine ridge. Most of the islands are hilly and of volcanic formation, except Anegada which rises only to about 8 m at its highest point. Virgin Gorda and the southern cays (Norman, Peter, Dead Chest, Salt, Cooper, and Ginger islands) are separated from Tortola by the Sir Francis Drake Channel, about 7 km at its widest point and 51 m at its greatest depth. The southern cays are very close to the edge of the submarine shelf. Jost Van Dyke is 5.5 km northwest of Tortola, and Anegada, the northernmost island, is about 24 km north of Virgin Gorda (NPT/ECNAMP, 1986). The BVI population was 17,733 in 1991, an increase of 47.4% (mostly as a result of immigration) from the 1980 total of 12,034.

Sea turtles have played an important role in the cultural and socio-economic development of the BVI. It does not appear that there was ever an established commercial export of sea turtles, but locally occurring species have been extensively exploited at the subsistence level. Although there has been a significant decline in the fishery, it continues to the present day and remains family or community oriented. Hawksbill (Eretmochelys imbricata) and green (Chelonia mydas) sea turtles are primarily captured by the use of nets, while leatherbacks (Dermochelys coriacea) have been (and to some extent still are) taken on the beach during nesting. The hawksbill and green turtle fishermen, known locally as 'turtle fishermen', are generally true fishermen who set turtle nets in addition to their fish traps. In contrast, the leatherback fishermen, known locally as 'trunkers', hunt at night on the nesting beach and are not involved in the hawksbill/ green turtle fishery. The industry thus has two components, and two distinct sets of cultural and socio-economic traditions have evolved.

The hawksbill/green turtle fishery was widespread historically and centered in the major fishing villages on each island (e.g., The Settlement in Anegada; North Sound and The Valley in Virgin Gorda; East End, Long Look, Baugher's Bay, and Road Town in Tortola; Great Harbour and East End in Jost Van Dyke). Nets were set throughout the territory from Anegada to Jost Van Dyke. The art of knotting, hanging, setting and hauling turtle nets, along with the handling and processing of the animals, was passed on from generation to generation within families and through apprenticeships. Turtle meat was an important and readily available source of protein and also an important source of income for local fishermen. Today, during the season when local restaurants are permitted to buy and sell turtle meat (1 December - 31 March), turtle is still a popular delicacy in some areas, commanding a price (per pound) somewhat less than fish. The exact number of turtles landed has never been formally recorded. The estimated catch of green turtles has declined over the last decade from 700 in 1981 to 200 in 1985 to 71 during the 1990-1991 open season. Similarly, the estimated catch of hawksbills has declined from 400 in 1981 to 75 in 1985 to 32 during the 1990-1991 open season.

Traditionally the shells ("turtle backs") of both hawksbills and green turtles were cured, cleaned and sold. In the 1940's, turtle shells, particularly hawksbill, were in demand by local craftsmen and thus fetched a good price. The sale of shells was a major source of income for the

fishermen. Apparently there was also some export of shells that were purchased from the fishermen by wealthy residents. With the advent of plastics and other substitutes, perhaps coupled with international pressure for sea turtle protection, the demand eventually diminished and the shell trade declined. Today shells are sold locally, given away, or kept by fishermen to be mounted and displayed in private homes, clubs, restaurants and hotels. The handicraft industry which once fashioned jewelry and trinkets from hawksbill shell scutes ("tortoiseshell") has declined noticeably over the last decade and is virtually non-existent today.

The leatherback, or trunk, fishery was concentrated in villages close to leatherback nesting beaches in Tortola and Virgin Gorda. This fishery has declined significantly and by 1986 when a closed season was established, the harvest had been reduced to the nesting beaches along the northeast coast of Tortola. The fishermen claim that they never took both turtle and eggs, in accordance with sections 3(d) and 3(e) of the now amended 1959 Turtles Ordinance, but this cannot be verified. Fishermen interviewed in 1987 recalled as many as six trunks per night nesting in the 1920's on beaches such as Josiahs and Long Bay Lambert (Tortola). Today it appears that fewer than ten females nest per *year* on all of Tortola. Since 1986, the most crawls observed during one year on any of the major leatherback nesting beaches on Tortola was three at Trunk Bay in 1990 (Morris, 1990) and four at Long Bay Belmont in 1991 (Hastings, 1991). There are numerous beaches where these animals no longer nest at all (e.g., Trunk Bay, Virgin Gorda; Cane Garden Bay, Tortola; White Bay, Guana Island). In 1991, two of an estimated total nesting population of four females were slaughtered.

Because of its seasonal nature, the leatherback fishery was never as important economically as the hawksbill/green turtle fishery. Leatherbacks are temperate Atlantic turtles which periodically leave foraging and residence grounds, such as in the northeastern USA and Canada, and migrate long distances to lay their eggs in the warm sand of the BVI and other Caribbean nations and territories. They can be found nesting during the months of March to July. In addition to the brief timeframe, there was not a large market for the primary product derived from the animal, which was oil. The meat and eggs were distributed in a subsistence fashion among families and the community. What this fishery lacked in socio-economic importance, however, it made up for culturally. "Trunking" is deeply rooted in tradition and mysticism. Some fishermen trace the roots of the fishery back to the days of slavery, while others believe it was actually brought over from Africa like so many other local customs.

Over the years knowledge has been gained about the trunk turtle (the nesting cycle, the arts of "turtle watching", capture, slaughter and preparation) through practical experience. There is also a certain "mystical knowledge" about the animals that is not so easily or logically explained. The sighting of the silhouette of a trunk turtle in the clouds with the head of the turtle pointing in the direction of the chosen nesting beach is the most widely experienced phenomenon. The silhouette is commonly experienced at the community level, with everyone being capable of recognizing the silhouette and sounding the alarm to watch for the expected animal. One of the authors (BBL) has personally observed this silhouette on numerous occasions from when he was a small boy until now, and there are several documented cases of trunk turtles being caught as a result of these signs in the sky. Noises in the bushes, sticks breaking, whistling, human voices, strange odors and ghosts of deceased trunk fishermen have been reported just prior to the emergence of the turtles on the beach.

When a trunk was slaughtered, the head, back, belly plate (=plastron), flippers and internal fat were boiled in sea water in a copper kettle on the beach. As the oil rose to the surface, it was siphoned off and bottled. Remains and entrails were buried well behind the beach; care was taken not to contaminate the beach or the nearshore water with any part of the turtle because it was believed that this would prevent turtles from nesting in the future. The tough meat was never as popular as that of the hawksbill or green turtles, but the eggs and, to a lesser extent, the oil were prized for their reputed aphrodisiac qualities. In addition, trunk oil was considered to have potent medicinal value, especially in the treatment of severe colds and other general respiratory ailments. The oil was sometimes mixed with seawater, lime and/or honey prior to drinking. Trunk oil is still available for sale on an informal basis. In 1992, it was selling for $30 for a small bottle and up to $200 for a larger bottle, such as a whiskey bottle.

The opportunistic harvest of sea turtle eggs for personal consumption occurs year-around (despite the 1 April-30 November closed season) and is considered a serious threat to sea turtle conservation. All factors indicate that the level of poaching has decreased in recent years, but the proportion of nests poached per season remains unknown. Fletemeyer (1984) estimated that the harvest approached 50% of all eggs laid. Winston Leonard (Leonard's Sea Food Ltd., pers. comm.) concedes that historically it was probably close to 100% in some areas; the target was primarily hawksbill eggs. Poaching has recently been reported from Rogues Bay (Tortola), Long Bay (Beef Island), Cam Bay and North Bay (Great Camanoe), North Beach (Guana Island), North Bay Beach and the West End beaches of Scrub Island, and all around Anegada. It is possible that the leatherback has been most affected by egg poaching, given its restricted nesting range and the ease of nest identification. Nevertheless, since virtually all sandy beaches are accessible by fishing boat, even relatively isolated nesting beaches on offshore cays, no species has escaped the theft of eggs.

The BVI participates in a number of regional and international treaties and organizations that are concerned with the conservation of sea turtles, including the Convention on International Trade in Endangered Species (CITES), the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (Cartagena Convention), the Western Atlantic Turtle Symposium (WATS), and the Wider Caribbean Sea Turtle Conservation Network (WIDECAST). In addition, hawksbill, green and leatherback turtles are listed as "endangered" under the First Schedule of the 1976 BVI Endangered Animals and Plants Ordinance, which prohibits their importation and exportation. In 1985, the Ministry of Natural Resources and Labour (MNRL), reflecting government policy, made the conservation of sea turtles a priority. A joint Sea Turtle Survey was initiated by the National Parks Trust and the Conservation Officer of MNRL. Funding for the project was solicited locally, as well as from WATS.

In 1986, technical assistance was sought from Dr. Karen Eckert, former co-Director of the Sandy Point Leatherback Research Project in St. Croix and current Executive Director of WIDECAST. Public awareness and education programmes about sea turtles were developed at that time and have since been expanded. These programmes take the form of public lectures, classroom slide shows, radio interviews, and newspaper articles. A volunteer network was established under the guidance of WIDECAST to assist in data collection and population monitoring for the BVI Sea Turtle Survey. The network consists of coastal residents, SCUBA divers, fishermen, boat captains, government personnel, and many interested citizens. In April

1986, periodic boat surveys (April-May, generally weekly) of the inaccessible beaches of the northern coast of Tortola and the northeast cays (Guana Island to Scrub Island) were initiated. In addition, efforts were made between July-October to survey beaches where hawksbill and green turtles had been reported to nest. Annual and increasingly comprehensive surveys conducted by foot, boat, and/or airplane are ongoing and are an important aspect of the Sea Turtle Conservation Programme.

In addition to field surveys, research, monitoring, and public education, the effective long-term conservation of sea turtles in the BVI will require planning and law enforcement. While the cultural and traditional uses of the sea turtles must be considered, the status of local nesting and foraging populations should be the most important factor in any decision-making process. The 1986 amendments to the 1959 Turtles Ordinance which lengthened the closed season and protected the leatherback turtle for the first time are a good start. In 1990, a Conservation and Fisheries Department (CFD) was formed within MNRL. A Chief Conservation and Fisheries Officer and a technical staff are now responsible for conservation and environmental management, with particular emphasis on coastal and marine resources. One of the first actions taken by the CFD in 1990 was to recommend a moratorium on the catch of leatherback turtles. The moratorium was never implemented, and in 1991 two nesting females were killed in April during the closed season. In 1992, new regulations seeking a maximum size limit for harvestable turtles were proposed by CFD, as well as a moratorium on the killing of leatherbacks (see section 4.23). The regulations have yet to be approved.

The main objective of this Sea Turtle Recovery Action Plan, first completed in December 1988 and revised for publication in 1992, is to provide policy-makers and non-government groups with detailed information requisite to make informed decisions regarding the conservation and recovery of depleted sea turtle populations in the BVI. The Plan includes the most up-to-date information on the distribution of sea turtles, a discussion of threats to their survival, detailed recommendations for their conservation, and a summary of the national and international legal responsibilities of the Government towards sea turtles. Gaps in present knowledge are indicated. In order to promote the survival of remaining stocks, a five-year plan for the Sea Turtle Conservation Programme is proposed (see section 4.6) to be implemented under the aegis of the CFD. The priority needs in the BVI are for improved sea turtle conservation legislation (including full protection from harvest at all times), more consistent law enforcement, comprehensive survey and research activities (including population monitoring), habitat protection (sandy beaches, coral reefs, sea grass), and enhanced public awareness.

II. STATUS AND DISTRIBUTION OF SEA TURTLES IN THE BVI

In the Caribbean Sea, five species of sea turtle are recognized as *Endangered* and a sixth, the loggerhead turtle, as *Vulnerable* by the World Conservation Union (IUCN) (Groombridge, 1982). Sea turtles are harvested throughout the region for meat, shell, oil, and skins. They are accidentally captured in active or abandoned fishing gear, resulting in the death of tens of thousands of turtles each year. Oil spills, chemical waste and persistent plastic debris, as well as the ongoing degradation of important nesting beaches and feeding grounds, also threaten the continued existence of Caribbean populations. A recent report concluded that about half the world's

nesting populations of hawksbill turtle 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 the BVI, three species of endangered sea turtle are known to nest: the hawksbill, the green, and the leatherback. In addition, foraging (=feeding) hawksbills and green turtles of varying sizes are present year-around. The giant leatherback, referred to locally as the trunk 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 in the BVI, but is occasionally caught offshore, particularly around Anegada, by local fishermen. Neither the Kemp's ridley nor the olive ridley has ever been reported. A general key to the identification of local species is presented in Figure 2. Table 1 summarizes all known nesting records; potential nesting beaches on the main islands are labeled in Figure 3.

2.1 Caretta caretta, Loggerhead Sea Turtle

The loggerhead can be recognized by its large head (to 25 cm wide), thick and somewhat tapered shell (=carapace), and frequently heavy encrustation of barnacles (Figure 2). The large head and strong jaws, for which the species was named, are necessary adaptations to a diet of mollusks and hard-shelled crabs; tunicates, fishes, and plants are also eaten (Dodd, 1988). Adults attain a 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 colour is red-brown to brown. The species has a predominantly temperate distribution, with the greatest numbers of nesting females recorded along the Atlantic coast of Florida (USA) and at Masirah Island in Oman. Nesting is also reported on the Yucatan Peninsula of Mexico and occasionally along the Caribbean coast of Central America (Belize, Honduras, Nicaragua). Nesting occurs only rarely in the Lesser Antilles (Dodd, 1988; Ehrhart, 1989) and is not known to occur in the BVI.

Loggerheads are periodically net-caught in the BVI, generally off the Island of Anegada. The fishermen report that the meat is disliked because it is "too oily" and apparently the turtle is often released unharmed when caught. Winston Leonard (Leonard's Sea Food, Ltd.), a resident of Tortola with a close association to the fishing community, reports that four loggerheads were caught in 1985 and three in 1984. There have been no documented sightings since 1985. There is no information to specify what age/size classes are (or were) caught most often or whether the species is a year-around resident. While the loggerhead presumably forages in BVI waters, dietary requirements are not known, nor have preferred foraging areas been identified. The species is considerably rarer in local waters than either the green turtle or the hawksbill.

2.2 Chelonia mydas, Green Sea Turtle

There are no indigenous common names other than "green turtle" or "tur'le". The green turtle is recognized by its round blunt face, slightly serrated beak, and smooth carapace plates (=scutes) that do not overlap one another (cf. hawksbill sea turtle, section 2.4). A single pair of scales is present between the eyes (Figure 2). The carapace is generally devoid of barnacles. Adult West Indian green turtles attain weights of 230 kg (ca. 500 lb) (Pritchard et al., 1983).

Adults generally measure 95-120 cm in straight carapace length (nuchal notch to posterior tip). A mean of 100.2 cm (n=2107) is reported for adult females nesting at Tortuguero, Costa Rica (Bjorndal and Carr, 1989). Individuals of varying sizes are present all year in the BVI. Juveniles show bold scute patterns, often with radiating wavy or mottled markings. The rear edge of the carapace can be serrated. Colour is variable, but shades of gray green or brown dominate.

Green turtles are herbivorous and in the Caribbean they feed primarily on the sea grass Thalassia testudinum (Bjorndal, 1982). Field studies indicate that individual turtles maintain feeding "scars" by returning to the same area of sea grass meadow to forage each day (Ogden et al., 1983). These scars, or grazing plots, are maintained by regular cropping for several months and the more digestible newer growth (higher in protein, lower in lignin) is preferred (Bjorndal, 1980). When the cropped grasses show signs of stress (blade thinning, increased inter-nodal distance), the turtle apparently abandons the scar and moves on to form another. Green turtles travel widely during their juvenile years. Individuals are long-lived and require 25-35 years to reach sexual maturity in the Caribbean (Frazer and Ladner, 1986). The age structure of populations foraging in local waters has not been studied. There are several sites in the BVI where foraging green turtles are predictably seen. These include Norman Island, Frenchman's Cay, Great Harbour (Jost Van Dyke), the western end of Anegada, the channel between Marina Cay and Great Camanoe, and the channel between Beef Island and Guana Island.

Green turtles have been traditionally netted and occasionally speared. All sizes, ranging from about 24 cm to mature adults, are landed, though the latter are rare. Nets set within 1 km of shore commonly yield green turtles and sometimes small hawksbills, while those set further away (2-4 km) catch predominantly hawksbills. Some fishermen use the "rodeo" style of capture, where turtles are approached while resting at the surface and captured by leaping on them from the boat. There are also accounts of fishermen cornering green turtles in the shallows of Trellis Bay (Beef Island) and literally running them onto the beach. There is no export of green turtles; those not sold to local restaurants are sold to or shared with members of the community. People from St. Martin (and perhaps other neighbouring islands) once traveled to Tortola twice each year to purchase green and hawksbill turtle shells. This activity has markedly declined in recent years as fewer green turtles have been landed in the BVI and CITES provisions (section 4.31) have restricted international commerce in endangered species, including sea turtles.

All parties agree that the catch of green turtles is declining, but the reasons are not clear. Some fishermen interviewed maintain that catches have declined simply because there is virtually no market anymore; thus, fewer turtles are brought in. Others complain that with the increasing use of outboard motors, it is difficult to keep turtle nets from being struck and ruined by propellers. As a result, fewer nets are set and fewer turtles are landed. Many fishermen and long-time residents believe that the turtles have been over-exploited, and that this has precipitated population declines that have resulted in a reduced catch per unit effort; consequently many fishermen have turned to more abundant commercial fishes for their livelihood and/or to conch and lobster which bring high prices. The over-exploitation hypothesis is widely supported by older residents who report a great abundance of sea turtles (both nesting and in the water) when they were young, far more than are present now. Given that several hundred turtles have been landed annually for many, many years without regard for the number of turtles present, and that eggs are widely collected, the over-exploitation hypothesis seems more plausible.

Based on 1990-1992 annual surveys conducted between September-December under the aegis of the CFD, it has been shown that green turtles still nest on selected beaches, though nowhere in large numbers (Table 2). Only five crawls were reported outside of Anegada during these three years, but an additional 23 potential nest sites were documented during 1992 surveys of the northern coast of Anegada. Information is still incomplete regarding which beaches are most important to this species, but it is very likely that Anegada includes the last important nesting beaches for green turtles in the BVI. It is certain that more nests would be counted if surveys began in June, but it is also likely that green turtle nesting throughout most of the BVI is very low. Furthermore, it is quite possible that while green turtle nesting may once have been higher, it may never have been abundant. Many of the older fishermen in the community cannot remember a time when green turtle crawls were common. Indeed, some believed that the green turtle laid her eggs in the surf, so rare was evidence of a nest (Halstead Lima, Assistant Conservation Officer, pers. comm., 1992).

It is noteworthy that there is no relation between the relatively large number of juvenile green turtles foraging in local waters and the small breeding assemblage. The juveniles and the adults represent different populations. Decades of tagging studies elsewhere in the region have shown that when a female is ready to lay her eggs, she leaves her resident feeding area (often located many hundreds of kilometers away) and journeys to the nesting beach. When egg-laying is complete, the female returns to her area of residence. Green turtles prefer to nest on open, sandy beach platforms. Nests are characterized by a deep pit (1.5-2 m wide and 1 m deep) and a symmetrical crawl (1-1.2 m in diameter) leading to and from the ocean. Gravid females will cross submerged coral and rock to reach suitable nesting beaches. It is not known how many nests an individual female will deposit in the BVI during a given season, but it is likely (based on data collected elsewhere in the Caribbean) that 2-6 clutches of 125-150 eggs each are laid at intervals of 12-14 days. Nesting is typically nocturnal. Again based on data collected elsewhere, a female would be expected to return to the BVI to renest at intervals of 2-3+ years.

2.3 **Dermochelys coriacea**, Leatherback Sea Turtle

The leatherback turtle, or 'trunk' turtle, is the largest of all turtles. Adult females typically weigh 300-500 kg (660-1100 lb). An adult male weighing 916 kg stranded on the coast of Wales (U. K.) in 1988 (Morgan, 1989). Leatherbacks lack a bony shell and cornified epidermal scales. The smooth, black skin is spotted with white. The carapace is strongly tapered, generally measures 130-165 cm in total (straight-line) length and is raised into seven prominent ridges (Figure 2). Powerful front flippers extend nearly the length of the body. Adults are excellent divers, having been recorded at depths exceeding 1000 m in waters off St. Croix, USVI (Eckert et al., 1989). Leatherbacks feed predominantly on jellyfish and other soft-bodied prey (Den Hartog and Van Nierop, 1984; Davenport and Balazs, 1991). Based on studies of diving by adult females nesting in St. Croix, Eckert et al. (1989) proposed that internesting dive behaviour may reflect nocturnal feeding on vertically migrating zooplankton, chiefly siphonophore and salp colonies.

Leatherbacks are seasonal visitors, migrating from temperate latitudes (cf. Eckert and Eckert, 1988) to nest on BVI beaches between March and July. Long-term studies of this species in the USVI and Puerto Rico have shown that gravid females produce an average of 5-7 clutches

per year at intervals of 9-10 days and will return to the same nesting beach every 2-3+ years. Clutch size averages 80-90 yolked eggs; a variable number of smaller, yolkless eggs are also laid in each nest. All indications are that nesting was much higher historically than it is now. Some beaches were named after this species (e.g., Big and Little Trunk Bays and Valley Trunk Bay in Virgin Gorda) and once supported nesting, but no longer do so. Relatively few beaches support nesting today (Tables 1, 3). A subsistence fishery active for most of this century has surely contributed to population decline. Five areas of leatherback nesting may still exist, the primary one encompassing the high energy beaches on the northeast coast of Tortola from Long Bay (Beef Island) to Trunk Bay; Long Bay Belmont on the northwest coast is also important. Less important areas are potentially Anegada (the west coast), Virgin Gorda, and Sandy Cay/Jost Van Dyke. Fewer than 10 nests have been recorded each year since 1987 (see section 3.3) when censuses began. Neither males nor juveniles have ever been observed.

There are several mystical aspects to the trunk fishery; the fishermen speak of music, unexplained movements in the vegetation, and maintain that they see turtle-shaped apparitions in the clouds that point to the beach where the female will lay her eggs. Leatherbacks have traditionally been killed for meat and oil. Trunk fishermen report that 50-60 gallons of oil can be rendered from a "big" leatherback and perhaps 35 gallons from a "small" one. These estimates are probably inflated and the exact figure is difficult to estimate because oil is routinely poured into assorted household containers. The absolute volume is rarely calculated. One source reported that 15-20 40-ounce bottles of oil were obtained from each turtle. In recent years, prices have ranged from $20-$40 per 40-ounce bottle, suggesting that the profit from a single turtle could approach several thousand dollars. Winston Leonard (pers. comm., 1987) reported a price of $30 per "fifth" (187.5 ml). Prices in 1992 ranged from $30 to $200, depending on the size of the bottle. Drinking the oil is said to "make you strong" and is sometimes reputed to have aphrodisiac qualities. The oil is most commonly used for medicinal purposes, generally in cases of respiratory congestion.

'Trunkers' (leatherback fishermen) are few in number and, for the most part, are elderly. They await the nesting females during the hours of high tide, believing that this is the most likely time of arrival; the full moon is preferred. When a turtle comes ashore, she is flipped over onto her carapace, a machete is used to cut a hole in each front flipper, and her front flippers are tied over her plastron (=belly). She is left until morning when the whole village community comes to share in the harvest. Women bring pans to carry chunks of meat home and the men dismember the turtle and boil it in large cauldrons on the beach to render the oil. Traditionally, some oil is shared with the community and the rest is sold locally. Sales have dropped in recent years and the lower demand lessens the desire of the young men to perpetuate the fishery. The unique cultural ties to the trunk turtle prompted the MNRL to begin study of this species in 1986 and later that year the species was afforded legal protection for the first time. Enforcement is inadequate, however, and nesting females have been killed during the 1 April-30 November closed season as recently as 1991. An unknown number of eggs are taken each year.

2.4 Eretmochelys imbricata, Hawksbill Sea Turtle

The hawksbill is distinguished by a narrow, pointed face and an "over-bite" which is useful in prying sponges and other soft-bodied organisms from the reef. The plates on the cara-

pace (=scutes) overlap, like shingles on a roof. Adults rarely exceed 80 kg (175 lb) (Pritchard et al., 1983). In the U. S. Caribbean the curved carapace length (CCL) of nesting females averages about 87 cm (n=61) (Hillis and Mackay, 1989; Richardson, 1990). At Buck Island, situated off the north shore of St. Croix, nesting females measured 78.7-100 cm CCL from 1988-1991 (Zandy Hillis, U. S. Natl. Park Service, pers. comm., 1992) Bright mottled colouration (brown, orange, gold) is common. Juveniles often have a sharply serrated posterior carapace margin which becomes less serrated as the turtle matures. Both the green turtle and the hawksbill have four pairs of lateral carapace scutes, but the hawksbill has two pairs of scales between the eyes and the green turtle has only one pair (Figure 2). Hawksbills of varying sizes are present in BVI waters throughout the year. They are generally net-caught offshore, but are occasionally speared or noose-caught. They are found most often in nets set some distance from shore (often 3-4 km) in reef areas. Size classes from 24 cm to mature adults are landed.

Despite the fact that hawksbills are the most common nesting turtle in the BVI (Table 2), they have proven difficult to study. Based on data collected in Antigua, females coming ashore in the BVI are likely to lay four to six clutches of eggs per year at intervals of 14-15 days (range 13-18 days; Corliss et al., 1989). Five nests were exhumed in March 1992 on Northwest Beach, Scrub Island, after hatchlings had emerged, revealing clutch sizes of 15, 80, 102, 132 and 172 eggs, hatch successes of 79-100%, and incubation intervals of 70-72 days (Bill Bailey, pers. obs.). Average annual clutch size at Mona Island, Puerto Rico, has ranged from 141.0 (1989) to 157.6 (1984); incubation lasts 47-63 days (Richardson, 1990). At Buck Island, USVI, average annual clutch size ranges from 137.3 to 153.4 eggs (n=262 nests) (Z. Hillis, pers. comm., 1992). Females often nest deep in the shelter of beach vegetation. Little evidence of the visit exists aside from a faint asymmetrical crawl (flippers alternating) about 70 cm wide leading to and from the ocean. Crawl widths measured at Scrub Island in 1991 ranged from 60-80 cm (B. Bailey, pers. obs.). As is true for other sea turtles, females predictably return to the same beach or area to renest every 2-3 years, again based on data collected in Antigua and Buck Island.

Three years of beach surveys (1990-1992) suggest that the majority of nesting, at least in the northern cays, occurs from August-January, peaking in November (B. Bailey, pers. obs.). The peak is later than has been reported for hawksbills nesting in neighbouring political jurisdictions. For comparison, the USVI nesting season extends from June to December (peak: August-September) on St. John (Small, 1982) and May to December (peak: July-September) on Buck Island (Hillis, 1992). Roughly 75% of all nests are laid from August-November on Mona Island, Puerto Rico (Richardson, 1990). In Antigua, the "primary nesting season" is mid-June to mid-November (Corliss et al., 1989), with most nesting taking place from July-October. Each individual hawksbill has herown "clock" and arrives at the nesting beach at the same time every nesting season (e.g., every two years). It is possible that the early season nesters have been exterminated in the BVI, leaving remnant assemblages consisting only of relatively late-nesting females. Further study into the frequency and timing of hawksbill nesting in the BVI is needed. Known nesting beaches are summarized in Table 1 (see also Figure 3).

The potential foraging habitat available to hawksbills is extensive. The species feeds almost exclusively on sponges in the Caribbean. The diet is taxonomically narrow and includes sponges that are toxic to other vertebrates. In a study of the gut contents of hawksbills from Panama, the Dominican Republic, and the Lesser Antilles, the ten most commonly ingested sponge

species were Geodia sp., Ancorina sp., Ecionemia sp., Myriastra sp., Chondrosia sp., Chondrilla nucula, Tethya cf. actinia, Aaptos sp., Suberites sp., and Placospongia sp. (Meylan, 1988). Based on repeated sightings, it appears that the following areas are important foraging grounds in the BVI: Eustatia Reef (North Sound), Guana Island, Marina Cay, Great Camanoe, the channel between Thatch Island and Jost Van Dyke, around the southern islands of Cooper, Salt, and Ginger, and in selected areas of the southern coast of Tortola. Many of these are favoured yachting areas, and thus a sampling bias is likely. Territory-wide surveys are needed. It appears, based on sightings reports, that juvenile hawksbills are most often encountered in water less than 40 ft deep. In contrast, adults are often (though not exclusively) seen in deeper water, frequently >80-100 feet (Sam Davies, Assistant Fisheries Officer, pers. comm., 1992).

The exquisite beauty of the shell scutes has long played a central role in jewelry and ornamentation in the Caribbean. Buyers from the Lesser Antilles (especially St. Martin) have been known to purchase hawksbill shell (known as "tortoiseshell") on Tortola, presumably for resale on other islands. This activity has declined in recent years. Some imported tortoiseshell jewelry was found for sale in Road Town, Tortola, in 1987 and Little Denmark had three pair of earrings for sale in November 1992; the products reportedly sell poorly and clerks typically confide that they will not be reordered (see section 3.3). The number of hawksbills harvested has declined in recent years but the precise number of turtles taken is not known, nor are historical data available. An unquantified level of egg harvest has been widespread for many years and continues today. Local tradition maintains that a silhouette of the turtle will be visible in the clouds on the evening of nesting, and that the turtle figure points in the direction of the nesting beach that will be used that night (W. Leonard, pers. comm., 1987); this phenomenon is also reported for leatherback turtles (section I).

2.5 Lepidochelys kempii, Kemp's Ridley Sea Turtle

There are no records of Kemp's ridleys in the BVI. This diminutive turtle 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, 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 (ca. 55-75 cm). Ridleys are carnivorous and eat mostly crabs, but also prey on other crustaceans, shellfish, jellyfish, sea urchins, starfish, and fish. With the exception of a single recapture from Caribbean Nicaragua of a "head-started" individual (Manzella et al., 1991), which may have displayed altered behaviour due to having been held captive during its first year (Woody, 1991), Kemp's ridleys are confined to the Gulf of Mexico and temperate northern Atlantic. Unarguably the most endangered sea turtle in the world, the total adult population is thought to number no more than 900 females and an unknown number of males (Ross et al., 1989). The species nests almost exclusively in the state of Tamaulipas, Mexico.

2.6 Lepidochelys olivacea, Olive Ridley Sea Turtle

There are no records of olive ridleys in the BVI, nor would the species be expected to occur. Olive ridleys are similar in appearance to Kemp's ridleys (section 2.5), having a nearly round carapace (width about 90% of the length) and an adult colour of olive green or brown dorsally and yellowish white ventrally. The turtle rarely exceeds 100 lb (45 kg) (Pritchard et al.,

1983). Each front flipper bears a single claw, the horny beak may be finely serrated, and carapace scutes do not overlap one another. The lateral scutes (those to either side of the median) are divided into 5-9 pairs, considerably more than other sea turtles which typically have 4-5 pairs. In the western Atlantic, olive ridleys have been reported from Brazil northward to Venezuela (Pritchard, 1969), but significant levels of nesting appear to occur only in Suriname and 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). Incidental catch and drowning in shrimp trawls has been implicated in their demise. Diffuse nesting occurs in northwest Guyana and in French Guiana (Reichart, 1989).

III. STRESSES ON SEA TURTLES IN THE BVI

3.1 Destruction or Modification of Habitat

Sea turtles depend on a healthy marine environment, especially coral reefs and sea grass meadows which provide food for hawksbill (section 2.4) and green (section 2.2) turtles, respectively. The most prominent causes of marine habitat deterioration are indiscriminate anchoring, dredging, ocean dumping, vessel groundings, sewage and other effluents, sedimentation, specimen collecting, coastal land reclamation, and trampling of corals by divers and snorkelers. Some coral reefs, including Coral Gardens at Dead Chest, The Indians, White Bay (Jost Van Dyke), and White Bay at Guana Island have sustained obvious damage from anchoring (Alan Baskin, Baskin-in-the-Sun, pers. obs.). An estimated 33 km (20.5 miles), or 18% of the total linear length of fringing reef in the BVI, have been "heavily impacted" by activities such as those noted above. The most seriously affected sites include portions of Horseshoe Reef, southwestern Virgin Gorda and North Sound, Beef Island, portions of Peter Island (especially Deadmans Bay), Jost Van Dyke (especially White Bay, Great Harbour, and Long Bay), and areas along the southern coast of Tortola including East End, Fish Bay, Baughers Bay, Slaney, Nanny Cay and towards West End (BVI Government, 1992).

Sea grass meadows have not received as much study or attention as coral reefs, but there are data to indicate that sea grasses are showing signs of stress in some areas. For example, sea grasses in Manchineel Bay (Cooper Island) and North Sound have been described as unhealthy as a direct result of anchoring (Salm, 1980; ECNAMP, 1981; Rogers et al., 1982) [N.B. the situation has improved considerably with the installation of moorings, see section 4.147]. Land-based sedimentation (run-off) and dredging also threaten the health of sea grass ecosystems in the BVI (BVI Government, 1992). In addition, the use of spear-guns, SCUBA, and bleach and other chemicals for the purpose of catching fish has resulted in damage to benthic communities and has accelerated the depletion of fisheries resources in general (Koester, 1987). Since sea turtles coexist with many species of commercial fishes, the turtles are affected by short-sighted fishing practices which involve the destruction of habitat. Coral reefs and sea grass meadows should be protected not just because they are important to endangered sea turtles, but because they provide a livelihood for many BVI residents involved in commercial and subsistence fishing and marine tourism.

Sandy beaches are vital to the survival of sea turtles. All sea turtle species come ashore to lay their eggs, which incubate unattended for about two months in the warm sand. Sand mining has already destroyed some nesting beaches (e.g., Fat Hogs Bay, Josiahs Bay) and coastal development, including roads and fences, has also brought its share of problems. The CFD has determined that 66% of Tortola beaches eroded and decreased in area by 20% between 1989 and 1990 (BVI Government, 1992). Shoreline development continues to accelerate and beach-front property is increasingly valued for its commercial potential, rather than its importance to wildlife. Coastal development generally brings increased activity to beaches, in addition to armouring, litter, artificial lighting, domestic animals, ease of access for poachers, and other hazards. As an example, modern development of Great Camanoe began in 1972; turtles nested at Low Bay in the early 1970's, but none have come there in the past 10 years (B. Bailey, pers. comm., 1992). Artificial lighting is particularly worrisome since it disorients hatchlings (preventing them from reaching the sea) and may discourage females from coming ashore. Hatchling disorientation has already been reported from some areas, such as Bercher's Bay in Virgin Gorda, Marina Cay, and Long Bay Belmont in Tortola. Nonetheless, not all forms of beach-front development are incompatible with sea turtle nesting. Solutions to a wide variety of threats are provided in sections 4.13 and 4.14.

The BVI National Report prepared for the U. N. Conference on Environment and Development in June 1992 (the "Earth Summit") attributes a "gradual deterioration in the state of the natural environment, not only in terms of resource depletion, but in a relative disregard for conservation policies" to (1) government policies which have sought to encourage a diversification of the economy by providing an atmosphere conducive to the development of an offshore financial centre in the BVI (giving rise to policies aimed at not unduly burdening the private sector with prohibitive taxes and regulations) and (2) an expanding tourism industry. Recent resistance to coastal zone management considerations and to environmental impact assessments are manifestations of this new reality (BVI Government, 1992). In order to reduce the destruction or adverse modification of habitat, especially of coastal and marine areas important to endangered sea turtles, the same report concludes that there is a need to incorporate environmental and physical planning considerations into the design and evaluation of public sector projects and for improved data generation and dissemination to aid inter-sectoral planning and project implementation.

3.2 Disease or Predation

There are no data on the extent to which disease and predators affect sea turtle survival in the BVI. Beach erosion and natural predators, including crabs, birds and mammals, contribute to the loss of eggs and hatchlings. Egg predation by mongooses (Herpestes auropunctatus) is high on neighbouring St. John (Nellis and Small, 1983; Zullo, 1986), for example, and in recent years has represented a major source of mortality to turtle eggs on Buck Island, St. Croix (Boulon, 1984; Zullo, 1986). Boulon (1984) estimated that 23% of the hawksbill eggs on St. John (1980-1981) were lost to mongooses, feral dogs, and/or beach erosion. The absence of information on nest fate in the BVI is unacceptable from a management standpoint. It is a recommendation of this Recovery Action Plan that a comprehensive evaluation be undertaken of the loss of sea turtle eggs and hatchlings to predators and other events (e.g., erosion, flooding) on selected beaches. The identification of "index beaches" for research and monitoring purposes is discussed in section 4.29.

In addition to losses on the nesting beach, birds and reef fishes consume hatchlings at sea, and sharks and orcas (Orcinus orca, "killer whales") hunt juvenile and adult turtles. The scutes (=carapace plates) from a young hawksbill weighing an estimated 28 kg were found in the stomach of a 4-meter tiger shark caught in St. Thomas (Boulon, 1984) and a similar account was recently published for Nevis (Young, 1992). Young leatherbacks apparently attacked by sharks have washed ashore in Barbados (Horrocks, 1987) and leatherback remains have been found in the stomachs of orcas in St. Vincent (Caldwell and Caldwell, 1969). There is no evidence that the loss of juveniles and adults at sea to predators is excessive or outside natural tolerances. A quantitative assessment of natural rates of mortality in juvenile and adult turtles at sea is virtually impossible and is not considered a priority at this time.

Green turtle fibropapilloma disease has not been documented in the BVI, but there are unconfirmed reports dating back to the 1970's. The disease is a herpesvirus-like infection and has been reported elsewhere in the Caribbean (e.g., Jacobson, 1990) and is extensively documented in Florida (Ehrhart, 1991). Symptoms include external tumors of varying sizes. Two green turtles with small papillomas (0.5-1.5 cm) were recently caught off St. Thomas as part of an ongoing tag and recapture study; they were not subsequently recaptured (Ralf Boulon, USVI Division of Fish and Wildlife, pers. comm., 1991). The tumors can result in blindness and turtles starving to death; in several cases, internal tumors have been seen in the lungs, intestinal surface, and kidneys (Jacobson, 1990). The cause of this debilitating and potentially fatal disease is not known. If turtles with visible tumors are captured they should be returned immediately to the sea; under no circumstances should diseased turtles be eaten by humans.

3.3 Over-utilisation

Formal catch statistics have never been kept. Fletemeyer (1984) reported that 600 green turtles were landed in 1981, and an additional 100 were caught incidentally. Winston Leonard (owner, Leonard's Sea Food, Ltd., Tortola) estimated that 250 green turtles were landed in 1983, 225 in 1984, and 200 in 1985 (pers. comm., 1986). His figures were computed by doubling the reported catch on the island of Anegada, where most of the turtles had been captured. In 1987, informed opinion within the MNRL held that the 1987 harvest was comparable to that estimated for 1983-1985; however, a former Fisheries Officer confided his belief that the 1987 catch was comparable to that estimated in 1981. Today it is still true that more green turtles are landed than hawksbills, although the turtles are, in general, smaller than they were a generation ago and the total harvest has been reduced to 10% of what it was a decade ago. According to Davies (1991), 71 green turtles were caught during the 16-week 1990-1991 open season. The average size was estimated to be 35-40 lb (range 25-200 lb; Davies, 1991). The fishery is still centered in Anegada, which supplies at least half of the annual catch. Most netting is done off the western coast of Anegada in sea grass habitat. Turtles are also caught by "jumping"; that is, leaping onto them from a boat. Two fishermen caught 35-50 greens (8-10 per trip) in this way off Anegada during the 1991-1992 season. Similarly, Roger White landed two greens (70, 80 lb) at Government Dock (East End Jetty) in December 1991, also by jumping. On 19 March 1992, the remains of a slaughtered green were found discarded on a side road in Road Town.

In the case of hawksbill turtles, Fletemeyer (1984) reported that 300 were landed in 1981 and an additional 100 incidentally net-caught. According to Winston Leonard, approximately

100 hawksbills were landed in 1983, 75 in 1984, and 75 in 1985 (calculated by doubling the number of landings reported for Anegada). It is generally believed that there has been a decline in stocks over recent decades and, especially now that the closed season extends through most of the nesting season, fewer hawksbills are landed today than five years ago. An estimated 30-50% of the catch is composed of hawksbill turtles, partly because green turtles are more common than hawksbills in nearshore waters and partly because nets are typically set in sea grass rather than coral reef or other "hard bottom" habitats. According to Davies (1991), 32 hawksbills were caught during the 16-week 1990-1991 open season. These turtles weighed 25-72 lb. A similar range is seen in local fisherman Kenneth Faulkner's data (Table 4). During the 1991-1992 open season, an observer reported to the CFD that a "60 or 70 lb" hawksbill was landed at St. Thomas Bay, Virgin Gorda, and 30-40 "small" hawksbills were landed at Gun Creek (North Sound, Virgin Gorda). The small animals were probably taken from Horseshoe Reef, Anegada. The data indicate that the reported catch is less than 10% of what it was a decade ago. However, opportunistic take, especially by spearing, has not been quantified and is believed by some to exceed the turtle fishermen's catch.

Not all the harvest occurs during the open season. For example, on 21 May 1991, the head of a slaughtered hawksbill was recovered at Havers (south of Nannie Cay, southwestern Tortola); CFD staff photographed the remains. On 28 July 1992, a concerned citizen notified the CFD that he had seen the remains of four hawksbills on the beach at Kingstown. Three green turtle shells were reported seen at Trellis Bay "in the water" during the closed season. The turtles had apparently been speared. The take of egg-bearing females has declined steeply since the 1986 extension of the closed season; nevertheless, some illegal killing continues on the nesting beaches as evidenced by shells occasionally found "hidden" in the bushes.

A Frame Survey conducted during June-July 1991 by the Fisheries Division (Alimoso and Davies, 1991) documented 49 turtle nets in the possession of 18 part-time turtle fishermen, 75% of which had been fished that year. Since the Frame Survey did not reach everyone, Fisheries personnel estimate a total of 24 part-time turtle fishermen and a total of 64 turtle nets (tangle nets, 10-12 inch mesh). There are an estimated 276 fishermen in the BVI, meaning that approximately 8.5% of them occasionally target turtles. [N.B. These are the green turtle/hawksbill fishermen, as opposed to the trunkers (leatherback hunters) discussed below.] A precise tally of turtle fishermen is difficult for several reasons. Not all net owners fish for turtles in a given year (it is not uncommon to fish for turtles one year and not the next) and in some cases fishermen who do not own a turtle net target turtles by borrowing a neighbour's net. In no case can a fisherman rely on turtles for his complete income because the season is only open for four months (1 December - 31 March). Nearly one-third of the declared turtle fishermen earn their livelihood from a profession other than fishing (Table 5). There are a few restaurants still serving turtle, but most of the catch is sold informally to friends and community. Turtle meat (live weight) sells for about $2/lb, cheaper than fish at $2.50-5.00/lb (local currency is US$).

Restaurant demand has traditionally focused on the green sea turtle. Locally popular dishes were common restaurant fare before the 1986 amendments to the Turtles Ordinance (section 4.21) extended the closed season from April through November. Turtle stew was a high price item, selling for approximately $8. Six local restaurants regularly sold turtle; generally 20-25 lunches per week. Thus, turtle was worth $1000-1200 per week to the restaurant commun-

ity as a whole (W. Leonard, pers. comm., 1986). With the passage of the 1986 amendments, some restaurants took a loss on turtle meat which had been legally purchased prior to 1 April but, with the advent of the new closed season, could not be sold. In April 1987, at least one restaurant in Road Town contacted the MNRL to ask advice concerning frozen sea turtles left in the freezer when the closed season commenced. Today only a few restaurants, including the Beach Club and Little Apple, still serve sea turtle. The risk of losing the investment made in turtle meat by not being able to sell it all during the 16-week open season is reportedly the impetus behind the declining number of restaurants offering sea turtle on their menus. The price for turtle steak at Little Apple in 1991 was $21, comparable to other seafood dishes.

The leatherback turtle is the most endangered turtle in the BVI. Residents recall as many as six per night nesting on Tortola beaches prior to World War II. Today it appears from annual survey data that fewer than ten leatherbacks nest *per year* on all of Tortola. Cambers and Lima (1989) concluded that it "may well be becoming extinct from some of the more developed islands in the BVI". The primary reason for the decline is certain to be the persistent harvest of gravid females on the nesting beaches for meat and oil (sections I, 2.3), the latter selling for as much as $200 per bottle in 1992. During the last five years, one female was killed in 1986 (Long Bay Lambert) and another in 1987 (Josiahs Bay); an unconfirmed killing was rumored in May 1990 (Table 6). Of a total estimated nesting population of four females in 1991, two were killed. While relatively few are taken, the harvest is significant in terms of overall population size.

Other factors contributing to the precarious state of the BVI colony may include incidental catch and drowning, beach sand mining, marine pollution, and garbage (especially plastics) carelessly disposed of at sea. These are not likely to be dominant factors, however, since important nesting beaches are still relatively undisturbed. Further, it would be difficult to defend the hypothesis that gravid females are killed in large numbers en route between feeding and nesting grounds. Leatherbacks nesting in St. Croix probably travel the same routes as those nesting in Tortola. Yet nesting trends at Sandy Point National Wildlife Refuge are stable, the difference being that nesting females (and all sea turtles) are protected in the USVI.

In addition to the use of sea turtles for meat and oil, the value of their shell, especially that of the hawksbill, is well known. In 1987, a few turtle products were found for sale in Road Town, Tortola. In one store, tortoiseshell bracelets and earrings were offered at $15 each. The products were imported, but the source country was not known by the clerk who expressed the opinion that the items were high priced, slow to sell, and would probably not be ordered again. In a second store, bracelets for $9 and rings for $8-10 were labeled "Farmed Green Turtle Products" from the Cayman Islands. Importation of sea turtle products is illegal under the BVI Endangered Animals and Plants Ordinance (1976), but Cayman Island Turtle Farm products may legally circulate amongst British territories. The sale of all sea turtle products, 'farmed' or not, should logically be banned since they are intended for sale to tourists who will simply have them confiscated upon re-entry into the USA, Latin America, and most of Europe because these nations are all Parties to CITES (section 4.31). A November 1992 survey of Road Town boutiques revealed only one store (Little Denmark) selling tortoiseshell; three pair of earrings were priced at $11.95 ea. The Little Denmark clerk indicated that the items had been imported (country of origin unknown), sold poorly, and were not likely to be reordered.

An artisan in The Valley (formerly Spanishtown), Virgin Gorda, told the authors in 1987 that tortoiseshell had not been offered for sale on that island since perhaps 1984. He used to buy the scutes locally and fashion them into jewelry, but harassment from divers and USVI enforcement officers prompted him to abandon the art. Scutes were purchased from turtles that had been killed for meat; turtles were not killed specifically for their shells. Generally the scutes were removed after soaking the carapace in water, but sometimes the entire shell was purchased and polished for sale. Whole shells from juvenile and adult hawksbills and green turtles, obtained before the present concern for the status of sea turtle species, grace the walls of many local restaurants, hotels, and businesses. Whole shells are no longer available for sale in local gift shops. The last such incident was of juvenile hawksbill shells reported for sale in the airport restaurant (Beef Island) in 1986. Fishermen report that shell used to bring $16-35/lb (W. Leonard reports $75-100 per shell).

At the present time the collection of sea turtle eggs is legal year-around (section 4.21). The harvest, which is primarily for personal consumption, is believed to be widespread but there has been no record-keeping in this regard. Fletemeyer (1984) estimated for the First Western Atlantic Turtle Symposium that the harvest approached 50% of all eggs laid. Winston Leonard concedes that historically it was probably close to 100% in some areas; the target was primarily hawksbill eggs and secondarily leatherback eggs. Contemporary harvest is reported from Rogues Bay (Tortola), Long Bay (Beef Island), Cam Bay and North Bay (Great Camanoe), North Beach (Guana Island), Scrub Island, and all around Anegada. In 1990, neither hawksbill nest laid on North West Beach, Scrub Island, was successful. One washed away and the other had the eggs removed. In 1991, two of four known nests on North Bay, Scrub Island, had all the eggs removed (B. Bailey, pers. obs.).

In summary, commercial product (jewelry, shells, curios, trunk oil) and restaurant (meat, soup) demand have both contributed to the decline of sea turtle stocks in the BVI. In addition, the personal consumption (as opposed to the commercial sale) of meat, oil, and eggs has traditionally affected all three of the most commonly occurring sea turtle species: the green, hawksbill, and trunk or leatherback. The BVI is fortunate in that it has never had a serious commercial import/export industry in sea turtles, and thus does not appear to have experienced the catastrophic declines in green and/or hawksbill turtle populations that have accompanied such ventures in other nations (e.g., the Cayman Islands). Nonetheless, it is apparent from interviews with longtime residents of the BVI that turtles were once much more abundant than they are today and the leatherback turtle, in particular, has all but been exterminated. The most serious threat facing sea turtle populations in the coming decades may well be the intensive harvest of eggs in recent decades. If, as some fear, there have been virtually no hatchlings emerging from many of the more prominent nesting beaches, then there will not be any turtles returning as adults to lay their own eggs, regardless of conservation efforts now being initiated.

3.4 Inadequate Regulatory Mechanisms

Sea turtle conservation legislation enacted in 1986 is inadequate to promote the recovery of depleted stocks. The regulations include a closed season between 1 April and 30 November, which effectively protects most breeding adults (except hawksbills) during their nesting period, but there are no size limits or other constraints on turtles harvested during the open season and

no protection at any time for sea turtle eggs. Improved legislation in the form of a draft Turtles Act of 1992 was submitted to the Minister of Natural Resources and Labour by the CFD in February 1992 and was presented to the Executive Council the following November (section 4.21). The proposed Act represents a significant improvement over the 1986 law, but falls short of calling for an unconditional ban on the harvest of sea turtles (section 4.23). When the 1992 Act was submitted, the CFD emphasized that it was to be viewed as an interim measure and that a full moratorium was needed. Such a moratorium is essential throughout the Caribbean Sea if migratory sea turtles are to be saved from extinction.

As is the case throughout the Caribbean (indeed, throughout the world), conservation law enforcement could be greatly improved. Since the BVI Royal Police are responsible for enforcing all legal statutes in the Islands there is, understandably, a distinct lack of personnel available for patrol of beaches, markets, boat landings, and open water. There is no enforcement branch specifically dedicated to the protection of natural biotic and abiotic resources. All CFD personnel have been deputized by the Minister to serve as Fisheries Inspectors and as such they are empowered to enforce fisheries legislation. In reality, however, the Fisheries boat is not capable of long distance surveillance or pursuit. Furthermore, CFD staff do not receive formal law enforcement training and are often hesitant to involve themselves in arrest procedures. Enforcement capability will be improved with the planned purchase of a new CFD surveillance vessel and could be enhanced considerably by the creation of a Division of Enforcement within the CFD (see section 4.24).

Enforcement capacity has been hindered historically because BVI Royal Police officers have generally lacked an awareness of conservation ordinances and regulations. In an attempt to rectify this situation, a February 1986 workshop entitled "Environmental Law Enforcement" was sponsored by the Eastern Caribbean Natural Areas Management Program (ECNAMP) in Tortola. All government Ministries were involved. The purpose of the workshop was to bring conservation law to the attention of all parties. In November 1991, a Surveillance Workshop sponsored by the OECS was convened in Tortola for the purpose of informing enforcement personnel from Customs, Police, Immigration, and the National Parks Trust (NPT) about existing environmental legislation and the need for vigilant enforcement. Workshops such as this should be repeated regularly. Further discussions of law enforcement are found in sections 4.123, 4.22 and 4.24.

In the arena of habitat protection, it is clear that legislative, administrative and technical provisions for town and country planning are modest and development planning has not been undertaken in a comprehensive manner. Some development plans have been prepared, but the machinery for their implementation has been far from adequate. While the pace of development remained slow and the population small, the lack of control over development did not result in any serious damage to either human or natural environments. However, that is no longer the case. On Tortola to a high degree, and on other islands to a lesser degree, the pressure on land and along the coast for residential, hotel and commercial development is creating a "critical situation" (BVI Government, 1992). The Land Development Control Ordinance, 1969, is the principal piece of planning legislation. Under the Ordinance a person wishing to develop land is required to obtain the permission of the Land Development Control Authority (LDCA). In addition, a person intending to erect a building or undertake construction activity on a building is

required to obtain the approval of the Building Authority under the Building Ordinance. More comprehensive legislation has recently been proposed in the form of a Coast Conservation and Management Act.

Finally, there is no holistic legislation which addresses the long-term conservation of coral reefs or sea grass communities, despite the fact that these natural communities are known to be very important to the survival of marine turtles, as well as to the survival of local fishing and tourism industries. Jurisdiction is not difficult to define, since the Government owns the seabed and therefore the coral reefs and sea grasses within the Territorial Sea. Some improvements have recently been made in that coral reefs within the boundaries of marine parks are now covered by specific legislation (section 4.21) and in 1990, the Horseshoe Reef southeast of Anegada was declared a protected area under the Fisheries Ordinance. Under this order it is illegal to harvest any marine product or to anchor any vessel except by special license from the Minister, but the Government's capability to enforce this order (which covers a very large area of the Horseshoe Reef complex) is limited. The Taking of Marine Products Order of 1991 prohibits the taking of any marine product using SCUBA gear and also prohibits spear fishing within the 10 fathom depth contour around Anegada (BVI Government, 1992). The Marine Parks and Protected Areas Regulations, 1991, prohibit anchoring in designated areas.

3.5 Other Natural or Man-made Factors

Hurricane Frederic (September 1979) devastated some reefs in North Sound, Virgin Gorda, but neither Hurricane David (August 1979) nor Hurricane Allen (August 1980) caused significant damage to BVI reefs (Rogers et al., 1982). The damage wrought by Hurricane Hugo in 1989 was never quantified, but empirical evidence suggests that many corals were broken and/or uprooted. Hurricane Hugo was a Category 4 hurricane which passed 60 miles (97 km) south of the BVI with sustained winds of 100 mph (161 km/hr). The storm had an estimated surge of 8 ft (2.4 m) and heavy rainfall. In addition to estimated damage of some $200,000,000, Hugo caused noticeable damage to some stands of elkhorn coral (Acropora sp.) which were found dead after the event. Since most of the storm-generated swells came from the east-southeast, most of the damage occurred along the southeast coastlines. The occasional erosion of nesting areas during periods of high northerly swells has also proven to be a problem in some areas. A recent example of this was November 1991 at Long Bay Belmont when a hawksbill nest already partially washed away by an ocean swell was rescued and reburied by an alert coastal resident.

A threat of unknown magnitude involves the catching of leatherbacks on longlines baited with squid. Foreign vessels paid the government of the BVI $7000 each in 1987 to fish for swordfish using longlines during the November-May season. The lines (ca. 35 miles in length) were set north of Anegada in 1000-2000 fathoms of water; hooks hung at 50 fathoms. Incidental catch was reported to include many nontarget species, including sea turtles and commercial fishes important to the livelihood of fishermen in Anegada. One leatherback was hooked in March 1987 and two more in December 1987; all were released apparently unharmed after the hook and line were cut (S. Davies, pers. comm., 1989). No hooking of sea turtles has been reported since and longlining is now done only part-time by one foreign and two local vessels. It is a recommendation of this Recovery Action Plan that the number of sea turtles caught incidentally on longlines be determined, as well as the rate of mortality associated with the long-

line hook remaining lodged in the turtle's throat (see also section 4.27). Incidental catch and drowning in net fisheries also occurs to an unknown extent. Two turtles (1 green?, 1 hawksbill) washed ashore together at Guana Island in early 1991, apparently having been drowned in offshore nets (S. Davies, pers. comm., 1991).

Recently, preparations have been made to build two desalination plants on Virgin Gorda, one at Handsome Bay and the other at South Sound. Both of these areas, especially South Sound, have extensive and healthy coral reefs which provide protection to the shoreline and calm areas for feeding by sea turtles. South Sound is a particularly good feeding and resting area for turtles, which are often seen diving and basking there. The introduction of very warm hypersaline water to the coastal zone will have a negative and potentially lethal impact on the coral reefs there, and for this reason should be discharged seaward of the coral community. In early 1991, a small hawksbill washed ashore dead on the east end of Tortola in Beef Island channel. The turtle had a sharp chop on its neck attributed to an encounter with a boat propeller or a jet-ski. The CFD received two reports of green turtles struck by boat propellers in October 1992; one washed ashore on Peter Island and the other at Havers. Finally, the entire coastline of the BVI, including its sandy beaches, is threatened by potential sea level rise.

IV. SOLUTIONS TO STRESSES ON SEA TURTLES IN THE BVI

4.1 Manage and Protect Habitat

The protection of marine and terrestrial habitats critical to the continued survival of sea turtles in the BVI is viewed as an essential component of any effective recovery programme. Two broad types of marine habitat are important to sea turtles: sea grass meadows and coral reefs. Green turtles depend almost exclusively on sea grasses for food (section 2.2) and loggerheads consume a wide variety of invertebrates (section 2.1), many of whom depend on sea grass for some part of their life cycle. Protection of sea grass is, therefore, vital for the survival and recovery of sea turtles. The great value of healthy sea grass beds need not be defined solely in terms of sea turtles, however. Sea grasses are characterized by an extensive root and rhizome system, dense leaf cover, high growth rates, and high organic productivity that rivals some of the most intensive agricultural crops. Sea grasses exert considerable influence over their environment. Their exceptionally high productivity is supplemented by that of associated epiphytic algae and benthic and planktonic micro-algae, which together provide food for a wide variety of marine animals.

Meadows of broad leaved "turtle grass" (Thalassia testudinum) and the more slender "manatee grass" (Syringodium filiforme) are particularly vital as nursery areas for commercially important fishes and invertebrates (e.g., queen conch, spiny lobster). Sea grasses, with their extensive root system, prevent the suspension of sediments, thus stabilising sand and other sediments. The leafy canopy slows waters movement and filters the water column. Once the sea grass cover is removed, the many ecological contributions of the grasses are lost, turbidity increases, and it becomes nearly impossible for new grass to recolonize the area (Wilcox, 1989). Sea grass can be damaged or eliminated by many factors, most notably pollution, sedimentation, coastal land reclamation, dredging, and anchoring. Sedimentation (smothering sea grasses with

silt and dirt) commonly results from dredging, anchoring and land-based run-off, the latter often associated with upland deforestation or other clearing of vegetation. The most important sea grass communities in the BVI are found along the south shore of Tortola, the sheltered bays of Virgin Gorda, the southwestern shoreline of Anegada, the southern coast of Jost Van Dyke, and surrounding many of the smaller islets.

Coral reef communities are also important. They provide food and shelter for hawksbill turtles, which consume mainly reef-associated sponges (section 2.4). Wilcox (1989), in her recent study of the marine resources of the Southeast Peninsula of St. Kitts, noted that in order to grow and flourish, coral reefs need clear, clean water and relatively high wave energy. In return, a healthy reef system, especially the barrier type of reef, continually acts to reduce incoming wave energy and provides a source of beach sand. In the BVI, the extensive barrier reefs (Eustatia and Colquhoun Reef) protecting North Sound, Virgin Gorda, make this an important hurricane anchorage (Rogers et al., 1982). Coral reefs are also critical habitat for the majority of bottom-dwelling or demersal fish living in nearshore areas of the Caribbean. As such, reefs are vital not only for sea turtles, but also for a wide variety of commercially important fishes. More than 300 fish species are found on Eastern Caribbean coral reefs, and approximately 180 of these are used for human consumption (Goodwin et al., 1986). Coral reefs, constructed by countless tiny coral animals, grow very slowly. Once they are destroyed by anchors or pollution, they require many decades to fully recover.

Fringing coral reefs are seen around all the islands and consist mainly of large boulder-type corals (e.g., Diploria sp., Montastrea sp. and Siderastrea sp.), branching-type corals (e.g., Acropora sp., Porites sp.), and several species of soft corals. The most extensive reef formations are located in North Sound (Eustatia Reef) and south of Anegada (Horseshoe Reef). These generally have an Acropora sp. backreef and crest with a typical spur-and-groove forereef. Within recent years BVI corals have come under increasing threat. Anchors of small yachts and cruise ships, as well as ship groundings have caused extensive damage (see section 4.147). Increased numbers of tourists diving and snorkeling also take their toll. Upland clearing for development, combined with the cutting of coastal mangroves, has increased the volume of sediment being deposited on reefs. This is especially obvious in areas where dredging is also occurring. Harvesting of coral for jewelry, although presently small in total volume, has had noticeably damaging effects in some areas. Pollution from sewage, nutrients, industrial waste, solid waste, antifouling paint and oil is also compromising the health of local corals. Finally, recent storms, especially Hurricanes Frederick (1979) and Hugo (1989) and Tropical Storm Klaus (1984) have caused damage.

In addition to managing and protecting marine habitat, the long-term integrity of sandy beaches is essential to the continued survival of sea turtles. Sandy beaches are widely distributed in the BVI and many are used for egg-laying (Table 1). There are no beaches protected specifically for sea turtles at the present time, but since all beaches are publicly owned, some threats are already controlled. For example, littering is prohibited and sand mining is allowed only by permit. Nevertheless, beaches are under intense pressure for tourist development and many (e.g., Bercher's Bay, Virgin Gorda; Long Bay Belmont, Tortola) already host lights and intense levels of activity which are likely to adversely affect nesting sea turtles. It is imperative that the most significant nesting beaches be identified quickly so that specific management plans

can be formulated before these important habitats are lost or irreparably degraded. In the sections that follow, the essential components of a comprehensive habitat management programme are discussed in detail. These subsections include identifying important habitats (section 4.11), developing management plans (section 4.12), and preventing degradation to nesting (section 4.13) and foraging (section 4.14) grounds. Recommendations are summarized in Appendix I.

4.11 Identify essential habitat

The identification of essential habitat is the first step in any effective species management programme. Ideally, a comprehensive, long-term survey of all potential foraging and nesting habitats should be implemented in order to fully quantify usage by marine turtles. However, the realities of an extensive territory and limited resources preclude such an undertaking. In lieu of a complete survey, maximum advantage should be taken of all ongoing CFD programmes that monitor specific coastal and coral reef habitats. These surveys should be modified as appropriate in order to accommodate the recording of sea turtle sightings. Supplementing the government effort, valuable empirical data can be gathered by divers, fishermen, and recreational boaters. Similarly, until such time as a comprehensive terrestrial survey can be undertaken, a selection of sandy beaches known to be visited by nesting sea turtles should be consistently monitored by government researchers and/or trained volunteers.

With these points in mind, it is the recommendation of this Recovery Action Plan that (i) relevant survey and monitoring programmes, such as those ongoing for coral reefs and proposed for sea grass meadows, incorporate sea turtle sightings and behavioural patterns in the database, (ii) fishermen, divers, and charter boat captains be provided with sightings forms and encouraged to report at-sea observations and patterns of habitat use by turtles, (iii) CFD hire and train seasonal employees to comprehensively monitor a subsample of important nesting beaches, (iv) trained community volunteers continue to monitor nesting activity, (v) as soon as practicable, the entire BVI be surveyed as a single management unit so that decisions regarding the most efficient use of limited human and monetary resources can be made based on an overview of important sea turtle habitat. These ideas are further developed in sections 4.111 and 4.112. It is noteworthy that a Coastal Inventory Project funded by the British Development Division and undertaken by the Natural Resources Institute-U.K. is expected to be completed by mid-1993. The final product will be an atlas of the distribution and extent of coastal resources in the BVI, including beaches, mangroves, coral reefs, and sea grasses.

4.111 Survey foraging areas

This vital task is greatly complicated in the BVI, which includes more than 40 islands, islets and rocks (29 with coastlines greater than 1 km in length) totalling about 153 square kilometers of land area. The area of the Territorial Sea is 1,469 square kilometers, some 10 times the land area. Although some preliminary assessments of the distribution of coral reefs and sea grasses have been made (e.g., Dunne and Brown, 1979; ECNAMP, 1980; Rogers et al., 1982) (Figures 4-6) and a comprehensive coastal atlas is in preparation (see section 4.11), neither the government nor the private sector has the financial means or the manpower to study all, or even a significant portion of, existing coral reef and sea grass habitat for use by sea turtles. Data currently available are largely anecdotal. For example, Rogers et al. (1982) noted, "We observed

only six turtles while in Virgin Gorda. Those which we saw well enough to identify were hawksbills, the largest being about 50 cm across. Turtles were seen at Colquhoun Reef, The Invisibles, Oil Nut Bay, Eustatia Island Reef, North of Prickly Pear, and off Bitter End Yacht Club." 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.

Continuing efforts to refine existing knowledge are being sponsored by the CFD (Lead Organization for the local WIDECAST network), NPT, and DOA. Ferry captains, fishermen, and the annual Sail Caribbean programme in the BVI are potential partners in this effort. A map of locations where sea turtles have been reported surfacing and/or foraging is continually updated by the CFD, based on sightings reported by the public. North Sound/Eustatia Reef and the channel between Beef Island/Tortola and the northern cays are frequently mentioned as important feeding areas. Divers and charter boat captains who lead SCUBA or snorkeling trips for tourists visit the same areas repeatedly and have been encouraged to keep records of turtles encountered as a means of monitoring stocks and identifying threats in localized foraging areas. Sightings forms have been developed and these, along with identification sheets produced by WIDECAST, have been provided to dive operators and other willing marine user-groups. Fishermen are encouraged to report sightings to Fisheries Extension Assistants. It would be useful if log books were provided to fishermen interested in reporting sightings on a regular basis. Finally, the CFD has established several coral reef monitoring sites, including sites at Cane Garden Bay (Tortola), White Bay (Jost Van Dyke), Muskmelon and White bays (Guana Island), and Horseshoe Reef (Anegada). There are also plans to assess coral reef and sea grass communities around Tortola and eventually throughout the BVI. During these studies, observations of sea turtle foraging habits will be recorded.

In the case of leatherbacks, nothing is known of feeding habits or foraging grounds (if any) in the BVI. Adults are encountered only occasionally at sea, such as the recent (June 1992) sighting at Little Harbour, Peter Island, and are periodically caught on longline hooks baited with squid (Cambers and Lima, 1990). Studies of offshore diving behaviour by adult females between bouts of nesting in St. Croix indicate that these turtles are capable of diving to depths exceeding 1000 m (Eckert et al., 1989). Eckert et al. (1989) have proposed that the diving, which is shallower and more regular at night, may reflect feeding on deep water plankton, including siphonophores and salps, which approach the surface after sunset. The typical diet of leatherbacks in temperate waters consists of jellyfish and related soft-bodied animals (e.g., Den Hartog and Van Nierop, 1984). In order to identify foraging areas for leatherbacks in the BVI, remote telemetry studies will be needed. To protect potential deep water feeding areas, general conservation measures are necessary, including efforts to eliminate pollution such as solid waste (garbage) and oil.

4.112 Survey nesting habitat

There are 49 miles (79 km) of beaches in the BVI, with Anegada (16 miles) and Virgin Gorda and surrounding islands (11.5 miles) boasting the greatest concentration of beach habitat (BVI Government, 1992). The first attempt to draw together existing fragments of information relating to the utilisation of these beaches by nesting turtles was made by the Eastern Caribbean

Natural Areas Management Program (ECNAMP, 1980). However, no original survey work was initiated by ECNAMP and no criteria for nest frequency, density, or species were employed. The first comprehensive attempt to survey BVI nesting beaches was undertaken by John Fletemeyer for the Western Atlantic Turtle Symposium (Fletemeyer, 1984). Fletemeyer conducted his survey over 12 days in July of 1981; the data, while understandably superficial, provided a starting point for subsequent efforts. In 1985, the MNRL and NPT targeted sea turtles for survey and study. In 1986, Dr. Karen Eckert of WIDECAST was invited to train MNRL and NPT personnel in the details of sea turtle natural history and assist in the design of a beach monitoring programme.

In 1986, a survey of selected nesting beaches began under the auspices of the MNRL Conservation Office. Government-sponsored ground and boat surveys have since continued on a yearly basis and were expanded in 1990 to include aerial surveys (see also section 4.291). Between 1986 and 1989, surveys were designed to count leatherback nests and thus were largely confined to April and May. In 1990, September-December surveys were added in an attempt to quantify green turtle and hawksbill nesting. Eighteen beaches were surveyed in 1990, 23 in 1991, and 14 (in addition to Anegada) in 1992 (Table 2). Volunteers have also contributed to the growing knowledge of nest distribution in the BVI by reporting observed incidents of nesting, hatching, or poaching. A few volunteer activists have monitored selected beaches since 1986 and their surveillance efforts have also served to reduce poaching. The ongoing survey of nesting habitat, which still consists largely of documenting crawls, is a priority for the CFD. Species are generally identified on the basis of crawl characteristics. In section 4.29, candidate "index beaches" are proposed where nesting is predictable and where serious monitoring programmes should be a priority.

Recent surveys have shown that sea turtles nest throughout the BVI, but nowhere in large numbers. Surveys beginning in July are needed in order to refine estimates of green and hawksbill turtle nesting and verification is needed regarding whether green turtles and/or hawksbills nest on a given beach; there is little evidence to suggest that these species were consistently correctly identified prior to 1990. It appears from data gathered so far that the most important nesting areas for leatherback turtles lie along the north coast of Tortola (Tables 1, 3). Less is known about the distribution of hawksbill and green turtle nesting. Beach surveys undertaken between 1990-1992 suggest that the cays north of Beef Island, including Scrub Island, Great and Little Camanoe islands, and Guana Island are important for hawksbills, as are selected beaches on Tortola (e.g., Long Bay Belmont) and Beef Island. In the latter case, it is possible that at least some tracks are obscured by heavy visitor traffic. Green turtle nests are rare. Anegada appears to be the most important nesting area for this species. Twenty-three potential nest sites were reported on Anegada between mid-July and late-November 1992 (Table 2). Excluding the Anegada records, only five nesting crawls attributed to green turtles have been reported to the CFD since 1990 when territory-wide monitoring began.

It is worth noting that ground and aerial surveys conducted since 1986 of leatherback nesting habitat are somewhat mystifying. On the one hand, it is quite clear that fewer than 10 females (perhaps typically <5) arrive each year to nest in Tortola and that Tortola is the only island with any measurable nesting. On the other hand, it is not clear why the surveys, which were designed to be comprehensive during peak nesting season (May), reveal a nesting pattern inconsistent with leatherback biology; that is, the data do not demonstrate site fidelity and renesting by individual turtles at 9-10 day intervals. Plausible explanations for the fragmented

record include: (i) the population has been reduced to such a low level that characteristic behaviour, including site fidelity, has broken down, (ii) females are harassed by hunters on the nesting beach, disrupting both beach fidelity and inter-nesting interval, and are eventually killed before all clutches of eggs have been laid (females should average 5-7 nests per year), (iii) aerial and boat surveys routinely miss nesting tracks on the beach. While it is highly unlikely that a significant number of the huge tracks are missed during the survey period, it is certainly true that the surveys do not encompass the entire nesting period. Leatherbacks are teetering on the brink of extinction in the BVI. They may be more endangered here than in any other Eastern Caribbean nation or territory. It is important that accurate, full-season (March-July) data be collected.

The Sea Turtle Conservation Programme proposed in section 4.6 reiterates the need for consistent monitoring by trained personnel on several key beaches. This cannot be over-emphasised. In the absence of adequate survey data, population size cannot be estimated, trends in population size cannot be observed, important habitat cannot be identified, threats cannot be appraised, and specific management plans cannot be designed.

4.12 Develop area-specific management plans

The Sea Turtle Conservation Programme proposed in section 4.6 has as one of its objectives to "develop holistic management plans for critical nesting and foraging habitats". Site-specific plans are useful because threats vary amongst areas and management options should be tailored to specific circumstances. Heavy tourist visitation may be a dominant problem in one area, whereas oil tanker traffic or sand mining may need priority attention at another site. At the present time, there are no area-specific management plans in place with regard to sea turtles. Only one area, the Wreck of the Rhone, has been designated as a Marine Park. There is no anchoring, collecting, fishing, or hunting at this site, and these restrictions also apply within 250 yards of all established moorings. Some management has recently been directed toward the Horseshoe Reef, as well, which was declared a Protected Area in May 1990 (Figure 7). In March 1991, marker buoys were installed along the reef to demarcate the protected area. Within this area anchoring and fishing are not permitted; SCUBA diving is allowed. No turtles may be taken at any time. Ongoing monitoring of fish populations and coral reef health is carried out every two months by CFD personnel in order to evaluate the effects of closing the area to mooring and fishing. A management plan for the area is being developed by the CFD which will, among other things, specify which areas should remain protected as refugia, and what criteria needs to be met before an area can be reopened to fishing. It will also recommend the installment of moorings prior to the reopening of an area. Additional marine protected areas are needed in order to safeguard sensitive marine habitat, offer refuge to endangered sea turtles, and boost commercial fish production.

In addition to management planning for marine areas, it is important that significant nesting beaches be identified as soon as possible so that appropriate management plans can be developed and implemented. Area-specific management may involve a wide array of options, from Park or protected area designation to more focused actions such as the establishment of a hatchery for eggs threatened by erosion or predators. In any case, sand mining (section 4.131),

artificial lighting (section 4.132), the construction of seawalls and jetties (section 4.133), and sewage and other waste disposal (sections 4.143, 4.144) should be closely evaluated in zones proximal to nesting beaches. A summary of recommended guidelines can be found in section 4.122. Several relevant management techniques are presented and explained by Pritchard et al. (1983) in the Manual of Sea Turtle Research and Conservation Techniques, prepared for the Second Western Atlantic Turtle Symposium and available in the CFD library. With regard to the Government purchase of Long Bay Belmont, Josiahs Bay, and Long Bay (Beef Island) as conservation and recreation areas, we recommend that management of these areas, which are all used for egg-laying by sea turtles, incorporate guidelines provided in section 4.122. Furniture and rental water sports equipment should be removed from sandy beaches at sundown so that they do not become obstacles to sea turtles coming ashore to nest.

It is a recommendation of this Recovery Action Plan that "Sea Turtle Reserves" be declared under the authority of the Marine Parks and Protected Areas Ordinance (1979). Alternatively, with passage of the Coast Conservation and Management Act the Minister would be empowered to designate "Special Resource Areas" which could easily be defined as sea turtle conservation areas. The Reserves should encompass the most important nesting areas and serve as a focal point for conservation, management, and monitoring of sea turtle populations [N.B. the Reserves should include the "index beaches" described in section 4.291]. Reserve status would not exclude residents from using the beach for recreation, fishing, etc. but constraints summarized in section 4.122 would apply. The harvest and harassment of sea turtles and their eggs would be illegal under all circumstances on the protected beaches. Since the support and involvement of residents would be central to the success of a Reserve, we recommend that the CFD and/or relevant non-government groups initiate a dialogue with land owners and coastal residents living near a proposed Reserve in order to solicit their input and encourage their support. Where needed, Wardens should be hired to monitor compliance with Reserve regulations. The following beaches are good candidates for Sea Turtle Reserve status: the beaches of Scrub Island, Guana Island (already a Nature Reserve), the beaches of Great and Little Camanoe islands, Long Bay Belmont, Sandy Cay, and the west end beaches of Anegada from Cow Wreck High Point to Pomato Point. As beach monitoring data reveal additional sites important to sea turtles, these sites should also be considered for Reserve (or other protected) status.

4.121 Involve local coastal zone authorities

Responsibility for development and use of the coastal zone is shared by two principal agencies. The MNRL is responsible for the foreshore and seabed and the issuing of seabed leases. The LDCA is responsible for development on land or the seabed. As an example, in order to build a hotel with a jetty, the LDCA must grant permission to build the hotel, MNRL must grant permission for the use of the seabed, and then the LDCA must grant permission for actual construction of the jetty. The MNRL refers these types of applications to an in-house technical review committee on Marine Applications. It is fortunate that decisions affecting foreshore and nearshore habitats are overseen by Natural Resources personnel (the CFD is represented on the Board of the LDCA). It is a recommendation of this Recovery Action Plan that the LDCA and its Office of Town and Country Planning be provided with a list of environmentally important or sensitive areas. Such a list would assist them in making environmentally informed decisions. In the case of sea turtles, the list should include significant

foraging and nesting areas. More integrated and centralized planning is anticipated with passage of the Coast Conservation and Management Act.

4.122 Develop regulatory guidelines

The proposed Coast Conservation and Management Act (see section 4.23) will constitute an important improvement over existing regulatory mechanisms and the authors of this Recovery Action Plan urge the Government to adopt and implement it as soon as possible. In addition to conditions imposed by the Act, it is a recommendation of this Recovery Action Plan that the following specific guidelines be adopted and implemented for nesting beaches and relevant coastal zones throughout the BVI. The recommendations are further expanded in the section(s) referenced in each category. The nesting beach guidelines were adapted from a beach management plan submitted by Orme (1989) and a sea turtle management plan submitted by Eckert (1989) to the Southeast Peninsula Land Development and Conservation Board in St. Kitts, West Indies.

Sand mining: Sand mining should be prohibited on all sandy beaches. Sand mining is currently prohibited under most circumstances (section 4.131), but consistent enforcement is needed. The removal of beach sand disrupts stabilising vegetation, may seriously exacerbate erosion, and has resulted in the complete loss of some BVI beaches (and hence the disappearance of some sea turtle nesting grounds). In addition, the mining pits not only invite injury to humans and livestock, but they accumulate water and serve as breeding areas 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 constructed on sandy beaches or in any nearshore zone if it is likely that such engineering structures will promote erosion or the loss of adjoining sandy beaches where sea turtles nest. Unfortunately, there is an increasing trend in the construction of private jetties in the BVI. Some jetties have already accelerated erosion and, in some cases, have resulted in the disappearance of actual or potential nesting areas (section 4.133).

Access: Access to beaches should be confined to specific locations and strictly regulated so as to minimise destruction of backshore vegetation and beaches by trampling and vehicle use. 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. The use of motorized vehicles should be prohibited on all sandy beaches (section 4.134).

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 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 (section 4.133).

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 gravid sea turtles from finding a nest site. Trash cans and regular pickup should be provided in high-use areas. To the extent that beach cleanup is necessary, it should be accomplished 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 stabilise 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 turtle eggs and hatchlings beneath the surface of the sand, and can disorient hatchlings. All beach fires should be restricted to designated grill facilities.

In addition to beach management policies described above, a variety of 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, taken from Eckert (1989), are as follows:

Anchoring: Anchor damage is a leading cause of destruction to sea grass meadows and coral reefs throughout the Eastern Caribbean. Several reef habitats in the BVI show signs of significant damage from anchoring. It is essential that yachts, mini-cruise ships, and vessels of all sizes 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. Therefore, ships >200 feet in length should be required to dock at port facilities or anchor in specially designated areas. Indiscriminate anchoring should not be permitted under any circumstances. Halas (1985) has designed a relatively inexpensive mooring system ($100-200 per mooring) which is adequate for holding yachts and live-aboard dive boats <55 feet in length (and <36 tons) and which has been installed in the BVI (section 4.147).

Waste disposal and general pollution: The dumping of solid waste into the sea should be prohibited. In addition to degrading the environment for residents and visitors alike, sea turtles often ingest tar, plastic, rope, and other substances, presumably mistaking these for food (section 4.144). One environmental cost of accommodating increasing boat traffic in the BVI is the dumping of solid waste and sewage at sea. The latter practice adds nutrients to the water which

can result in eutrophication and algae overgrowth in shallow coastal areas. Ideally, only yachts and sailboats with proper holding tanks should be admitted to offshore moorings and/or planned marinas. Unfortunately, as there are no pump-out facilities in the BVI, holding tank contents disposed of on shore are ultimately dumped at sea at Slaney Point with the land-based sewage. Some solutions to this problem have been proposed (see section 4.146).

Physical destruction of coral and sea grass: Neither coral reefs nor algal ridges should 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.

4.123 Provide for enforcement of guidelines

Law enforcement is important to the perpetuation of any protected area management programme. Guidelines should be formulated with the needs of the surrounding communities in mind. Ideally, a general acceptance of the guidelines and of the importance of the protected area will result from community involvement. Civic groups, proximal residents, and frequent commercial users (e.g., fishermen, divers) 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 the new guidelines and regulations and ensuring that all reports of violations are properly addressed by the appropriate enforcement entity. Wardens should be hired to oversee compliance with protected area regulations.

It is a recommendation of this Recovery Action Plan that an enforcement division de-voted specifically to environmental law be established (section 4.24). At the present time, both the Fisheries Ordinance (1979) and the Marine Parks and Protected Areas Ordinance (1979) provide for enforcement personnel. The proposed Coast Conservation and Management Act also has provisions for the appointment of authorized enforcement officers. There are currently two Marine Parks Wardens responsible for law enforcement in the Wreck of the Rhone Marine Park, as well as all mooring areas established under the NPT. Surveillance is facilitated by the NPT vessel, *Rhone Ranger*. A disadvantage in the present system is that the Wardens are authorized to enforce the laws of the BVI only within the confines of the only designated marine park, the Wreck of the Rhone.

4.124 Develop educational materials

It is a recommendation of this Recovery Action Plan that materials be developed for each management area that explain why it is an important ecological area. These can include signs or

displays on site, fliers or posters placed in public areas (airports, hotels, government offices), books and pamphlets available from the NPT or MNRL, guided tours or field trips to the area, regular media attention, public forum slide shows or interpretive programmes. Revenue can be generated by offering supervised access to protected areas and developing interpretive programming. The NPT has several excellent interpretive posters, pamphlets, books and maps available for currently protected areas. A poster developed by the DOA and the NPT identifies moorings and provides information about regulations within Marine Parks. Newspaper and magazine articles and press releases concerning the Horseshoe Reef Protected Area have been published and several radio interviews have aired to inform the public of the importance of this protected area, as well as the long term benefits to be gained. A poster and pamphlet for the Horseshoe Reef Protected Area are being developed for general distribution, especially to visitors entering the territory. Insufficient funding and staff time are major impediments to the development of educational materials.

4.13 Prevent or mitigate degradation of nesting beaches

4.131 Sand mining

On the beach, natural sand deposits are important for recreation by residents and tourists and serve as a barrier against storm waves, thus protecting coastal residences and commercial investments. Removed from the beach, sand is a vital component of the construction industry as a raw material for cement. Unfortunately, the chronic removal of sand for construction or for any other purpose often accelerates beach erosion and degrades or destroys stabilising coastal vegetation by uprooting it or flooding it with seawater. In severe cases, such as at Josiahs Bay on the north coast of Tortola, saline ponds are formed in pits left by mining operations and shoreline trees and associated vegetation have been lost to the sea. In other cases, such as at Fat Hogs Bay, entire beaches have been eradicated. With their loss, the coast's potential to support recreation, tourism, commercial development, and wildlife such as sea turtles is reduced. For this reason, sand mining is prohibited by the Beach Protection Ordinance (1985) (as well as by the draft Coast Conservation and Management Act), except by permit from the Government.

There are several sites for beach sand mining in the BVI and in some areas the mining poses a serious threat to important sea turtle nesting habitat. Although it is prohibited on the foreshore (mean high water mark to mean low water mark) except by special permit (see section 4.21), and it is theoretically prohibited under all circumstances when likely to result in shoreline erosion, some beaches continue to be mined with the permission of the Government to the extent that large saline ponds have been created. Due to sand mining for construction, the sea has encroached into Josiahs Bay beach for more than 300 ft (100 m) and created an unsightly pit. Some mined beaches, including Well Bay and Bluff Bay on Beef Island and Josiahs Bay, Fat Hogs Bay, Lloyds Beach, and Capoons Bay on Tortola, were once important for turtle nesting. Josiahs Bay beach now consists of eroded dunes and fallen trees (BVI Government, 1992); only three leatherback crawls were reported there between 1986-1992. Bluff Bay may still support limited nesting, but there is no monitoring at this site. Turtles no longer visit the other sites. It is laudable that Smiths Gore Overseas Ltd. has erected fences at access points to Well Bay and Bluff Bay to prevent illegal mining vehicles from working on these beaches.

There is some evidence that mining affects more than just the beach where sand is removed. The excavation at Josiahs Bay may be starving adjacent beaches to the west (Cooten and Carrot) which are now largely cobble but, according to older fishermen, were once broad and sandy and regularly visited by leatherback turtles. It is a recommendation of this Recovery Action Plan that close and careful attention be given to the evaluation of permit applications and to the oversight of permitted mining operations. In addition, legislation needs to be strengthened and ambiguous regulatory terms defined. The Beach Protection Ordinance of 1985 prohibits the removal of sand from the foreshore and beach if likely to cause inroads by the sea. The legislation is inadequate and has been so proven in court, the term "inroads by the sea" being subject to many interpretations (BVI Government, 1992). Site-specific management plans, such as the one developed for Josiahs Bay beach, are an important advance and should be negotiated for other sites as well. In the case of Josiahs, sand mining is now restricted to 100 m behind the dune line and miners are required to restore damage previously done to the beach as a result of sand extraction. This agreement is precedent-setting and should become standard policy.

Since sand is a valuable commodity needed for the development of the BVI, it is a recommendation of this Recovery Action Plan that a consistent and sustainable policy be developed and implemented with regard to the acquisition of sand, be it from offshore mining, extraction from designated inland deposits, or imported from other islands. Sandy beaches should be completely protected from mining activities and, to the extent possible, beaches previously degraded by mining should be restored. Sites should be designated from which sand can be obtained with the least environmental cost. Stiffer penalties, including higher fines for convicted violators, are needed, as is vigilant field enforcement and judicial follow-up. It is a measure of progress that during 1991 there were two convictions of violations against the Beach Protection Ordinance; each resulted in a $500 fine. Since $500 fines (the maximum monetary penalty allowable by law) are inadequate to deter illegal activity, it is a recommendation of this Recovery Action Plan that the draft Coast Conservation and Management Act incorporate stiffer penalties for the contravention of coastal conservation regulations.

4.132 Lights

Sea turtle hatchlings orient to the sea using the brightness of the open ocean horizon as their primary cue (e.g., Mrosovsky, 1972, 1978). When commercial, residential, security and/ or recreational lights shine on the nesting beach, hatchlings often orient landward toward these lights instead of toward the ocean horizon. The typical result is that the little turtles are crushed by passing vehicles, eaten by dogs or other predators, or die from exposure in the morning sun. Nesting females are also sometimes misdirected landward by artificial lighting. Studies in Florida (USA) and Tortuguero (Costa Rica) reveal that the presence of mercury vapor lights all but eliminates nesting on affected beaches; nesting by green turtles and loggerheads on beaches so lit was 1/10 and 1/20 that observed on darkened beaches (Witherington, 1992). With this in mind, some beach-front owners in Florida have switched to low pressure sodium (LPS) vapor lighting, which shines primarily in the 590 nm range and has little if any effect on nesting females. Unfortunately, low pressure sodium lights do not appear to constitute a complete answer to this difficult problem because they mildly attract green turtle hatchlings (though to a much lesser extent than do mercury vapor lights; Blair Witherington, pers. comm., 1991).

An absence of lighting is the best guarantee that hatchlings will safely find the sea. Where this is not an option, Witherington (1990) proposes several "next-best" solutions, including (i) time restrictions (lights extinguished during evening hours when hatching is most likely to occur; e.g., 1900-2300 hrs during the hatching season), (ii) area restrictions (restrict beach lighting to areas of the beach where little or no nesting occurs; the effectiveness of this is diminished, however, since sources of light several km away can disrupt hatchling orientation), (iii) 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), (iv) shielding and lowering light sources (low intensity lighting at low elevations can be both attractive and adequate for most purposes; the glow can be shielded from the beach by ornamental hedges or other barriers), (v) alternative light sources (LPS lighting is known to be less attractive to hatchlings than full-spectrum white light).

It is a recommendation of this Recovery Action Plan that existing and planned developments on sea turtle nesting beaches be required to incorporate the above suggestions to the extent necessary to preclude light shining on the beach at night.

It is important that developers and residents alike understand that sea turtles are very sensitive to light whilst on the beach. Lights, even low pressure sodium vapor lights, should always be shielded from shining directly on the beach. An effective technique for accomplishing this is to plant a decorative hedge of vegetation between the sea and shoreline developments. As an alternative, shields can be built into the lighting fixture (see Raymond, 1984). Coastal developments in many parts of Florida are required to turn lights out during specified evening hours during the hatching season so as to reduce hatchling disorientation. In the U. S. Virgin Islands, an overview of the problems posed by beach-front lighting and a review of potential solutions (Raymond, 1984) is issued to all developers seeking permits for projects which may have an effect on sea turtle orientation due to lighting. Most developers now include this information in their environmental impact assessments and are designing appropriate lighting systems (Ralf Boulon, USVI Division of Fish and Wildlife, pers. comm., 1990). In Belize, recent applications to build beach-front resorts were granted under the condition that there be no "bright lighting on the beach" (Smith et al., 1992).

Some beaches where nesting occurs are heavily developed (i.e., Cane Garden Bay and Sophie's Bay, Tortola; St. Thomas Bay, Virgin Gorda; Great Harbour, Jost Van Dyke). It is a recommendation of this Recovery Action Plan that studies be initiated to determine whether sea turtle disorientation is a problem in these areas. In May of 1988, a leatherback came ashore to nest on Anegada and died in the morning sun after being disoriented by the security lights of a local business (Lettsome, 1988). Disorientation has also been reported from Bercher's Bay, Virgin Gorda, where in October 1990 several leatherback hatchlings were found wandering in the vegetation. In October 1992, hawksbill hatchlings were rescued at Marina Cay after being disoriented and crawling inland toward lights. There is a large development planned for Long Bay Lambert (Tortola), which is one of the few remaining leatherback nesting areas; it is recommended that the architect plan lighting that does not result in beach illumination. Lighting restrictions should be incorporated at the time of permit application, or acceptance by the LDCA. Since recommendations are often taken from Town and Country Planning, TCP should be fully aware of potential lighting problems and solutions.

Finally, it is a recommendation of this Recovery Action Plan that the CFD send letters to all hotels and restaurants built near the beach asking that (1) security or other personnel report incidents of sea turtle nesting on the beach and (2) lights shining on nesting beaches be re-directed, shielded, or extinguished. If the latter is impossible, the grounds should be inspected each morning to rescue hatchlings that mistakenly crawled away from the sea. Rescued hatchlings should be kept quiet and shaded in a bucket with damp beach sand until nightfall when they can be released to the sea. Further information on construction, materials, and other details concerning "turtle sensitive" lighting can be obtained from Dr. Blair Witherington (or Barbara Schroeder, Sea Turtle Recovery Coordinator), Florida Department of Natural Resources, 19100 SE Federal Hwy, Tequesta, Florida 33469-1712 USA. The Florida Department of Natural Resources and Florida Power and Light are collaborating on a booklet on the subject of coastal lighting which, when published, will be provided by WIDECAST to all WIDECAST Country Coordinators, including the CFD.

4.133 Beach stabilisation structures

Most beaches are naturally dynamic. In order to protect commercial investments such as beach-front hotels, beach stabilisation typically involves the use of breakwaters, jetties, impermeable groynes and/or seawalls. Unfortunately, these structures are expensive and rarely effective in the long-term. Furthermore, because they interfere with the natural longshore transport of sediment, the armouring of one beach segment can result in the "starvation" and eventual loss of other beach segments down current. There are several examples in the BVI of solid jetties which are known to have contributed to the destruction of adjacent beaches (e.g., the Buck Island jetty at the east end of Tortola; Fat Hogs Bay, Tortola). Coastal erosion resulting from the construction of a solid jetty, combined with nearshore dredging, resulted in over 20 vertical feet of beach loss at Fat Hogs Bay, East End, Tortola (ECNAMP, 1981). Jetties are also located on the islands of Anegada, Beef (Trellis Bay), Eustatia, Frenchman's Cay, Great Camanoe (Low Bay, Lee Bay), Little Thatch, Peter (Sprat Bay), Salt (Salt Island Bay), and at numerous sites in Tortola and Virgin Gorda.

It is a recommendation of this Recovery Action Plan that hard engineering options to beach protection, sometimes referred to as "beach armouring", be regarded as a last resort. In particular, alternatives should be sought when armouring is likely to result in the deterioration of sandy beaches where endangered species of sea turtle nest. In all cases, the construction of impermeable structures to alter the transport of nearshore sediments and/or to protect coastal development should be carefully evaluated in light of long-term negative effects on the very investment they are designed to "protect". In many cases, the long-term scenario is likely to include exacerbated erosion and even beach loss. If some type of shoreline armouring is inescapable, we recommend that the structure be situated at a slope of 1:2 to 1:3 so that the natural build up of sand is more likely to be retained than would be the case for vertical seawalls or unconsolidated boulders. Finally, there is an escalating trend in the number of private jetties constructed in the BVI. The need for these structures should to be carefully evaluated and they should be made permeable if possible; that is, constructed on pilings.

The better solution to beach maintenance is an enforced construction setback adequate to reduce or eliminate the risk of losing coastal buildings to routine erosion or violent storms. Un-

der the Development Control Guidelines, buildings have to be set back 50 ft (15 m) from the high water mark. This setback is clearly inadequate and it is not always enforced. Hurricane Hugo in 1989 illustrated an inadequacy of this guideline when the south coast highway on Tortola was severely damaged along 4.3 miles (7 km) of its length, and one hotel on Peter Island built partly on reclaimed land was also severely damaged (BVI Government, 1992). It is a recommendation of this Recovery Action Plan that setback regulations be revised and strengthened, including defining ambiguous terms such as "high water mark", and that conservative setback regulations apply to all lowland coasts below the 10 ft (3 m) contour. Setback limits should be defined that reflect the damage likely to be caused to the beach and backshore environment during a major storm, and that take into consideration beach and backshore characteristics. Because of the undeveloped nature of much of its coastline, the BVI still has the potential to utilise coastal development control as a low cost solution to shoreline erosion.

4.134 Beach cleaning equipment and vehicles

The Litter Abatement Ordinance (1987) "prohibits the deposit of litter in a public place except in a receptacle provided for that purpose." The maximum fine under the Ordinance is $250. Despite the legislation, beach littering occurs. In addition, ocean-borne debris (including seaweeds) sometimes accumulates at the high tide line. It is a recommendation of this Recovery Action Plan that beach cleaning, when necessary, be done using hand tools such as shallow rakes and not heavy machinery or tools which deeply incise the sand. While the uppermost eggs in a green turtle or leatherback nest commonly incubate 20 cm (8 in) or more beneath the surface, hawksbills construct shallow nests in which eggs are protected by less than 10 cm (4 in) of overlying sand. Damage to incubating eggs (or hatchlings awaiting an evening emergence) is easily caused by compaction or puncture arising from mechanized beach cleaning techniques.

If raking seaweeds or debris by use of a tractor or other heavy machinery is inevitable, this activity should be confined to beach zones below the mean high tide line in order to avoid the compaction of sand above incubating eggs. Repeated compaction will kill developing embryos. At the present time, mechanized beach cleaning is not known to occur in the BVI. Some beaches are regularly cleaned by hand rake (e.g., Long Bay, Beef Island; Deadman Bay and White Bay, Peter Island) and this is not considered harmful to sea turtles. Beach cleaning personnel should be alerted to watch for signs of sea turtle nesting and to report crawls and hatchlings to the CFD.

The use of motorized vehicles should be prohibited on beaches at all times. Where vehicles are needed to transport heavy fishing or recreational equipment, multiple access points should be provided and vehicles parked landward of the line of permanent vegetation. Driving on the beach creates unsightly ruts, exacerbates erosion, and can lower sea turtle hatch success by compacting nests and crushing embryos. Tyre ruts also present a significant hazard to hatchlings crossing the beach. The tiny turtles fall into the ruts, which often run parallel to the sea, and because they cannot get out they die in the morning sun or become easy prey for predators. It is a recommendation of this Recovery Action Plan that driving on sandy beaches be prohibited by law, perhaps by the Coast Conservation and Management Act presently under consideration.

4.135 Beach rebuilding projects

There are no beach renourishment projects presently underway in the BVI, but one has been proposed for Brandywine Bay, Tortola. It is a recommendation of this Recovery Action Plan that beach rebuilding in areas of sea turtle nesting be conducted outside the nesting and hatching seasons. Properties of replacement sand should be closely akin to that which was lost. Sand brought to a beach from inland or offshore deposits is often of a constitution (e.g., grain size, organic content) different from that of the original beach sand. The most common problem is that new sediments become compacted and useless for sea turtle nesting. In Belize, for example, beach replenishment on Caye Chapel resulted in "hard compacted sand beach unusable to sea turtles for nesting" (Smith et al., 1992).

The best approach is to avoid expensive rebuilding projects altogether by implementing sound coastal construction policies (such as are advocated in the draft Coast Conservation and Management Act), prohibiting sand mining (section 4.131), minimising beach armouring and adhering to conservative setbacks (section 4.133). With few exceptions, undisturbed sandy beaches replenish themselves. In contrast, unsound and short-sighted development eventually leads to costly rebuilding and is more likely to diminish the suitability of the shoreline for sea turtle nesting. 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

Koester (1987) reported that the fishermen of Anegada sent a petition to the government in 1984 "outlining a series of problems including spear-fishing, dynamiting [Horseshoe] reef and trap theft", but that the petition was never acknowledged. We have been unable to confirm incidences of dynamiting by talking to fishermen and Fisheries Officers on Tortola. Presumably this kind of activity is rare; however, it is strongly recommended that the government investigate any such charges immediately and take whatever steps are necessary to prevent this potentially devastating environmental destruction from recurring. The use of dynamite to stun fishes, making it easier to capture them, results in severe damage to surrounding coral.

Recognizing that it is not presently illegal for a fisherman to employ the use of dynamite in the catching of fish, and in light of the destructiveness of this technique, it is a strong recommendation of this Recovery Action Plan that an unconditional ban on the use of explosives in catching fish be included in any revised BVI Fisheries Regulations. The Fisheries Regulations are currently under review by the Fisheries Division of the Conservation and Fisheries Department. The slow-growing and virtually irreplaceable reefs serve as nurseries, refugia, and foraging grounds for many species of commercial fishes; they are crucial to the sustained health of local fishing and marine tourism industries. They also provide important refugia and forage to sea turtles (see sections 2.4, 4.1).

4.142 Chemical fishing

In 1986, a group of fishermen in Anegada reported that foreign fishermen (allegedly Puerto Ricans, perhaps from the USVI) were using chlorine bleach on Horseshoe Reef. The offenders, reportedly seeking lobsters, were never identified or apprehended. There have been no such complaints or reports in recent years. Another potential opportunity for chemical fishing lies in the aquarium fish trade. In recent years, licence applications to collect aquarium fish for the export market have been received and denied by the Government. There are likely to be more applications in the future. Many commercial aquarium fish collectors employ the use of chemicals sprayed directly at schools of fish in order to expedite the collection process. The use of any chemical to stun fishes or to assist in the capture of lobsters is a short-sighted and destructive form of fishing that should be prohibited under all circumstances. If allowed to continue, this activity will result in the death of vast communities of coral which, in turn, will adversely affect the survival prospects of locally depleted sea turtle stocks and will diminish fishing and tourism profits.

It is a recommendation of this Recovery Action Plan that an unconditional ban on the use of chemicals in catching fish be included in any revised BVI Fisheries Regulations. The Fisheries Regulations are currently under review by the Fisheries Division of the Conservation and Fisheries Department. In support of informal CFD policy, it is also a recommendation of this Recovery Action Plan that any applications for the commercial collection of reef fish for export be denied.

4.143 Industrial discharges

There are no heavy industries in the BVI, but sewage (section 4.146), toxic anti-fouling paints (widely used in the yachting/cruise industry with little disposal oversight), and phosphate effluent from local laundry operations have been identified as potential sources of nearshore pollution. The common anti-fouling paint used in the BVI includes T.B.T., a toxin outlawed in the USA, UK, and many other European countries. As boats are hauled up in the yacht yards and their bottoms scraped clean for repainting, the run-off drains into the sea (B. Bailey, pers. comm., 1992). The Ports Regulations, 1988, prohibit the discharge of pollutants within territorial waters. Fines upon conviction include a maximum fine of $1000. With the assistance of the Caribbean Environmental Health Institute, a water quality monitoring programme was developed in the BVI in 1988. Monitoring is carried out by the CFD and the Water and Sewage Department on a monthly basis at various marinas and nearshore areas where contamination of sea water is a potential problem. Water quality monitoring at present determines total and faecal coliform counts; however, more suitable indicators and environmental standards for tropical waters are being researched.

It is not clear at the present time exactly what the cumulative effect of land- and marine-based discharges has been or will be on local populations of sea turtles. However, it is logical to conclude that damage to coral reefs and sea grass meadows, which provide essential prey items for sea turtles, will further harm the already depleted sea turtle fauna. In addition, there is always the possibility for episodes of debilitating or lethal poisoning of sea turtles caused by industrial effluent or accidental spills. It is a recommendation of this Recovery Action Plan

that investment in infrastructure to treat and properly dispose of commercial and industrial wastes be a priority for both Government and industry. Routine monitoring for compliance with environmental standards is essential.

4.144 At-sea dumping of garbage

The Dumping at Sea Act (1974), which was extended to the BVI in 1975 and implements the Convention on Marine Pollution by Dumping of Wastes and Other Matter, prohibits the dumping at sea of certain kinds of wastes (Caribbean Law Institute, 1991). The BVI Ports and Marine Services Regulations, 1988, promulgated under the authority of the Ports and Marine Services Act (Act No. 19 of 1985), state: "90. (1) No person shall discharge or deposit any pollutants upon the territorial waters. (2) The master of a vessel or a person who permits or fails to prevent the discharge or deposit of pollutants into or upon the territorial waters is guilty of an offence and, in addition to any other punishment provided by the Act and other laws of the Territory, is liable to a penalty of one thousand dollars. (3) For the purposes of these Regulations "pollutants" includes any discharge or deposit of oil, oily waste or sludge which causes a slick, film or sheen upon the surface of the water or, causes a sludge or emulsion beneath the surface of the water."

Sea turtles often consume tar, plastic, rope, and other substances (e.g., Mrosovsky, 1981; Balazs, 1985; Lutz and Alfaro-Schulman, 1991), presumably mistaking these for food. It is commonplace for turtles to confuse plastic bags with jellyfish and to ingest them. Mrosovsky (1981) summarized data showing that 44% of adult non-breeding leatherbacks had plastic in their stomachs. The disposal of waste at sea is recognized as a growing problem throughout the Caribbean and death to marine organisms as a result of ingestion or entanglement is widespread (e.g., O'Hara et al., 1986; Laist, 1987; CEE, 1987). Balazs (1985) summarized worldwide records of ingestion of oceanic debris by marine turtles and listed a wide variety of items consumed, including discarded banana bags which were ingested by green sea turtles in Costa Rica. To date, there have not been any documented reports of sea turtles ingesting or becoming entangled in marine debris in the BVI. In the neighbouring USVI (St. Croix), a hawksbill was recently found so entangled in discarded monofilament fishing line that it was barely able to surface to breathe (Zandy Hillis, U. S. National Park Service, pers. comm., 1992).

Several categories of waste have been identified as having been dumped in the Territorial Sea of the BVI, including pitch (road surfacing), scrap automobiles, oil, gas, bottles, and tyres. Items too bulky for the landfill are routinely disposed of off the shelf south of Peter Island (600 m depth). Sewage, plastics, and other waste from the yachting/cruise industry also have the potential for becoming a serious threat. 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. In the USVI there is an annual campaign to alert boaters to bring home their refuse -- everything from sandwich bags and beer cans to motor oil canisters and tangled fishing line. Announcements are prepared for radio and newspaper. It is a recommendation of this Recovery Action Plan that a similar campaign be undertaken in the BVI under the aegis of the CFD, NPT, DOA, BVI Marine Trade Association, the media, and/or interested industry and civic groups.

4.145 Oil exploration, production, refining, transport

There has been some formal oil exploration off the north coast of Tortola, and there is talk of more; however, no commercial reserves have yet been discovered. There are no production or refining industries. There is some transport through BVI waters of both refined and crude oils, but no spills or other hazardous incidents have been reported to date. The most likely origin of a serious spill in BVI waters is the shipping corridor north of Anegada where there is considerable oil tanker traffic. The pumping of boat bilges and the disposal of engine oil into the sea are serious problems in some areas and there are no designated sites to dispose of such waste. The Ports and Marine Services Regulations, 1988, make it an offence to deposit any pollutant into the Territorial Sea (as noted in section 4.144), but this provision is not enforced. Because disposal facilities are not available, there are few if any alternatives to the indiscriminate dumping of oil at sea, in ponds, in swamps, or in streets where it eventually runs to the sea. [N.B. In Barbados, some oil companies collect used automobile engine oil and store it until sufficient quantities can be shipped off-island for recycling (Julia Horrocks, UWI-Barbados, pers. comm., 1992); similar efforts should be encouraged in the BVI.] The BVI has been fortunate to avoid any noticeable effects from recent oil spills in the northeastern Caribbean, but the reality of these repeated spills indicates the very serious nature of this threat.

In September 1989, following Hurricane Hugo, a 42,000 gallon spill of #6 fuel oil (heavy crude oil) at the Water and Power Authority facility in Christiansted, St. Croix, left south coast beaches on that island heavily oiled. Pelican Cove, a hawksbill nesting beach, was buried under 0.3 m of crude oil (Z. Hillis, pers. comm., 1990). On 6 March 1991, 13 nm north of Nevis, the Trinidad-registered barge Vestabella, loaded with about 560,000 gallons of #6 fuel oil, sank in 600 m of water after a towing cable snapped; the initial oil slick was more than 30 miles long (Simmonds, 1991). According to *The Daily News* (30 March 1991), a USVI newspaper, tar balls and tar sheets began appearing on St. John on 21 March; tar balls washed ashore soon thereafter on St. Thomas, St. Croix, Culebra, Vieques, and the main island of Puerto Rico. Several BVI beaches also experienced oil fouling as a result of this spill; several oiled pelicans were found dead. A hawksbill soaked in oil attributed to the Vestabella was recovered near Guayama on the south coast of Puerto Rico (Benito Pinto R., Depto. Recursos Naturales, pers. comm., 1991). One year later, on 15 March 1992, a pipe ruptured during ship-to-shore pumping of #6 fuel oil to a transfer station at St. Eustatius Terminal on the west coast of St. Eustatius. About 150 barrels of crude oil were released to the sea (Sybesma, 1992).

Behavioural experiments indicate that 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 hrs (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.

The BVI does not have the equipment or capability to deal with a major oil spill (BVI Government, 1992). Nevertheless, an oil spill contingency plan does exist which outlines the framework in which resources are to be marshalled and coordinated in the BVI for the purpose of responding to any large-scale pollution of the marine environment which may result from a spill of oil or another noxious substance. The contingency plan assumes that external assistance will be requested and obtained through bilateral or regional arrangements to deal with larger spills beyond the capacity of local resources. It is a recommendation of this Recovery Action Plan that the oil spill contingency plan be strengthened as necessary, and that oil response teams be properly trained in first response protocol. Perhaps joint training sessions could be arranged with USVI counterparts.

4.146 Agricultural runoff and sewage

Plantations of sugar cane and cotton dominated local agriculture in the 1800's and early 1900's. Following the demise of the plantation era, small scale agriculture enterprises prevailed. Recently there has been a movement of labour from agriculture to tourism, and agriculture now contributes a mere 1.8% to the GDP (BVI Government, 1992). Agricultural techniques are traditional and few chemicals are used. There is a government research station at Paraquita Bay (Tortola) and there is some chemical runoff associated with testing done there. At the present time there is pressure to increase agricultural output in order to reduce imports. A five-year plan to encourage agricultural diversification and productivity has been prepared. It is a recommendation of this Recovery Action Plan that agricultural chemicals be registered and that their use be monitored for compliance with accepted safety standards. There is no list of pesticides approved for use in the BVI, no records or control of imports, and no controls on distribution or disposal. Many agricultural pesticides and herbicides enter the natural environment as persistent toxins which accumulate up the food chain, presenting a significant threat to higher order consumers such as some species of fish and sea turtles, and ultimately to human beings when contaminated species are consumed.

Tortola sewage not disposed of in a septic tank is released in 70 ft (21.5 m) of water from a pipe that runs along the sea floor at Slaney Point. Currents dissipate the effluent and environmental degradation has not been observed. However, domestic septic tanks are often siphoned into collecting trucks which discharge their loads into the mangroves at Paraquita Bay. Residents complain of foul smells in this area. Rogers et al. (1982) report that sewage from Biras Creek (Virgin Gorda) has damaged nearby benthic communities. Yacht sewage discharges and general pollution arising from bilge flushing on the part of local ferries are sometimes reported to the CFD by fishermen and other residents (S. Davies, pers. comm., 1992). Few of the marinas have pump-out stations and there are no regulations concerning holding tanks. Bacterial water quality monitoring conducted regularly since 1988 by the Water and Sewage Department and the CFD, indicates pollution problems at some marinas and some popular beach sites (BVI Government, 1992).

It is a recommendation of this Recovery Action Plan 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

Sea grasses in Manchineel Bay (Cooper Island) and North Sound (Virgin Gorda) have been described as unhealthy as a direct result of anchoring (Salm, 1980; ECNAMP, 1981; Rogers et al., 1982). An estimated 17,000 boats anchored in North Sound (Virgin Gorda) between 1977-1980, causing widespread turbidity and ruin to sea grass beds (Salm, 1980). Fortunately, moorings subsequently installed at Bitter End Yacht Club, Leverick Bay, and Vixen Point have significantly allayed this damage. Similarly, irreparable damage to coral reefs (e.g., Coral Gardens at Dead Chest; The Indians; White Bay at Jost Van Dyke; White Bay at Guana Island) in the 1980's ignited concern amongst dive operators that their very livelihood was at stake, so pervasive was the destruction caused by mini-cruiseships and ever larger numbers of yachts, dive boats, and other pleasure and commercial vessels. The arrival of two mini-cruisers in 1986 and seven in 1987, plus increasing numbers of visits by larger charter yachts like the 'Aquanaut Explorer' (live-aboard dive boat, 142-foot), only heightened the DOA's concern. At popular dive sites such as The Settlement (Salt Island), The Indians (Pelican Island), and Alice in Wonderland (Ginger Island), sea grass meadows were ripped and fragmented and coral heads shattered by the action of anchors and their chains.

A comprehensive system of moorings was clearly needed. In 1988, the DOA surveyed proposed anchoring sites and marked with buoys and flags those they felt would invite the least environmental damage. The Association labeled five of the 11 popular cruise-ship anchor sites as 'extremely sensitive' and in immediate need of moorings (or strict anchoring regulations) if they were to survive the following season. These included The Settlement (Salt Island), Great Harbour (Peter Island), The Byte and The Caves (Norman Island), and Great Harbour (Jost Van Dyke). Soon "Stop Reef Busting" T-shirts were sold by the Association and donations solicited to pay for the placement of permanent moorings. Alan Baskin, DOA President at that time, sent proposals to several organizations (e.g., World Wildlife Fund), in an effort to raise enough money to install the planning moorings. Eventually $30,000 was awarded by CIDA [Canadian International Development Agency] and a matching grant was generously donated by a local Rotary Club member. The DOA arranged for John Halas (Key Largo National Marine Sanctuary), inventor of the mooring technology selected for use in the BVI, to visit the islands, examine and critique the mooring plan, and provide the necessary training.

In September 1988, the first 32 moorings were installed by members of the DOA. Installation continued under the aegis of the NPT. By July 1992, 170 of the planned 250 moorings were in place. Only one has been lost, and that to a mini-cruiser illegally moored at The Indians which ripped out the entire mooring apparatus. The system is perhaps the most sophisticated in the Western Hemisphere, with supporting legislation, a comprehensive user-fee schedule, an enforcement vessel, and two paid Marine Park Wardens. The Marine Parks and Protected Areas Regulations of 1991 prohibit anchoring, using any mooring without a permit, and carrying out any activity that could result in "damage or destruction to any flora or fauna or artifact" within a Marine Park. The NPT is empowered to revoke or suspend mooring permits for improper behaviour; persons convicted of violating the Regulations are liable to a maximum fine of $500 and/or six months imprisonment. Permit fees are assessed for use of the mooring system. The NPT has produced an excellent video for yachting and public television audiences explaining the mooring system and extolling the economic benefits of protecting coral reefs.

Mini-cruiseships are a topic of continuing controversy. Yachting representatives have long claimed that the anchors and anchor chains of these larger vessels are doing enormous damage to popular reef areas. Hard evidence was made public in 1988 when the DOA released underwater video footage of destruction to a reef near The Settlement after a mini-cruiser had dropped anchor there and the action of the chain uprooted an entire coral head. Jackson (1987), in a report prepared for the BVI Government, recommended reducing the number of anchorages used by mini-cruiseships from 21 to nine and identifying specific areas for anchor placement. Subsequently, nine sites were designated: Long Bay (Beef Island), Cane Garden Bay (Tortola), Savannah Bay, Pond Bay, and Long Bay (Virgin Gorda), Vixen Point (Prickly Pear), Pomato Point and West End (Anegada), and Salt Island Bay. The support of mini-cruiseship captains and agents in restricting the anchoring sites of their vessels has been solicited. It is a recommendation of this Recovery Action Plan that (i) the mooring system be expanded on an ongoing basis, (ii) mooring legislation be stringently enforced, and (iii) designated cruiseship anchorages be made into law.

4.148 Others

Dredging, land reclamation, and sedimentation are clear threats to coastal and marine environments in the BVI. Dragline dredging in 1982 in the cove just south of Bitter End Yacht Club (Virgin Gorda) caused extensive damage to the sea grass meadows there (Rogers et al., 1982). Recent dredging in Trellis Bay (Beef Island) has all but destroyed the benthic (bottom-dwelling) communities in the western side of the bay. Now a new dredging site at Parham Harbour on the east end of Tortola has been established, but it is not expected that this site will affect sea turtles; there are few turtles reported there and apparently no sea grass or coral. In contrast, dredging for construction materials at Sandy Point on the southwest coast of Tortola eliminated the beach there, as well as nearshore sea grasses. The permit to dredge at Sandy Point expired in November 1990, but the activity continues. Ongoing shallow water dredging at Long Bay (east coast Jost Van Dyke) for construction sand has also severely degraded both the adjacent nesting beach and the offshore sea grass. Local fishermen report significant numbers of juvenile conch, shellfish, and sea turtles north of the East End Harbour in the vicinity of Long Bay (S. Davies, pers. comm., 1992).

Land reclamation is ongoing at several points on the coast of Tortola. The prerequisite filling of mangrove areas with garbage is unsightly and ultimately fatal to these unique and productive ecosystems. Reclamation at Sea Cow Bay, Fat Hogs Bay, and Baughers Bay has already claimed nesting habitat, since sandy beaches where turtles once came ashore to lay their eggs have been eliminated. In the case of sedimentation, this is related to the clearing of land for development and leaving cleared land unvegetated for long periods of time, both of which result in increased soil erosion. Most of the eroded soil is carried by ghuts (stream valleys) to the sea during heavy rainfall, where it can smother coral and sea grass. Nearshore waters often turn brown in colour after heavy rains (BVI Government, 1992). An increased public awareness is needed concerning soil erosion and nearshore sedimentation caused by upland clearing and development, cutting of roads, etc. Finally, physical damage from fish pots dropped on coral reefs is evident in some areas and greater numbers of dive tourists are stressing coral reefs with high visitation. A NPT brochure informs divers and boaters that divers should not touch brittle corals, and that correct buoyancy adjustment can avoid damage caused by SCUBA fins.

4.2 Manage and Protect All Life Stages

In addition to long-term stewardship of the marine and coastal environments of the BVI, it is essential to the recovery of local sea turtle stocks that an indefinite moratorium on the harvest of sea turtles and their eggs be implemented. Such a moratorium was proposed for the leatherback in 1990, but has not yet been enforced. As a result of decades of harvest, only a handful of leatherbacks nest each year (sections I, 2.3, 3.3). Even with full protection, we will not see during our lifetime the return of this species in numbers remembered by fishermen alive today. The timing of their recovery, which will take several decades, will depend on strict protection in British waters, as well as in adjacent French, U. S., and Dutch territorial waters. The simple lesson to be learned from the collapse of the local leatherback colony is that sea turtles cannot indefinitely be harvested in the absence of data on population size and rates of recruitment. Without a strong commitment now to protect all sea turtle species, all of which are depleted, the green and hawksbill turtles will inevitably go the same way as the leatherback. The BVI is not alone in its struggle to conserve sea turtles. All nations and territories in the Caribbean Sea are working toward the same end. Migratory sea turtles are a shared resource. The following sections review existing conservation legislation in the BVI, propose new regulations where needed, and discuss the challenges of law enforcement.

4.21 Review existing local laws and regulations

The first Ordinance to offer protection to sea turtles was the Turtles Ordinance of 1959. Young (<20 lb) sea turtles were protected at all times and all sea turtles (except leatherbacks, locally referred to as trunk turtles) were protected during a closed season between 1 July and 31 August. Similarly, all sea turtle eggs (including leatherback eggs) were protected during the same closed season, it being an offence to take, attempt to take, buy, sell, expose for sale or possess the eggs during this time. Persons convicted of contravening the Ordinance were liable to a fine not exceeding one hundred dollars. The Ordinance also provided for seizure of turtles, their parts or their eggs during the closed season and forfeiture of "any net, instrument or thing" used in connection with the offence.

The Ordinance was amended in 1986 to include the protection of leatherback turtles and the closed season was extended from 1 April to 30 November. During these eight months, the amended Ordinance made it unlawful "(a) to catch or take or attempt to catch or take or cause to be caught or taken any turtle; (b) to slaughter any turtle or buy, sell, offer or expose for sale or have in possession the whole or any portion of the meat of any such turtle." Unfortunately, since the two provisions just quoted repeal and replace all provisions in Paragraph 3 of the 1959 Ordinance (described above), there is at the present time no protection whatsoever for sea turtle eggs and no size restriction on sea turtles caught. Thus, adult turtles and large juveniles, the most important components of any sea turtle population (sections 4.232, 4.233), can be legally caught. Furthermore, the penalties for a convicted offence were not changed by the Turtles (Protection) (Amendment) Notice, 1986, and are insufficient to act as a reasonable deterrent.

Recognizing the inadequacy of the present legislation, the CFD submitted the Turtles Act of 1992 to the MNRL in February 1992. The Act is intended to repeal and replace the Turtles Ordinance, as amended. The Act provides for full protection to trunk turtles and their eggs at *all*

times, retains the 1 April-30 November closed season for green turtles and hawksbills (but eliminates protection to other species of sea turtle, some of which, like the loggerhead, are occasionally encountered in BVI waters), prohibits the taking, catching, killing, buying, selling, or exposing for sale any green or hawksbill turtle during the closed season, establishes a maximum size limit of 24 inches (60 cm) shell length for green and hawksbill turtles caught during the open season, prohibits the take, capture or disturbance of any green or hawksbill turtle or their eggs on shore or within 100 yards thereof at *all times*, and increases the maximum penalty to a fine of $1000.

The proposed Turtles Act of 1992 was sent to the Executive Council in November 1992 (Sheila Browne, MNRL, pers. comm., 1992). The Act represents a clear advance over present legislation in that it protects nesting turtles and their eggs at all times and sets a maximum size limit on legal catches during the four-month open season, but it falls short of a full moratorium on the harvest of all sea turtles. Therefore, it must remain the recommendation of this Recovery Action Plan that a ban on sea turtle catch be implemented throughout the Territory as soon as possible. Nevertheless, we applaud the actions of the Ministry in acting on the recommendation of the CFD to strengthen the legislative framework protecting sea turtles. We suggest that the proposed Turtles Act be adopted as an interim measure and that it be enforced for a period of time not to exceed one year, at which time a moratorium on the capture of all sea turtles (and collection of their eggs) should be announced. During the interim period, fisheries personnel should be preparing the fishing community for the complete protection of endangered sea turtles. It is noteworthy that such a moratorium is required by the Protocol to the Cartagena Convention concerning Specially Protected Areas and Wildlife (section 4.32) and urged by the Organization of Eastern Caribbean States (OECS/FAO, 1992). Further discussion of these recommendations is provided in section 4.23.

In addition to legislation protecting sea turtles, several other laws are important to the recovery of sea turtles in the BVI. The Marine Parks and Protected Areas Ordinance (1979) empowers the Governor in Council to proclaim any area to be a marine park or protected area, so long as part of the area is submarine within the territorial sea of the BVI and the remaining area, which may be adjoining land or swamp, forms with the submarine area a single ecological entity or complementary ecological units. It gives the NPT responsibility for the supervision and management of marine parks and protected areas, and prohibits spearfishing and "removal of objects or willful damage to flora and fauna". The 1991 Marine Parks and Protected Areas Regulations forbid, in sites so designated by the NPT, anchoring, mooring without a permit, fishing, exceeding the posted speed limit, and carrying out any activity that could endanger the health and safety of divers and snorkelers, or that would result in damage or destruction of any flora or fauna or any artifact within the boundary of a protected area. A permit fee schedule is included. If convicted of an offence against these Regulations, persons are liable for a maximum fine of $500 and/or six months in prison.

All BVI beaches are protected under the Beach Protection Ordinance (1985). This Ordinance prohibits the removal of natural sea barriers or sand, stone, or gravel foreshore except by permission of the Minister and prohibits under all circumstances removal that is likely to result in shoreline erosion. The Ordinance permits the carrying away of quantities of sand small enough to be removed without an animal or a wheeled vehicle (including wheel barrows). It also

prohibits the fouling of the foreshore with garbage or any other debris and establishes penalties for violations. Finally, the Marine Products (Prohibited Methods of Taking) Order, 1989, prohibits the harvesting of marine products using SCUBA. It is a recommendation of this Recovery Action Plan that this law be interpreted to include as an offence the catch of any sea turtle by means of a speargun when using SCUBA.

4.22 Evaluate the effectiveness of law enforcement

The enforcement of environmental legislation is widely known to be less than adequate. The BVI Royal Police lack sufficient personnel to provide vigilant enforcement of conservation statutes and there is a general indifference on the part of the public and judiciary with respect to environmental law enforcement. There have been notable recent exceptions to the norm, however, and these illustrate the depth of concern some residents feel for local wildlife. The following incident involving a leatherback sea turtle (as reported in the BVI *Beacon*, 16 May 1991) reflects this sentiment and also shows how enforcement can be made more effective by the active participation of residents. A female leatherback was dragged ashore on 29 April 1991 at Little Apple Bay, Tortola, as it swam in shallow water, apparently seeking a nesting area. The turtle was flipped over and its neck and flippers trussed with rope. As an alternative to the impending slaughter, local fisherman Albert Stoutt and several others in the gathering crowd persuaded the captors that the turtle was endangered and should not be harmed during its nesting season. "This was a special turtle," Stoutt told the *Beacon*, "very old, and maybe the biggest I've ever seen. I'd never eat such a thing and certainly not stand around and let others kill it."

The article went on to tell how Constables Simon Gilbert and Otho Gibbons soon arrived on the scene in response to an anonymous phone call. Constable Gilbert, supported by several bystanders, told the crowd that turtle season was over and that the turtle was an endangered species and should be set free to lay her eggs unmolested. Deputy Police Commissioner Vernon Malone confirmed that both officers received official commendations for their actions. Citizen involvement such as occurred at Little Apple Bay is vital, since enforcement officers cannot be in all places at all times. Arrests and convictions are, however, also needed. There has never been a fine or other penalty levied against persons who have violated the closed season for sea turtles, or any other environmental regulation (dredging, pollution, etc.) with the exception of occasional fines for sand mining in violation of the Beach Protection Ordinance. Apprehending violators at sea is especially problematic. Current efforts by CFD staff to regularly patrol BVI waters should force a stricter following of fisheries regulations on the part of the public. Crimes against endangered species and habitats erode an irreplaceable national heritage that is unique to the BVI and belongs equally to all her people, present and future.

4.23 Propose new regulations where needed

Existing sea turtle legislation -- the Turtles (Protection) (Amendment) Notice, 1986 (see section 4.21) -- is inadequate to promote the recovery of local populations. While there is an eight-month closed season (1 April-30 November), there is no protection for sea turtle eggs and no size limit for turtles legally captured during the open season. Thus, it is a strong recommendation of this Recovery Action Plan that the 1986 Notice be repealed and that revised legislation make it an offence to slaughter, catch or take (or attempt or cause same) any species

of sea turtle encountered in the BVI, be the turtle on land or at sea, and to collect any turtle eggs. Furthermore, the buying, selling, offering or exposing for sale, or possession of the whole or any part of the meat, shell, oil, or eggs of any turtle should be prohibited at all times. Such a law is an essential component of any national strategy to promote the survival of remaining sea turtle stocks. Leatherback turtle has been all but exterminated in the BVI and green turtles and hawksbills are noticeably depleted from their former abundance (see section 3.3).

Should an immediate and indefinite moratorium on the harvest of sea turtles and their eggs be politically impossible at the present time, then the reluctant but unavoidable recommendation of this Recovery Action Plan is that the Turtles Act of 1992, presently under consideration by the MNRL (see section 4.21), be adopted and implemented during an interim period not to exceed one year. During this period, Fisheries personnel should be preparing the fishing community for a complete ban. It should be recognized that whilst such interim regulations represent a significant advancement over the present regulatory framework in that they (1) provide protection at all times to leatherback turtles, turtles found on a nesting beach or within 100 yards of shore, and all sea turtle eggs and (2) set a maximum size limit for green and hawksbill turtles harvested during a four-month open season, the Act is not capable of realizing the objective of a sustained recovery of depleted sea turtle stocks. It should be viewed only as a credible intermediate step toward full protection. Under the framework of the Cartagena Convention (see section 4.32), all nations of the Caribbean are now working toward a common goal in providing full protection to migratory, shared sea turtle stocks. The BVI is urged to join hands with the Caribbean community in this regard.

In addition to the need for revised sea turtle legislation, passage of the Coast Conservation and Management Act is important to the long-term survival of sea turtles and the habitats upon which they depend. The draft Act was recently returned to the MNRL by the Legislative Council and is being revised. The Act establishes a mechanism whereby the Minister can declare any area of the foreshore or seabed a "Special Resources Area" (to protect mangroves, coral reefs, sea grasses, or other special resources from destruction or deterioration) or a "Special Use Area" (to ensure the safety and welfare of the public and for the preservation of the coastal environment). The Act requires that persons obtain a permit prior to engaging in "any development activity within the coastal zone", allows for technical and public review of permit applications, and gives the Minister the option to require an environmental impact assessment. In addition, sand mining is prohibited from the foreshore and any other land within the coastal zone without a permit. Pollution of "any part of the coastal zone whether by discharging oil or depositing sewage, solid waste, garbage or other waste" is forbidden.

It is a recommendation of this Recovery Action Plan that a strong Coast Conservation and Management Act be adopted as soon as possible.

4.231 Eggs

It was, presumably, an oversight which eliminated protection for eggs from sea turtle legislation in 1986. Nevertheless, the result has been that at present there is no closed season on the harvest of sea turtle eggs. Egg collection has traditionally been widespread and high (despite a July-August closed season between the years 1959 and 1986), and it continues at an unquanti-

fied level. Fletemeyer (1984) estimated the take at 50% of all eggs laid, but some residents place it close to 100% in some areas. The removal of eggs is currently reported from Long Bay (Beef Island), Trunk and Rogues Bays (Tortola), Cam Bay and North Bay (Great Camanoe), North Bay Beach and the West End beaches of Scrub Island, and all around Anegada. In some areas, such as the northern cays, documented poaching approaches 100% of the eggs laid (Bill Bailey, pers. obs., 1992; see section 3.3).

In order to realize the recovery of depleted sea turtle populations, it is important that sea turtle eggs of all species be protected at all times. This has been a consistent stance of the OECS in recent years (Harmonized Fisheries Regulations) and is required by the Cartagena Convention (section 4.23). Thousands of eggs may be laid by a single female during her reproductive years, which may span two decades or more. Because young juvenile mortality is so high, it is essential that hatchling production is not compromised by egg poaching. Upon reaching sexual maturity (generally at 20-30 years of age), sea turtles will return to the beaches where they were hatched in order to lay their own eggs. If the majority of eggs are stolen, then there will be no "BVI hatchlings". The inevitable result, despite all other conservation measures, will be the disappearance of local nesting populations.

It is a recommendation of this Recovery Action Plan that the harvest of sea turtle eggs and the disturbance of sea turtle nests be forbidden at all times and under all circumstances.

4.232 Immature turtles

The eight-month closed season (1 April to 30 November) for sea turtles adopted in 1986 was an excellent first step toward a comprehensive sea turtle recovery programme in the BVI. The extended time period offers substantially greater protection to foraging juveniles than had been the case when the season was closed only during July and August (see section 4.21). Nevertheless, because turtles of all sizes can be legally caught during the remaining four months of the year, legal recognition of the fact that large juveniles are especially important to population survival is still lacking. Most species of sea turtle require upwards of two decades to reach sexual maturity in the Western Atlantic and Caribbean (e.g., Frazer and Ehrhart, 1985; Frazer and Ladner, 1986). Natural rates of mortality are high for eggs and small turtles, which are constantly replenished from productivity on the nesting beaches, but larger juveniles represent a decade or more of selective survival and their loss, especially in populations already declining, can be catastrophic (e.g., Crouse et al., 1987; Frazer, 1989).

It is a recommendation of this Recovery Action Plan that pending an anticipated moratorium on the harvest of all sea turtles, the Turtles Act of 1992 be adopted and implemented on an interim basis for a period not to exceed one year. The Act protects leatherback turtles at all times, as well as adult and near-adult green and hawksbill turtles larger than 24 inches (60 cm) shell length.

4.233 Nesting females

The recent extension of the closed season for all sea turtle species (section 4.21) was a great stride forward in the effort to conserve BVI turtles, but protection for adult turtles at *all*

times is still needed. It is important to remember that natural mortality for an adult sea turtle is very low. In undisturbed populations the average adult survives for many years, often decades. Some tagged females in long-studied populations, such as in Georgia (USA), have returned to the same nesting beach to lay their eggs for more than 20 years (J. Richardson, pers. comm., 1990). Repeated nesting is necessary because very few of the eggs laid will result in a mature turtle. Indeed, it is likely that fewer than 1% of the hatchlings entering the sea will survive the many years required to reach adulthood. Thus, several hundreds, if not thousands of eggs may be needed to replace an adult female and her mate in the next generation. If a female is killed during her reproductive years, much more than just a single turtle has been lost. The effect of harvesting breeding adults is nowhere more clearly demonstrated than in the BVI, as seen by the total collapse of a once thriving leatherback (trunk turtle) colony.

It is a recommendation of this Recovery Action Plan that pending an anticipated moratorium on the harvest of all sea turtles, the harassment, capture, and/or killing of adult turtles, especially nesting females, be strictly forbidden at all times. This could be accomplished by adoption and implementation of the proposed Turtles Act of 1992 which includes protection for sea turtles larger than 24 inches (60 cm) shell length and all turtles encountered on the shores of the Territory or within 100 yards thereof.

4.234 Unprotected species

The amended BVI Turtles Ordinance (see section 4.21) protects only green sea turtles, hawksbills, and leatherbacks. However, all sea turtles need protection, even those rarely seen in BVI waters. Therefore, it must be a recommendation of this Recovery Action Plan that all Caribbean sea turtle species be protected at all times and under all circumstances. These are the loggerhead (Caretta caretta), green turtle (Chelonia mydas), leatherback or trunk turtle (Dermochelys coriacea), hawksbill (Eretmochelys imbricata), Kemp's ridley (Lepidochelys kempii), and olive ridley (L. olivacea).

4.24 Augment existing law enforcement efforts

The Fisheries, National Parks Trust, Public Health, and Marine Ordinances all have provisions for their respective Ministers to deputize Officers within the Ministry (or hire enforcement personnel) to enforce local Ordinances. These options are rarely exercised. Little enforcement outside of routine law enforcement offered by the Police takes place. It has been suggested by several parties that a Government division be created specifically for environmental law enforcement. This would promote administrative continuity and more efficient use of personnel, training, time, and equipment. In the interim, CFD personnel have been deputized as Fisheries Inspectors with the authority to enforce the Fisheries Ordinance and commercial dive operators and fishermen have been encouraged to support formal law enforcement efforts. Divers and fishermen are in unique positions to monitor offshore damage to habitat, report out-of-season catches, and exert peer pressure to prevent violations. The owners of residential and commercial beach-front property have also been enlisted to report sea turtles caught or eggs collected out of season, and to monitor nesting beaches for poaching and other disturbances.

Recognizing that environmental law is becoming increasingly important and increasingly technical in the BVI, as is the case throughout the Eastern Caribbean, and it is a recommendation of this Recovery Action Plan that a Division of Enforcement be formed under the aegis of the MNRL Conservation and Fisheries Department. The Division should be charged with duties similar to those of the USVI Department of Environmental Enforcement. 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, coastal zone permits and compliance, etc. Officers would logically coordinate closely with NPT Wardens who have enforcement responsibility for Parks and Protected Areas. One option to ensure adequate coverage of the entire territory is to station extension/enforcement officers on each of the major islands. Initially, 2-4 full-time officers should be based in Tortola; additional officers should be stationed in Virgin Gorda and Anegada as resources permit. Island offices will need reliable access to marine vessels and other essential transport.

In order to facilitate enforcement of environmental legislation by Police, Customs, Immigration, and other relevant agencies, a concise yet comprehensive manual of existing environmental legislation is presently being developed for public distribution.

4.25 Make fines commensurate with product value

The maximum fine for violating the Turtles Ordinance is $100 and the forfeiture of equipment used (section 4.21). This fine is wholly inadequate, however, since leatherback oil can sell for as much as $200 a bottle (section 3.3), implying a potential profit of several thousand dollars per animal, and the meat of an adult green or hawksbill turtle easily exceeds $100 at a price of $2/lb. It is a recommendation of this Recovery Action Plan that a maximum fine of $2000 be included in any revised sea turtle legislation. Such legislation should also provide for the seizure of turtle parts or products taken in offence of the Turtles Act and the forfeiture of any boat, vehicle or other equipment used in committing the crime.

4.26 Investigate alternative livelihoods for turtle fishermen

While no one depends on income derived from sea turtles to provide a majority portion of their living, the monies earned may be important in some cases and consideration should be given to the men still seasonally active in the turtle fishery. In the case of green/hawksbill turtle fishermen, which number fewer than 20 on a part-time basis (section 3.3), such consideration may include purchasing turtle nets and/or offering training and other support toward increasing income derived from fish. Before reasonable alternatives can be formulated, however, it is necessary to determine the extent to which fishermen will be affected by a moratorium on the capture of turtles. There is no known market for turtle shell, but a few restaurants still offer turtle meat in season and purchase it from local fishermen. The trunkers (leatherback fishermen) are a small group of men, most of them elderly, who historically watched the nesting beaches at regular intervals to obtain gravid females. With the near extinction of the trunk turtle in the BVI, the fishery has all but ended. So few leatherbacks have been killed over the last decade (Table 6) that no one can be considered dependent on this activity for their diet or livelihood.

It is a recommendation of this Recovery Action Plan that the Fisheries Division conduct a Sea Turtle Fishery Frame Survey. To the extent possible, bearing in mind that formal records have not been kept, the following should be determined: (i) number of men active in the turtle fishery, (ii) number of turtles caught per year, (iii) species and size classes caught, (iv) capture methods, (v) capture/landing sites, (vi) catch per unit effort, (vii) gear in possession, (viii) gear used and frequency of use, (ix) cost of gear, (x) market price for turtle meat and products, (xi) income and proportion of total income derived from turtles. The exercise will also provide an opportunity for Fisheries personnel to talk with fishermen about the endangered status of sea turtles, emphasize the importance of a region-wide moratorium on these migratory species, and solicit comments on a moratorium in the BVI. Historical trends in catch per unit effort are also important to determine whenever possible. Do hunters have to travel further today than they did 20 years ago to obtain turtles? Set their nets (or wait on the nesting beach) for longer periods of time? With Frame Survey data in hand, credible scenarios for enhancing alternative sources of income can be developed and implemented.

The following points should be made when talking to fishermen about endangered turtles and the necessity for protecting them:

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

There have already been several efforts on the part of the Fisheries Division to enhance the fishing success, and thus the income, of local fishermen, including part-time turtle fishermen. These have included the increasing use of fish attracting devices (FADs), the culture of sea moss, and the planned development of pelagic fisheries. These programmes will continue in conjunction with efforts to conserve commercially important fish stocks. It is well known that the decline in sea turtles has occurred in concert with the depletion of fisheries resources in general. Statistics for Anegada, where the majority of fish are caught in the BVI, are most telling. Koester (1987) reported that reef fish, conch, and lobster have all declined in Anegadan waters over the last several decades. He quoted one fisherman saying that he "now sets twice as many traps" (40 vs. 15-20) but "only catches one-third" (140 lb vs. 400 lb/week) of what he hauled 20 years ago. Other fishermen reported that they now set three times the number of traps they once did. Furthermore, not only are fewer fish caught per unit effort, they are uniformly smaller in size. More recent statistics from the shallow reef trap fishery (BVI-wide) reveal a decline in average yield from 5 lb per trap in 1975 to 2 lb per trap in 1991 (CFD, 1992).

4.27 Determine incidental catch and promote the use of TEDs

Longline vessels in BVI waters and elsewhere unintentionally hook sea turtles. This situation deserves further study. One leatherback was hooked off Anegada in March 1987 and two more in December 1987; all were released apparently unharmed after the hook and line were cut. Lines are usually set north of Anegada in 1000-2000 fathoms of water; hooks hang at 50 fathoms. The small year-around fishery peaks during November-April. The capture of sea turtles by longlines has been documented elsewhere in the northeast Caribbean (e.g., Fuller et al., 1992; Tobias, 1991), as well as in the southeastern U. S. (Witzell, 1984) and Gulf of Mexico (Hildebrand, 1987). It is not known how long the turtles survive after being released with a large hook embedded in their mouth or throat. It is a recommendation of this Recovery Action Plan that the full extent of incidental catch be determined for the longline industry in BVI waters. This information is especially important because the BVI is considering expanding its pelagic fishing capabilities, including longlining. Fisheries personnel should interview the captains involved and ask that they report future incidents of sea turtle capture. Asian (Taiwanese?) longliners reportedly fish illegally for tuna in waters offshore Anegada. The extent of illegal activity should be determined.

There is no shrimp trawling in the BVI. Therefore, commercial trawling does not pose a threat to local sea turtles and turtle excluder devices (TEDs) designed in the USA to release trawl-caught turtles before they drown are not needed. Should trawling be undertaken in the future, the Ministry of Natural Resources and Labour should contact the U. S. National Marine Fisheries Service (Gear Division, P. O. Drawer 1207, Pascagoula, Mississippi 39567 USA) for technical information on the use of TEDs. TEDs are highly effective in reducing trawl-related sea turtle deaths and reducing unwanted bycatch (Crouse et al., 1992).

4.28 Supplement reduced populations using management techniques

Hands-on sea turtle management with the objective of enhancing productivity is important but is not a high priority at the present time. The reason for this is that threats, such as excessive predation or beach erosion at major rookeries, which lend themselves well to specific

management action have not been documented. Rather, (i) adopting a moratorium on sea turtle harvest and passing a strong Coast Conservation and Management Act (section 4.23), (ii) creating a CFD Division of Enforcement (section 4.24), (iii) establishing a comprehensive system of protected areas (section 4.12), and (iv) enhancing public awareness of and participation in sea turtle conservation (section 4.4) are seen as the best ways to promote sea turtle survival. Protecting habitat is essential, and many relevant recommendations are offered in sections 4.13 and 4.14. Should the adoption of more elaborate strategies, such as sea turtle tagging programmes or the maintenance of an egg hatchery, become necessary or desirable, methodology should follow that described in the WATS Manual of Sea Turtle Research and Conservation Techniques (Pritchard et al., 1983). The Manual is available in the CFD library. WIDECAST can assist in the organization and presentation of management techniques workshops.

Certainly one of the most commonly employed management techniques is the reburial of threatened eggs. While an individual sea turtle has the capacity to lay thousands of eggs in her lifetime, 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.

In lieu of centralized hatcheries, protecting individual nests from erosion and predators can be useful. Such action should be initiated only after careful consideration. If the occasional erosion-prone nest is to be relocated to a safe place on the beach, the decision to do so should be made at the time of egg-laying. If eggs are moved after the first 24 hours of incubation, 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 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, in the beach forest, etc.) so that the temperature of incubation is not altered. Hatchlings should always be allowed to emerge from the nest naturally and should traverse the beach unaided as soon as they emerge. Each hatchling is very important and contributes to the probability that enough turtles will survive the two decades or more to sexual maturity and eventually return to the BVI to lay the eggs of the next generation.

4.29 Monitor stocks

The status of sea turtle populations, and thus evaluation of the success (or failure) of specific management programmes, cannot be known unless population size is determined 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 sea turtle populations of the BVI are virtually nonexistent. To this end, it is a recommendation of this Recovery Action Plan that the following actions be taken: (i) designate index beaches for intensive monitoring, (ii) design and implement a programme for the proper statistical evaluation of existing numbers of sea turtles, (iii) establish a data-gathering system to ensure that data are comparable among locations, turtle species, and observers, (iv) encourage research that will provide statistical estimates of stocks and develop a long-term stock assessment program to identify trends over periods of decades, and (v) designate the CFD as the official repository for statistical data. The following subsections articulate the proper methods to be used in 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 the BVI, 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 one major nesting beach or area on each major island should be selected as an index beach and protected from activity that will compromise the suitability of the habitat to support sea turtle nesting. On Tortola, the Atlantic beaches from Trunk Bay east to Long Bay (Beef Island) are logical candidates because they receive nearly all leatherback nesting in the Territory. The relatively remote island of Anegada supports the largest number of nesting green and hawksbill turtles and should be a high priority for protection and study. The northern cays (Scrub Island, Great and Little Camanoe islands, Guana Island) are important hawksbill rookeries and are also excellent candidates for long-term protection and monitoring efforts. Surveys are still needed to identify critical nesting areas on Jost Van Dyke, Virgin Gorda, and the so-called southern cays (especially Norman, Peter, and Cooper islands).

Leatherback nesting is likely to commence in March or April, followed by green turtles in June, and hawksbills in July [N.B. there is some evidence that hawksbill nesting does not begin until October or November on some BVI islets; see section 2.4]. Elsewhere in the Caribbean, leatherbacks generally terminate nesting by mid-July, but the other species will continue to nest into the winter season, with hawksbills active through December or later. Hawksbills are the most common nesters in the BVI. In contrast, fewer than a dozen green turtles and leatherbacks combined probably arrive to nest each year. Monitoring the deposition of eggs provides a wealth of useful information, including the distribution and timing of the breeding effort, the species involved, the location of the most important breeding habitats, and nest fate.

A successful management programme must be based on accurate estimates of productivity (number of nests laid) and mortality (losses due to erosion, feral animals, crabs, birds, mongooses, poachers, etc.). Monitoring nests will also provide baseline data with which to evalu-ate the success of nest and habitat protection efforts. Positive results will not be seen right away. Eggs protected today are not likely to mature into breeding adults for two decades or more.

Nest monitoring efforts to date have relied on reports from residents and crawl counts obtained by CFD staff during diurnal (daytime) ground and aerial surveys (see also section 4.112). The number of crawls counted has formed the basis for comparison among beaches and among years. There has been no consistent distinction, however, between successful egg-laying and unsuccessful egg-laying (a "false crawl") because such a determination is problematic after the fact. Whether or not eggs are deposited depends on obstacles (erosion bluffs, fallen trees, beach lagoons) encountered by the female during the course of her time on the beach, disturbance (human activity, dogs, lighting), injury, and the physical condition of the site chosen. If the female encounters impenetrable roots, debris or water, or the sand is too dry to construct an egg chamber, the nesting attempt is likely to be aborted. As funds become available, personnel will be hired to conduct more in-depth, nocturnal censuses of important nesting beaches in order to document the actual deposition of eggs (section 4.6). A nest:false crawl ratio determined from proposed night patrols will permit an estimate of nest density from crawl tallies obtained during diurnal census efforts.

While it is difficult to confirm egg-laying during diurnal (and especially aerial) surveys, sometimes it is obvious that a turtle returned to the sea without ever attempting to dig. This is a "false crawl" and should be reported as such. Alternatively, eggs are confirmed when a poacher or predator exposes the nest or hatchlings are observed. When the activity site includes both a crawl and an associated disturbance which may or may not contain eggs, 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 the subsequent bacterial invasion attacking the broken egg(s) 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, rather than nests, has been and should continue to be the basis of reporting. When a crawl has been counted, it should be disguised with a palm frond, hand rake, or 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 the crawl to species is easy 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 create a symmetrical crawl, but it is only about 1 m in width and 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 quite faint 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.

Once the nest:false crawl ratio has been determined for a beach and the number of nests laid (per species) is known, a knowledge of the average number of clutches laid per female will enable the CFD to estimate the number of breeding females at that site. Leatherbacks deposit, on average, about six clutches of eggs per season (Tucker and Frazer, 1991) and hawksbills five

(Fuller et al., 1992). Thus, 30 hawksbill nests represents approximately six individual females. The clutch frequency for green turtles is not known, but is likely to fall between four and five. To obtain a more accurate assessment of the number of nesting females than is possible from converting nest counts, all-night patrol must be undertaken by trained personnel and tagging 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 to gain knowledge beyond that obtained from daily nest counts. However, valuable insight on the international movements of local sea turtles can be obtained from even short-term tagging (sections 4.33, 4.62).

4.292 Hatchlings

Any successful management programme must be based on credible estimates of reproductive success. Thus, while nest counts are vital (see above), follow-up at the hatchling stage is also important. Estimates of mortality, including losses due to erosion or high seas, domestic or feral animals (dogs, pigs), natural predators (crabs, mongooses, birds), and poachers should be obtained. Other threats should also be watched for and reported. These might include entrapment in debris, entanglement in beach vines, disorientation by artificial lighting, and harassment by onlookers. Some information can be collected on an opportunistic basis; for instance, disorientation, predation, or the spilling of eggs from a bluff created during a storm. In addition, it is useful if some nests are marked for study. It is not recommended that the nest site *per se* be marked, but rather the distance from the nest site to two proximal objects, such as trees or other landmarks, should be measured and recorded so that the site can be found at hatching two months later by using triangulation.

Hatchling emergence at the beach surface usually occurs at dusk and can be observed with ease. Predators, disorientation, and/or entanglement at the time of emergence should be noted. If the emergence is missed, the hatch can be confirmed by the presence of dozens of tracks leading from the nest site to the sea. After a day or two has passed, the nest can be excavated and the number of hatchlings roughly estimated from the remains of broken egg shells. In addition, unhatched (whole) eggs can be counted to determine the proportion of eggs which did not produce hatchlings. These eggs may subsequently be opened for an analysis of embryo stage death. If a particular problem recurs, such as nest flooding, then a conservation programme to move eggs either at oviposition or early the next morning to higher ground should be considered. In this case, it is crucial that nest dimensions (depth and width) reflect the original so that incubation temperature and hence hatchling sex is not distorted (for methodology, see section 4.28). It is a recommendation of this Recovery Action Plan that an in-depth evaluation of hatch success be undertaken by trained personnel at selected important nesting beaches as soon as resources permit. A permitting process under the aegis of the CFD should be established to allow the handling of endangered sea turtle eggs for legitimate conservation purposes.

4.293 Immature and adult turtles

The monitoring of juvenile and adult turtles at sea requires special preparation and is more difficult than counting nests or evaluating hatchling mortality. Systematic surveys at known foraging grounds and the tagging of individuals are required in order to evaluate popula-

tion size, foraging behaviour, and movement (the latter revealed when a turtle is captured at a point distant from where it was tagged). In the short-term, until established methods are available to quantify foraging populations with statistical accuracy and the resources are available to implement such an undertaking, an effort is being made to record turtle sightings, particularly repeated observations in specific areas. Data sheets designed by WIDECAST have been distributed by the CFD for this purpose and a network of volunteers, including ferry captains, divers and fishermen, have been recruited. Summer camp groups which sail around the islands may also assist in these efforts. Ongoing coral reef monitoring and proposed assessments of coral reefs and sea grass beds around the BVI by the CFD can also contribute important information regarding foraging distribution and behaviour and the relative numbers of turtles encountered in local waters.

Beyond sightings data, specific and highly valuable information can be gained using biotelemetry. 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 reproductively active adults. The monitoring of gravid females during the nesting season is particularly important. Where regular surveys of leatherback and hawksbill nesting have occurred (northeast coast of Tortola and the northern cays, respectively), disturbing irregularity in site fidelity and clutch frequency has been observed. It is possible that routine disturbance of gravid females during egg-laying is occurring, or perhaps populations have been reduced to such low levels that characteristic nesting behaviour has broken down (section 4.112). In both these species, a suite of beaches, rather than just one primary beach, appear to be used. Without accurate information on the inter-nesting movement of the females, comprehensive habitat protection is not possible. We recommend that the CFD seek assistance from qualified professionals to design and implement a study to monitor stocks at sea using biotelemetry.

4.3 Encourage and Support International Cooperation

4.31 CITES

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

The United Kingdom ratified CITES in 1976 and soon thereafter the BVI implemented it with the Endangered Animals and Plants Ordinance of 1976. In addition, any article that does not have proof of legal importation is liable to forfeiture under the BVI Customs Ordinance of

1975. The difficulty is that Customs Officers are not adequately trained to recognize endangered species, or products derived therefrom, and regular checks do not occur. It is a recommendation of this Recovery Action Plan that training be provided for Customs officials with regard to the details of implementing CITES. Such training should include identification of animal and plant parts and products, the proper issuance of documents, permit fraud, shipping container standards, the transport of live animals, methods of search and seizure, etc. The need for such training should be communicated to John Gavitt, Enforcement Officer, CITES Secretariat, 6 rue du Maupas, Case postale 78, 1000 Lausanne 9, Switzerland.

The effect of the international market on Caribbean sea turtles, especially hawksbills, should not be underestimated. Because Japan entered a "reservation" on some sea turtle species when it joined CITES, Japanese imports of raw hawksbill shell (tortoiseshell, or 'bekko') between 1970 and 1989 totalled 713,850 kg, representing >670,000 turtles; more than half the imports originated from the Caribbean and Latin America (Milliken and Tokunaga, 1987, updated by Greenpeace to 1989). In addition, between 1970 and 1987 Japan imported 675,247 kg of stuffed hawksbills (Greenpeace, 1989). Milliken and Tokunaga (1987) estimated that in order to maintain these levels of importation, the annual slaughter of at least 28,000 hawksbills was required. Between 1970 and June 1989, Japan imported 368,318 kg of bekko from the Wider Caribbean alone, the equivalent of more than a quarter million turtles; in 1988, Japan imported from the Wider Caribbean the tortoiseshell from nearly 12,000 adult hawksbills (Canin, 1989). As a result of this activity, an IUCN/CITES report on the global status of hawksbills concluded that about half of the known nesting populations are known or suspected to be in decline; in particular, "the entire Western Atlantic-Caribbean region is greatly depleted."

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

4.32 Regional treaties

In 1940, the Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere was opened for signature to Member States of the Pan American Union, now called the Organization of American States. It was a "visionary instrument" (Lyster, 1985) that protected species from man-induced extinction, established protected areas, regulated international wildlife trade [this aspect has been largely superseded by CITES; section 4.31], and encouraged international participation in the conservation of migratory species. Unfortunately the Convention contains no mechanism for reaching decisions binding upon the Parties; thus, it has been described as having "little or no practical value" (Lyster, 1985). In any event, the United Kingdom never ratified it (UNEP, 1989). The Bonn Convention for the Conservation of Migratory Wild Animals (1979), if ratified by enough nations in the wider Caribbean, could be an effective tool in the conservation of sea turtles. It was developed to deal with all threats to migratory species, including habitat destruction and taking for domestic consumption. It has not

been effective in the Caribbean basin largely because only the Netherlands, Suriname, and the United Kingdom, among nations of the Wider Caribbean, have ratified it (UNEP, 1989).

At the present time, the most promising vehicle for regional cooperation on behalf of depleted and endangered species in the Wider Caribbean is the United Nations Environment Programme's (UNEP) Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (Cartagena Convention). In March 1983, a Conference of Plenipotentiaries met in Cartagena, Colombia, to negotiate the Convention. Representatives from 16 States participated, including Great Britain. The Conference adopted both the Convention and a Protocol concerning cooperation in combating oil spills in the region. The Convention describes the responsibilities of Contracting Parties to "prevent, reduce and control" pollution from a variety of sources (i.e., pollution from ships, from at-sea dumping of waste, from land-based sources, from sea-bed activities, and from airborne sources). Article 10 is of special interest in that it addresses the responsibilities of Contracting Parties to "individually or jointly, take all appropriate measures to protect and preserve rare or fragile ecosystems, as well as the habitat of depleted, threatened or endangered species, in the Convention area." The United Kingdom ratified the Cartagena Convention on 28 February 1986.

In January 1990, a Protocol concerning Specially Protected Areas and Wildlife (SPAW) to the Cartagena Convention was adopted by a Conference of Plenipotentiaries, including Great Britain. This landmark Protocol provides a mechanism whereby species of wild fauna and flora (listed in three categories, or annexes) can be protected on a regional scale. 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, including Great Britain, 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 (UNEP, 1991; Eckert, 1991). The unanimous vote on this issue is a clear statement on the part of Caribbean governments that the protection of regionally depleted species, including sea turtles, is a priority. It is a recommendation of this Recovery Action Plan that the UK ratify the SPAW Protocol (which was signed on 18 January 1990) and fully implement the letter and spirit of the Convention and its Protocols in the BVI and throughout the British West Indies.

4.33 Subregional sea turtle management

Sea turtles are amongst the most migratory of all Caribbean fauna. Consequently, it is not possible to fully realize the recovery of local populations without the cooperation of neighbouring states. The USVI already protects all sea turtles under all circumstances; similar

regulations are necessary throughout the northeast Caribbean and indeed throughout the region as a whole. The latter will be achieved when all Caribbean nations ratify and implement the Cartagena Convention and SPAW Protocol (section 4.32). In the absence of cooperation, resources expended on enforcement and monitoring are wasted when "BVI turtles" are killed outside the BVI. It is well known that leatherbacks nesting in the BVI are seasonal visitors from temperate waters. Greens and hawksbills remain in tropical waters throughout their lives, but travel widely in the two decades or more prior to sexual maturity. Once mature, routine migrations, which may encompass several hundred kilometers, are undertaken by green turtles at 2-3+ year intervals between nesting beaches and what are believed to be more or less fixed feeding grounds.

An award-winning short story written by Clarissa Drew of Francis Lettsome Primary School emphasizes that we all must work together if the turtles are to survive. She wrote, "I am a little sea turtle. Not long ago a fisherman tried to catch me while I was laying my eggs one night. I had not finished laying my eggs when he turned me over, lifted me up and started to take me to his boat. I continued to lay eggs in the net. When he was almost to his boat, the net was torn and I fell into the sea. I quickly swam away and told the other sea turtles the whole story. They were so mad that we all decided to go to Dominica. When we got to Dominica the same thing happened there. Last of all we went to Barbados but the same thing happened there, too. There was no place for us to go because fishermen were looking out for us in every island. It seems as though people like to eat our flesh, and they can make nice things from our shells. That is why we have no resting place." The story won First Place (Creative Writing, Class 3) in the 1990 CFD-sponsored Art/Creative Writing Contest/Exhibition for BVI Primary Schools.

Scientific evidence for international movement is not difficult to come by. Leatherbacks tagged in locales as distant as Chesapeake Bay (USA) and Tortuguero (Costa Rica) have been killed after swimming into Cuban waters (Carr and Meylan, 1984; Barnard et al., 1989). One leatherback tagged while nesting on St. Croix (USVI) later stranded in New Jersey (Boulon et al., 1988); another was captured in Campeche (Boulon, 1989). Adult green turtles tagged while nesting in Costa Rica have been recovered from the Greater Antilles (Cuba, Jamaica, Puerto Rico), the USA, Mexico, throughout Central America, and from Colombia and Venezuela (Carr et al., 1978; Meylan, 1982). Juvenile green turtles tagged in the USVI have been recaptured in the Grenadines, the Dominican Republic, and the Bahamas (Boulon, 1989). Green turtles nesting in Suriname are routinely recaptured in Brazil (Pritchard, 1976). Juvenile hawksbills tagged in the USVI have been recovered in Puerto Rico, St. Lucia, St. Martin, Ginger Island (BVI) (Boulon, 1989) and the Dominican Republic (Ralf Boulon, USVI Div. Fish and Wildlife, pers. comm., 1991). A hawksbill tagged on Long Island (Antigua) whilst nesting was later captured by a fishermen in Dominica (J. Richardson, pers. comm., 1992). Tagging studies designed to provide data on the movement of local turtles into distant waters are proposed in section 4.6.

As an example of how discrepancies in legal protection can cause problems between nations with a shared resource, USVI enforcement officers report that USVI fishermen resent not being able to kill turtles when they know that BVI fishermen are allowed to take these same animals when they cross into British waters. Furthermore, it is tempting for USVI fishermen to break the law, since the open port on the east end of St. Thomas is an easy entrance point for turtles legally caught in British waters and illegally imported into the USVI. A case in point was the November 1988 seizure of the "Jenny", a 44-foot Thompson trawler, at Red Hook, St.

Thomas, by the U. S. National Marine Fisheries Service on charges that the vessel was utilised to import large volumes of green sea turtle meat to the USVI from Anegada. Finally, BVI fishermen reportedly illegally catch turtles in USVI waters and return safely across the border to legally market the catch in Tortola. These facts point to the fundamental importance of consistency between nations when widely ranging endangered species are involved.

4.4 Develop Public Education

4.41 Residents

Several excellent environmental awareness programmes were made available to local schools through the MNRL and NPT in the 1980's. In 1990, when the Conservation and Fisheries Department (CFD) acquired a full-time Environmental Awareness Officer, the CFD and the Department of Education worked together to design and present regular programmes on mangroves and sea turtles for Class 3 students and coral reefs and beaches for Class 4 students. These programmes include an audio-visual presentation and a follow-up field trip. The programmes have been presented to primary schools on Tortola, Virgin Gorda, Anegada and Jost Van Dyke. The entire natural history series was designed to be transferred to the Department of Education as a standard part of the curriculum. In order to facilitate this transfer, the CFD produced Educational Packages and audio-visual presentations for each school; each Package includes all four natural history subjects. Each Package includes a slide show with accompanying narration, background information for teachers, follow-up activities for students, and descriptions of field trips for each of the four study subjects. With the assistance of the OECS-NRMU and the University of the Virgin Islands, a two-week diploma course was held on Tortola in July 1992 to teach teachers about the issues covered in the natural history series. The course was designed to familiarize teachers with the material and help them incorporate it into the primary school curriculum as of September 1992.

In addition to educational programmes in the primary schools and slide presentations given to High School students, field trips to National Park sites are led on request by NPT personnel. Electronic and print media have also contributed meaningfully to public awareness. Media attention to environmental issues has taken the form of newspaper articles (e.g., a regular column in the *Island Sun*), radio interviews (GIS, ZBVI), and films. A locally produced film entitled "Island Web" explains the natural and cultural history of the BVI and cautions against overzealous development. The Friends of the National Parks Trust edits and distributes a regular newsletter devoted to natural history topics. Many other community groups, such as the Botanic Society, East End/Long Look Action Committee, Historical Society, Lion's Club, Rotary, the DOA, Brownies, Guides, and Boy Scouts, have also become actively involved in conservation issues and community activities (e.g., beach clean-ups, recycling, tree planting, and sea turtle surveys). Public meetings (e.g., church and civic groups) are ideal as forums for environmental awareness presentations. Environmental exhibitions and competitions have also been successful in involving residents and groups in conservation efforts.

We recommend that the published "Sea Turtle Recovery Action Plan for the British Virgin Islands" be announced in a Press Conference convened by the MNRL. The objectives and major recommendations of the Plan should be articulated at the Press Conference, public

support for a ban on turtle fishing solicited, and public participation in ongoing habitat surveys encouraged. In addition, it would be very useful if a regular feature of either radio or newspaper would excerpt pertinent sections of the Plan, using the document to broaden and deepen public understanding of the biology of sea turtles, their endangered status, and how to become more involved in their conservation. Finally, the WIDECAST brochure, *Sea Turtles of the British Virgin Islands*, should be updated and reprinted and at least one poster produced for display throughout the Territory. Local art, photography, and/or poetry should be featured.

4.42 Fishermen

There are no formal education programmes for fishermen at the present time. The education of fishermen, as well as their involvement in issues that concern them, would be greatly enhanced by a stronger Fishermen's Association (FA). The FA is neither a registered organization nor a legal body, and it is not perceived as having much power to influence Government. As a consequence, fishermen do not activity participate in the Association and it is generally ineffective. There has been some discussion within the Fisheries Division of assisting the FA in improving their effectiveness by, for example, revising the constitution so that the Association can lobby, fund-raise, and be more supportive of the fishing community. In turn, more fishermen would be likely to participate in the FA (meaning it would more fairly reflect the fishing community as a whole) and Fisheries personnel would have the benefit of working with a strong liaison to their fishing constituency.

There is also a need for more extension work on the part of the Fisheries Office, particularly targeted to turtle fishermen. Regular "Town Meetings", such as were convened (and well received) on several islands during the preliminary stages of the recent frame survey, would be very useful. We recommend that informal Town Meetings be planned on each major island to focus specifically on the subject of sea turtle biology and the need for an indefinite moratorium on the harvest of turtles and their eggs. In this way, fishermen would learn why late-maturing, long-lived species such as turtles must be managed very differently from the way most fishes are managed, they would have an opportunity to see that the Government is serious about the protection of sea turtles, and they would have a chance to discuss ways in which the transition to a zero quota could be eased. Enhanced awareness on the part of user groups, such as fishermen, of why sea turtles are endangered is central to any successful conservation initiative. See also section 4.26.

4.43 Tourists

There is no organized education toward tourists, but most members of the DOA make a concerted effort to educate dive tourists about coral reef etiquette. In 1987, the Caribbean Conservation Association's *Caribbean Conservation News* noted that the DOA had the following recommendations for divers and boaters: (i) do not take any live coral, plants or shells, (ii) do not spear fish, (iii) do not take lobster or conch, (iv) never anchor on a reef, (v) weight divers correctly to avoid any diver damage to reefs. Some dive shops, such as Baskin in the Sun, refuse to sell gloves, preferring instead to encourage divers to touch nothing. In 1991, the BVI Marine Trade Association requested a list of "dos and don'ts" from the Conservation and Fisheries Department to share with tourists. These included restrictions concerning littering, boat sewage

disposal, anchoring, and a request not to harass sea turtles. In addition, *Sea Turtles of the British Virgin Islands*, a brochure designed by WIDECAST for the NPT, is available at the tourist office and in selected hotels and dive shops.

It is imperative that visitors be made more aware of the adverse environmental effects of such activities as indiscriminate anchoring, garbage disposal, spear-fishing, the harassment of marine life, and the collection of corals, sponges, shells, and plants. Tourism is a significant source of income for the BVI; it would be ironic if tourists were allowed to destroy the very resources that attracted them to the area in the first place. Charter operations, divers, and hotel owners should have (and in many cases do have) materials available to tourists concerning the legality of activities such as those just listed, and encouraging visitors to report any violations. The MNRL, NPT, DOA are probably in the best position to design and distribute the necessary materials. Recently, the CFD requested the assistance of the DOA and several charter boat operators in reporting sightings of turtles at sea. Reports were received from both operators and visitors alike, showing that operators are sharing this important ecological information with visiting guests.

In 1992, a video was produced by the NPT entitled, "Welcome to Paradise" which explains the mooring system and urges marine users to treat the fragile marine environment of the BVI with care. Charter boat operations and private vessels are encouraged to purchase and to view the video. Colourful displays at the airport and new cruise port would be very useful for tourists arriving through either of these ports of entry. The displays should explain the endangered status of sea turtles and alert tourists to regulations pertaining to the conservation of sea turtles, beaches, coral reefs, and sea grasses. Posters aimed at the education of tourists should be produced and displayed in boutiques, the BVI Tourist Board Office, rental car agency officers, dive shops, and other relevant venues. It is noteworthy that *The Welcome* tourist magazine, published bi-monthly, usually includes at least one article on conservation and/or natural history in the BVI.

4.44 Non-consumptive uses of sea turtles to generate revenue

It would be useful if income could be generated from the protection of sea turtles, rather than from killing them. Some hotels in the Caribbean, such as Jumby Bay Resort in Antigua, sponsor and support sea turtle research and conservation projects on their beaches. In the case of Jumby Bay, lodging is provided to a team of biologists during the breeding season and hotel guests are professionally guided to the beach to quietly witness egg-laying and research activities. This has been extremely popular with the guests and promotes an awareness within the hotel regarding beach cleanliness, the importance of beach vegetation, the problems associated with artificial beach-front lighting, etc. If BVI beaches can be identified where sea turtles still nest in appreciable numbers, expeditions might be organized to allow the public to view this activity in a controlled and responsible manner. If these activities are not properly controlled, the turtles may be driven away by the disturbance.

If significant turtle habitat is protected within a Park or other protected area, it is recommended that revenue generated from expeditions be recycled into Park conservation or interpretive programmes. A number of Marine Parks and Protected Areas are currently planned

and some turtle nesting sites are included (e.g., Anegada, Sandy Cay). It is possible that regular sea turtles programmes could be initiated in these areas to enable the public, for a fee, to engage in "turtle watching". Field expeditions should be organized under the aegis of the NPT and/or the CFD and should enlist the technical advice of WIDECAST. In addition to viewing turtles on the nesting beach, encountering sea turtles whilst diving or fishing adds interest to these trips and makes them more enjoyable for tourists. This contributes to the economy of the BVI in the long-term, as it results in more business for local guides through recommendations and returns.

There is no question in the mind of the authors that more revenue and more recreational and commercial options will be available to the people of the BVI if native species and habitats are protected for the benefit of future generations, than if they are exploited for short-term gain. Working with the environment, not against it, is the key to success.

4.5 Increase Information Exchange

4.51 Marine Turtle Newsletter

The Marine Turtle Newsletter (MTN) is published in both English and Spanish and is distributed quarterly, free of charge, to readers in more than 100 countries. The MTN provides a means for decision-makers to remain informed about current sea turtle research, as well as sea turtle conservation and management activities around the world. The Director of the Conservation and Fisheries Department, the Fisheries and Assistant Fisheries Officers, the Director of the National Parks Trust, the Guana Island Wildlife Sanctuary, and a few interested residents currently receive the newsletter. Others, especially local libraries, are encouraged to subscribe to this resource. To receive the MTN, please write to: Editors, Marine Turtle Newsletter, Hubbs-Sea World Research Institute, 1700 South Shores Road, San Diego, California 92109 USA.

4.52 Western Atlantic Turtle Symposium (WATS)

The BVI has participated in both Western Atlantic Turtle Symposia: WATS I in Costa Rica, 1983, and WATS II in Puerto Rico, 1987. The territory was represented by Mr. Louis Walters, formerly of the Ministry of Natural Resources and Labour, at WATS I and by Dr. Karen Eckert (WIDECAST) at WATS II. National reports were submitted by Fletemeyer (1984) and Lettsome (1987). The government expects to continue to participate to the extent possible in this valuable regional database. The WATS Manual of Sea Turtle Research and Conservation Techniques (Pritchard et al., 1983) is available in the library of the CFD.

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

Beyond supporting the local and national efforts of governments and non-governmental organizations, WIDECAST works to integrate these efforts into a collective regional response to a common problem, the disappearance of sea turtles. WIDECAST is supported by the 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, coastal residents, educators, developers, and other interested persons are encouraged to join WIDECAST's efforts. In the BVI, the Ministry of Natural Resources and Labour, the National Parks Trust, the Dive Operators Association, and a large number of interested residents are active in the WIDECAST network. The network is participating in the collection of data concerning the nesting and foraging habitats of sea turtles and, as a result of these efforts, critical management decisions, such as closed seasons and protected areas, will be based on solid information. WIDECAST is implemented through the MNRL-CFD.

4.54 IUCN/SSC Marine Turtle Specialist Group

The Marine Turtle Specialist Group (Dr. Karen Bjorndal, Chair) is responsible for tracking the status of sea turtle populations around the world for the World Resources Union (IUCN)

Species Survival Commission (SSC). The Group is presently drafting an outline for a global Marine Turtle Action Plan. The Group is a valuable source of information about sea turtles and technical advice on conservation projects. For further information, contact Dr. Karen Bjorndal, Archie Carr Center for Sea Turtle Research, University of Florida, Gainesville, Florida 32611.

4.55 Workshops on research and management

Karen Eckert (WIDECAST) and Conservation and Fisheries Department (CFD) personnel have convened several seminars on Tortola and Virgin Gorda to inform interested residents about how to distinguish one species of sea turtle from another and how to gather appropriate data for CFD's ongoing Sea Turtle Survey. Information packages have been distributed for this purpose and data sheets provided to be completed and returned to the Department. In February 1992, a workshop was held by the CFD and the Caribbean Stranding Network to train volunteers and government personnel in marine mammal and sea turtle identification, rescue, rehabilitation and salvage methods. The main emphasis of this workshop was the need to determine causes of injury and/or mortality so that management strategies may be developed accordingly. Overseas training opportunities have also been encouraged. The Caribbean Conservation Corporation's Sea Turtle Conservation Short Course held in Tortuguero, Costa Rica, was attended by Halstead Lima in September 1991. Financial assistance for Lima's participation was provided by WIDECAST and by the Government of the BVI.

Future training of CFD personnel should include visits to Sandy Point National Wildlife Refuge, St. Croix, to participate in nightly surveys and tagging of leatherback turtles, collaborative work with Ralf Boulon (USVI Division of Fish and Wildlife) on capture-tag-release efforts to census turtles at sea, and participation in the WIDECAST project with hawksbill sea turtles at Jumby Bay Resort, Antigua. Local workshops focused specifically on research and management techniques are also available on request through WIDECAST. Several years ago WIDECAST prepared a narrated slide show on the biology and status of endangered local sea turtles for the NPT; this has now been updated and expanded by CFD personnel for use in public schools and other fora and is part of the routine training provided to volunteers before they begin their work censusing beaches for sea turtle crawls.

4.56 Exchange of information among local groups

In almost any field there is always a need for greater communication and information exchange. The many islands and large territory of the BVI magnify this basic challenge. Nonetheless, government and non-government organizations have worked well together to promote an awareness of natural resources, including sea turtles. In the early 1980's Bertrand Lettsome (Conservation Officer, MNRL) and Dr. Nicholas Clarke (then Director, NPT) seriously advocated public awareness of local conservation issues. Books and articles were written, field trips were initiated, and work began to incorporate natural history information, including sea turtles and other marine resources, into the public school curricula. Today the CFD, DOA, and other local groups are heavily involved in resident and visitor education.

Since 1990, the CFD in particular has made a concerted effort to increase environmental awareness among local people. Although this has been geared toward the BVI as a whole, the

majority of the public awareness activities and information exchange has been on Tortola. In order to increase information exchange on other islands it is a recommendation of this Recovery Action Plan that representatives of the CFD (extension officers) be stationed on each of the major islands to act as liaisons between the CFD and local residents. These representatives would also be in a position to monitor regulatory compliance and report back to the CFD. The North Sound Heritage Project being developed on Virgin Gorda would provide an opportunity for this type of extension service on that island.

The role of the broadcast (television, radio) and print (newspaper) media cannot be over-emphasized. The NPT newsletter is a useful source of information, as is The Welcome Magazine and the *Beacon*. It is important that every avenue be explored in order that advocacy groups and the interested public retain contact with one another. Sea turtle survival will require awareness and support on the part of everyone, not just the attention of a few select agencies.

4.6 Implement Sea Turtle Conservation Programme

4.61 Rationale

It is clear from the information provided in this Recovery Action Plan that three species of sea turtle, all categorized as Endangered by the World Conservation Union (Groombridge, 1982; Groombridge and Luxmoore, 1989), nest in the BVI. These species are the hawksbill, leatherback, and green turtle (Figure 2). The loggerhead turtle is occasionally reported and is sometimes captured but is not known to nest. Extensive harvest combined with the destruction of nesting and foraging habitats has resulted in depleted sea turtle populations. We are particularly concerned about the leatherback (trunk) turtle which has plunged from an estimated six females per night on some Tortola beaches during peak season in the 1920's to fewer than ten turtles per year on all beaches combined during the last decade. It is vital that we protect the remaining trunk turtles, as well as plan responsibly for the conservation of green and hawksbill turtles so that they do not meet the same fate.

In 1985, the MNRL, reflecting BVI Government policy, made the conservation of sea turtles a priority. The result of this was a joint research project entitled the BVI Sea Turtle Survey which was initiated by the NPT and the MNRL Conservation Office [now the Conservation and Fisheries Department]. Since 1986, public awareness and education programmes about marine turtles have been carried out through lectures and seminars, classroom slide shows, radio interviews, and newspaper articles. Sea turtle conservation is at present being incorporated into the primary school curriculum. A volunteer network has also been established to assist in data collection and population monitoring. With funding from WWF-United Kingdom, aerial surveys of leatherback nesting beaches were flown in 1990 and 1991 during the April-July nesting season. A number of technical reports have been prepared from these surveys by the Conservation and Fisheries Department (CFD).

At the present time, the status of sea turtles in the BVI is jeopardized by two main factors: (1) the legal and illegal harvest of turtles and eggs and (2) the destruction of nesting and foraging habitat as a result of increasing development due to a thriving tourism industry and increasing human population. A lack of funding prevents the CFD from carrying out a number of

important activities, such as implementing comprehensive surveys of turtle populations, conducting more frequent aerial surveys of remote areas, enforcing existing legislation, buying turtle fishing nets from fishermen, and purchasing tags, tagging equipment, and other basic research supplies. Conservation efforts are also hindered, to varying degrees, by the following:

1. The BVI consists of 36-plus islands. It is very difficult to survey remote beaches consistently due to a lack of personnel and/or transportation, not to mention occasional rough seas. Surveys of nesting beaches are, for the most part, sporadic because of the lack of funds and personnel and, as a result, having to depend on volunteers to perform field duties.

2. The BVI coastline includes approximately 49 miles (79 km) of beaches widely distributed across nearly 84,000 square miles of the northeastern Caribbean Sea. Consequently, it is impossible with present resources to carry out regular and comprehensive patrols of isolated and remote beaches throughout the year, or even during the eight months (April-November) when sea turtles would be most likely to nest.

3. The beaches which are surveyed tend to be those which are easily accessible. These are most likely to be commercially developed and may no longer be appropriate nesting beaches. It would be useful to be able to survey and monitor more remote beaches which could perhaps give more representative figures for existing population numbers and a clearer idea of reproductive periodicity.

4. Due to the infrequency and irregularity of surveys and beach patrols, poachers are often able to kill turtles or dig nests without being caught. In 1991 alone, two gravid leatherbacks (of an estimated 1991 nesting population of four) were slaughtered and volunteers surveying beaches reported several cases where turtle nests had been raided.

The constraints described above have made it difficult to reach conclusions on such factors as the distribution and size of breeding populations, nesting frequency and success, distribution and size of foraging populations, and extent of legal and illegal exploitation. Meanwhile, it is clear from interviewing local fishermen that sea turtle stocks (especially nesting assemblages) have noticeably declined from pre-World War II levels and ongoing censuses indicate that leatherback (trunk) turtles have all but been exterminated in the BVI.

4.62 Goals and objectives

The broad goals of the proposed Sea Turtle Conservation Programme are to obtain comprehensive and accurate data on the distribution of sea turtle nesting and foraging, to implement an integrated, scientifically sound conservation programme based on the information and recommendations assembled in this Recovery Action Plan, and to promote the recovery of remaining sea turtle stocks. The specific objectives of the Programme are as follows:

1. Lobby for a moratorium on the catch of sea turtles and their eggs, as well as passage of the Coast Conservation and Management Act (the latter to provide a legislative framework for the protection of critical habitat).

2. Determine nest density and nest success in three important rookery areas – Anegada, the north coast of Tortola, and the "northern cays" from Scrub Island to Jost Van Dyke – over five consecutive years based on ground and aerial surveys.

3. Collect information relative to the distribution and abundance of turtles at sea over five consecutive years based on sightings data assembled during ongoing coral reef and proposed sea grass monitoring programmes, as well as taking advantage of a volunteer sightings network.

4. Identify critical nesting and foraging habitats, based on the results of field surveys described in 1. and 2. above, and develop holistic management plans for critical nesting and foraging habitats based on the recommendations articulated in this Recovery Action Plan.

5. Increase our understanding of the residency patterns and movements of local sea turtles, including evaluating the extent to which turtles are shared with neighbouring jurisdictions (e.g., USVI, Anguilla, St. Martin), by initiating tagging programmes and participating in satellite and other telemetry efforts.

6. Quantify the exploitation of sea turtles, based on user and market surveys.

7. Improve law enforcement by increasing manpower, both employed and volunteer, and increasing public awareness.

8. Promote community support of and participation in sea turtle conservation by increasing public awareness through ongoing education programmes in the schools, public talks, press releases, brochures, posters, etc.

9. Solicit assistance from the public in documenting turtle sightings (nesting and at sea), reporting illegal activities, and safeguarding turtles and nests from poaching by providing informal surveillance.

4.63 Activities

Activities proposed for the Sea Turtle Conservation Programme to meet the goals and objectives outlined above include:

1. Urge revision of the Turtles Act of 1992 to include a moratorium on the capture and sale of sea turtles and their eggs, as well as the adoption and implementation of the Coast Conservation and Management Act.

2. Undertake daily ground surveys of known nesting beaches in the BVI over five consecutive nesting seasons, with emphasis on Anegada, the north coast of Tortola, and the small cays and islands from Scrub Island to Jost Van Dyke (see Figure 3). Student interns will be hired and trained for this purpose by the CFD. Volunteers will also be recruited to assist and will receive any necessary training by the CFD.

3. Initiate long-term tagging studies at accessible and significant nesting grounds, capture-tag-release studies at important foraging sites, and telemetry (movement, behaviour) studies of both juvenile and nesting adult turtles. There is some in-house expertise in this regard; additional training in proper methodology will be solicited from WIDECAST personnel in Antigua, Barbados, the USVI and USA.

4. Acquire field and camping equipment for sea turtle surveys, as well as data collection materials (e.g., measuring tapes, tags, flashlights, clipboards, tents, sleeping bags, cooking utensils, a small dinghy). These may be obtained by direct purchase, as well as by soliciting the donation of items.

5. Conduct interview and market surveys in order to determine or estimate the number of sea turtles caught during the annual open season (1 December-31 March). 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.

6. Provide funds for the purchase of turtle fishing gear from fishermen in order to encourage them to give up turtle fishing and to compensate them for lost income.

7. Develop holistic management plans for critical nesting and foraging habitats within existing legislation, taking into account the recommendations of this Recovery Action Plan.

8. Provide for the long-term protection of important sea turtle habitats, such as Anegada and the East End of Tortola, and hire and train wardens to oversee such areas to enforce compliance with appropriate regulations.

9. Improve enforcement by soliciting the assistance of Fisheries Extension Assistants to oversee compliance at landing sites; support the efforts of the NPT Wardens to enforce sea turtle conservation regulations within the boundaries of the NPT system; support the creation of a Division of Enforcement within the MNRL/CFD.

10. Provide training opportunities for field personnel in data collection techniques. Whenever possible, encourage persons to attend relevant training

programmes overseas (such as the training course offered at Tortuguero, Costa Rica) or visit ongoing research projects in neighbouring islands (such as Sandy Point National Wildlife Refuge, St. Croix; Pasture Bay, Long Island, Antigua).

11. Host workshops for volunteers, SCUBA dive operators, yacht and charter-boat crews, etc. to provide training in sea turtle identification. This activity will promote accurate reporting of sea turtle nesting and at-sea sightings to the CFD, as well as enhance public awareness of depleted sea turtle stocks. Provide volunteers with log books.

12. Record sightings of sea turtles as part of ongoing coral reef and sea grass monitoring programmes. Data sheets will be designed for this purpose, and participants will be trained in the identification of sea turtle species.

13. Host "Town Meetings" on major islands for fishermen in order to provide them with information on sea turtle biology and conservation and to solicit their support for a ban on turtle fishing.

14. Expand the existing environmental education programme for schools and the general public by purchasing audio-visual materials and literature on sea turtle biology and conservation, designing a sea turtle identification poster to aid the public in reporting sea turtle sightings, reprinting the WIDECAST brochure "Sea Turtles of the British Virgin Islands" (revising it as necessary), producing a sea turtle conservation poster, and placing a sea turtle display at the airport.

These activities, which will be coordinated by the CFD, may be summarized as follows:

Activity	**Year 1**	**2**	**3**	**4**	**5**
Determine size/number turtles caught during open season; market surveys	X	X			
Host "Town Meetings" for fishermen	X				
Revise turtle legislation to fully protect trunk turtles and adults of other species; revise CCM Act	X				
Revise turtle legislation to fully protect all species of sea turtle at all times; pass CCM Act		X			

continued . . .

Activity	**Year 1**	**2**	**3**	**4**	**5**	
Purchase turtle nets from fishermen	X	X				
Comprehensive nesting beach surveys	X	X	X	X	X	
Ongoing marine habitat surveys	X	X	X	X	X	
Ongoing personnel training, workshops	X	X	X	X	X	
Ongoing reporting of sightings by volunteer network	X	X	X	X	X	
Ongoing environmental awareness; acquire A/V materials, literature	X	X	X	X	X	
Appointment/training of two Wardens or existing Fisheries Inspectors	X	X				
Reprint "Sea Turtles of the BVI" brochure		X				
Distribute sea turtle conservation poster		X				
Develop sea turtle display at airport		X				
Acquisition of field and camping equipment for survey work		X	X	X		
Tagging studies of green and hawksbill turtles in nesting and feeding areas			X	X	X	
Telemetry studies to determine foraging and and inter-nesting movements			X	X		
Compile existing data, formulate management plans for critical nesting areas				X	X	X

4.64 Results and outputs

Results and outputs of the proposed five-year Sea Turtle Conservation Programme can be summarized as follows:

1. Comprehensive legislation will be in place for the protection of sea turtles and their habitats.

2. Index beaches (important nesting areas) will be identified to serve as a focus for conservation and management activities.

3. A network of volunteers will have been identified to collect data on nesting, hatching, nest fate, and observations of turtles at sea. Annual workshops will be convened for the purpose of training these volunteers.

4. A Manual will be developed describing how to conduct beach surveys, complete sightings data forms, etc.

5. Annual reports will be published by the CFD summarizing data collected during daily ground surveys of known nesting beaches, as well as sea turtle sightings accumulated during marine habitat surveys.

6. One workshop will be convened for the purpose of training tagging personnel, and annual reports will be published by the CFD summarizing results from tagging projects.

7. A comprehensive report will be published by the CFD summarizing data collected during interviews with turtle fishermen and market surveys.

8. All turtle nets identified in Fisheries Division frame survey will be purchased or otherwise removed from commission; three "Town Meetings" will be convened to involve fishermen in sea turtle conservation efforts.

9. Management plans will be developed for at least three important sea turtle nesting areas and two important foraging areas; these will be based on recommendations provided in this Recovery Action Plan.

10. Two permanent CFD staff members will have received formal training in sea turtle conservation and management.

11. A video will be produced, oriented to the tourist industry, for the purpose of educating visitors about regulations concerning the marine environment and opportunities to participate in marine surveys.

12. The *Sea Turtles of the British Virgin Islands* brochure will be reprinted and distributed.

13. A sea turtle conservation poster will be produced.

14. The Educational Packet developed for BVI teachers will be revised and distributed. A Sea Turtle study unit will be designed by the CFD and pro-

vided to the Department of Education for integration into the standard curriculum; the unit will include audio-visual materials, background information for teachers, and follow-up activities for students.

15. A colourful display in a prominent location, such as at the airport and/or cruiseport, will be in place to alert visitors of the endangered status of sea turtles and the rules pertaining to their conservation in the BVI.

4.65 Budget

Financial support for the Sea Turtle Conservation Programme is needed. The CFD will actively seek support for the activities described above. Proposals will be submitted to WWF-UK, OECS-NRMU, and other potential donors. Three project proposals were submitted in March 1992 to the Chairman of the IUCN/SSC Marine Turtle Specialist Group for inclusion in the upcoming "Global Action Plan for Marine Turtles". These brief proposals described the need for (1) a comprehensive survey of nesting hawksbill and green turtles, (2) a comprehensive survey of nesting leatherback turtles, and (3) monitoring sea turtle (family Cheloniidae) populations in the BVI. The Global Action Plan will provide potential donors with a description of sea turtle research and conservation projects around the world seeking financial assistance. WIDE-CAST will support the CFD in its fund-raising efforts. The projected costs to implement a five-year BVI Sea Turtle Conservation Programme are as follows:

Item	**D/G ***	**Yr 1**	**2**	**3**	**4**	**5**	**Total US$**
Wages: wardens - 2 wardens @ $250/mo, 12 mo/yr	G	6000	6000	6000	6000	6000	30000
Wages: trainees - 8 students @ $2500/3mo in field, 1mo in office (3 yr)	G	20000	20000	20000	---	---	60000
Wages: taggers - 3 students (as above)	D	---	---	7500	7500	7500	22500
Student training	G	2000	2000	2000	2000	2000	10000
Transport to/from study sites	D	5000	5000	5000	1000	1000	17000
Accommodations/ food for students	D	16000	16000	16000	16000	16000	80000

Budget, *continued*.

Item	**D/G ***	**Yr 1**	**2**	**3**	**4**	**5**	**Total US$**
Tents - 5 @ $160	D	800	---	---	---	---	800
Tags/pliers	D	---	---	100	100	100	300
	G	---	---	100	100	100	300
Communication (radios)	D	800	---	800	---	---	1600
Stoves - 5 @ $135	D	675	---	---	---	---	675
Misc (maps, first	D	400	400	400	---	---	1200
aid, etc.)	G	---	---	---	400	400	800
Dinghy & engine - 2 @ $5000	D	10000	---	---	---	---	10000
Dinghy fuel	G	500	500	500	500	500	2500
Buy-back nets	D	2000	1000	---	---	---	3000
Training and	D	2000	2000	2000	2000	2000	10000
workshops	G	1000	1000	1000	1000	1000	5000
Educ. materials	D	1000	1000	1000	1000	1000	5000
Turtle poster	D	2000	---	---	2000	---	4000
Airport display	D	1500	---	---	---	---	1500
Contingencies	D	4218	2540	3280	2960	2760	15758
(10%)	G	2950	2950	2960	1000	1000	10860
TOTAL/YR		78843	60390	68640	43560	41360	
GRAND TOTAL							US$ 292793

Donor contribution US$ 173333
Government contribution US$ 119460

* D = Donor contribution; G = Government contribution

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Table 1. Summary of sea turtle nesting records in the British Virgin Islands. Green (Chelonia mydas) = G; Hawksbill (Eretmochelys imbricata) = H; Leatherback (Dermochelys coriacea) = L; G/H indicates that the species in question is definitely not a Leatherback, a conclusion often based on a crawl <1.5 m wide. Species listed in parentheses are suspected to nest but have not actually been observed; a question mark in parentheses indicates that nesting may occur but species is unknown. "WATS I" refers to the BVI National Report to the 1983 Western Atlantic Turtle Symposium (Fletemeyer, 1984). "ECNAMP" data were taken from Resource Data Maps prepared by the Eastern Caribbean Natural Areas Management Programme (ECNAMP, 1980). Annual population estimates are fairly well defined for Leatherback turtles, but population size is not known for either Green turtles or Hawksbills, nor is it likely that the latter two were consistently or accurately differentiated on the basis of their crawls on the nesting beach prior to 1990 (as evidenced by the code "G/H" seen below on numerous occasions). Clarification is greatly needed in this regard. CFD = Conservation and Fisheries Department, Ministry of Natural Resources and Labour. Beach length measured in kilometers (km).

Beach	**Length**	**Species**	**Source**
ANEGADA			
Creque's Restaurant	--	L	nester disoriented by street lamp; found dead 14 May 1988 (Lettsome, 1988)
"west end beaches" where there are breaks in reef	--	L	CFD staff
Pomato Pt/ West End	3.2	G, H, L	WATS I (aerial survey, ECNAMP), residents
		G	Ruffling Pt: 1 nest, 12 Jun 1992 (Sam Davies, CFD)
West End/ Cow Wreck	3.4	H	WATS I (aerial survey)
		H	4 nests, 21 Nov 1992 survey; 2 nests, 4 Dec 1992 survey (B. Bailey)
Cow Wreck/ Windlass	3.5	G/H	WATS I (ECNAMP)
		H	recent nest, 20-21 Nov 1992 survey (B. Bailey)
Windlass/ Soldier Pt	3.0	G, H	WATS I (fishermen)
Soldier Pt/ Loblolly Pt	3.4	G/H	WATS I (ECNAMP)
		G	6 old nests, 6 Nov 1992 (K. Eckert); 1 new nest, 21 Nov 1992 (B. Bailey)
		H	3 nests, 20-21 Nov 1992 survey; 2 "old", 1 recently hatched (B. Bailey)

Table 1, *continued*.

Beach	Length	Species	Source
Soldier Pt/ Loblolly Pt (continued)		H	2 nests, 4 Dec 1992 survey (B. Bailey)
Loblolly Pt/ East Pt	6.9	G, H	WATS I (aerial survey, fishermen, ECNAMP)
		G	15 nests, 20-21 Nov 1992 survey (B. Bailey)
		H	24 nests, 20-21 Nov 1992 survey (B. Bailey)
		H	4 nests, 5 Dec 1992 survey (B. Bailey)
BEEF ISLAND			
1. Well Bay	0.2	(G), H	WATS I (fishermen)
		H	1 nest, 8 Sept 1990 (Hastings, 1992)
2. Bluff Bay	--	H	B. Lettsome, N. Clarke
3. Trellis Bay	0.3	(G)	WATS I
		H	WATS I (aerial survey)
		H	1 crawl, 20 Oct 1991 (Hastings, 1992)
		L	N. Brathwaite (hatching, 16 Jan 1991)
4. Long Bay	0.4	G, H	WATS I (aerial survey, ECNAMP)
		H	M. Doran (hatch report, Jan 1986)
		H	T. Davies (hatch report, Mar 1987)
		H	1 crawl, 22 Aug 1990 (Hastings, 1992)
		H	nest poached, 13 Mar 1992
		L	B. Lettsome, pers. obs.
		L	hatching; Feb 1990, May 1992 (CFD data)
BUCK ISLAND			
West Beach	--	no data	
North Beach	--	no data	

Table 1, *continued*.

Beach	Length	Species	Source
COCKROACH ISLAND			
No beaches suitable for nesting			
COOPER ISLAND			
Manchioneel	0.7	(G), (H)	WATS I (fishermen)
Coral Bay	--	H	W. Leonard, pers. comm.
Hallover's Pond	0.9	G/H	WATS I (ECNAMP)
DEAD CHEST ISLAND			
unnamed	--	H	W. Leonard, pers. comm.
EUSTATIA			
North End Beach	0.6	(?)	WATS I
FALLEN JERUSALEM			
North Lee Bay	0.1	H	W. Leonard, pers. comm.
		H	1 nest, 7 Oct 1992 (CFD)
FRENCHMAN'S CAY			
No beaches suitable for nesting			
GEORGE DOG			
Crabbe Hill	0.2	(?)	WATS I
GINGER ISLAND			
South Bay	0.4	H	W. Leonard, pers. comm.
Wedego Bay	0.2	H	*ibid.*
The Sound Beach	0.3	H	*ibid.*
Grape Tree Landing	--	H	*ibid.*
GREAT CAMANOE			
Cam Bay	0.4	G/H	WATS I (fishermen)

Table 1, *continued*.

Beach	Length	Species	Source
Cam Bay		H	H. Lima (CFD), pers. obs.
(continued)		H	5 nests (3 poached), Oct-Nov 1992 (CFD data)
Low Bay	0.2	(?)	WATS I; "none in 10 yrs" (B. Bailey, pers. comm.)
Lee Bay	0.3	(?)	WATS I
North Bay	0.4	G/H	ECNAMP
		H	B. Lettsome, pers. obs.
		H	A. Freeman: 2 nests late Aug, 4 early Sept 1990
GREAT DOG			
North Bay	0.4	G/H	ECNAMP
South Bay	0.5	G/H	*ibid*.
GREAT TOBAGO			
Camp Bay	0.1	(G), H	WATS I (fishermen)
GREAT THATCH ISLAND			
The Hollow	0.5	(G), H	WATS I
GREEN CAY			
No beaches suitable for nesting			
GUANA ISLAND			
White Bay	0.6	G/H	WATS I, residents
Muskmellon Bay	0.5	G/H	WATS I (fishermen)
North Beach	0.9	H	A. Freeman: 10 nests mid-Sept; 6 nests 25-27 Oct 1990
		H	10 nests plus 2 non-nesting crawls, Jun-Oct; 1 hatch, 16 Aug 1992 (CFD data)
		G	nest, 30 Oct 1992 (CFD)
Dig-a-Low Beach	--	G/H	crawl, 12 Apr 1989 (CFD)

Table 1, *continued*.

Beach	Length	Species	Source
JOST VAN DYKE			
1. Saddle Bay	0.2	(?)	WATS I
2. White Bay	0.6	G	WATS I (aerial survey; 3 crawls)
		H	nest, 13 Oct 1991; nest, 19 Jul 1992 (CFD)
3. Upper Dog Hole	0.4	(?)	WATS I
4. Great Harbour Beach	0.3	G/H	ECNAMP
5. East End Beach	0.2	(?)	WATS I
6. Long Bay	0.6	(?)	*ibid.*
7. North Side Bay	0.3	(?)	*ibid.*
LITTLE CAMANOE			
East End/ South Bay	--	G, (H)	WATS I (aerial survey)
		H	2 nests, 3-7 Oct 91 (Hastings, 1992)
		H	1 nest, 8 Jun 1992 (CFD)
LITTLE JOST VAN DYKE			
Crawl Beach	--	G/H	B. Lettsome, pers. obs.
LITTLE THATCH ISLAND			
Northwest coast	--	H	B. Selzer, pers. comm.
LITTLE TOBAGO			
No beaches suitable for nesting			
MARINA CAY			
Jetty beach	--	H	hatchling found disoriented by lights, 30 Oct 1992; unlikely it hatched there
MOSQUITO ISLAND			
Manchioneel	0.4	G/H	WATS I (fishermen)

Table 1, *continued*.

Beach	Length	Species	Source
NECKER ISLAND			
Devil Hill Bay	0.4	G/H	WATS I (fishermen)
West End Beach	--	G, (H)	WATS I (aerial survey)
NORMAN ISLAND			
Buff Bay	0.7	G/H	WATS I (fishermen)
PELICAN ISLAND			
unnamed	--	H	H. Lima (CFD), pers. obs.
PETER ISLAND			
Little Reef Bay	0.3	(?)	WATS I
		(H)	B. Lettsome
Big Reef Bay	--	(H)	B. Lettsome
Deadman Bay	0.8	G/H	WATS I (fishermen, divers)
		L	"Resource" magazine (Oct/Dec 1985): nester killed
Sprat Bay	0.6	(?)	WATS I
Rock Hole/ Rogers Pt	--	(H)	B. Lettsome
West of Key Pt	--	(H)	*ibid.*
White Bay	--	(H)	*ibid.*
Sand Pierre Bay	0.6	G/H	ECNAMP
Stoney Bay	0.9	(?)	WATS I
PRICKLY PEAR			
Opuntia Pt/ Asbestos Pt	1.6	G/H	WATS I (fishermen, ECNAMP)
		G	1 nest, 21 Sept 1990 (Hastings, 1992)
Bandy Point (=Prickly Bay)	1.4	G/H	WATS I (fishermen)
Vixen Point	0.9	(?)	WATS I

Table 1, *continued*.

Beach	Length	Species	Source
ROUND ROCK			
No beaches suitable for nesting			
SANDY CAY			
Sandy Cay Beach	0.7	G, H	WATS I (aerial survey)
		L	B. Lettsome, N. Clarke
		L	crawl report to CFD, 5 May 1990
SANDY SPIT			
Sandy Spit Beach	0.05	G, H	WATS I (aerial survey)
		H	nest report to CFD, 16 May 1990
		H	3 crawls, Jun 1992 (CFD)
SALT ISLAND			
South Bay	0.3	H	W. Leonard, pers. comm.
Salt Island Bay	0.2	H	*ibid*.
Sound Beach	0.3	H	*ibid*.
SCRUB ISLAND			
North Bay	0.3	G/H	ECNAMP
		H	A. Freeman: 2 nests Aug; 1 nest mid-Sept 1990
		H	B. Bailey: tracks (21 Sept 1990); poached nest, egg shells found, 22 Oct 1990
		H	crawl: 21 Aug 90; 2 nests: 25 Sept, 12 Nov 1991 (Hastings, 1992)
		H	hatch, 19 Jan 1992 (CFD)
West End beaches	--	H	W. Robinson, pers. obs.
		H	A. Freeman: 1 crawl, mid-Oct 1990
		H	1 nest, 10 Aug 1991 (Hastings, 1992)

Table 1, *continued*.

Beach	Length	Species	Source
North West Beach	--	H	"nests", Nov 1991 (Hastings, 1992)
		H	2 nests: Jan 1992 (CFD)
		H	5 nests hatched, March 1992 (CFD)
		H	1 nest: 5 Nov 1992 (CFD)
West Corner Beach	--	H	4+ crawls, Sep-Nov 1991 (Hastings, 1992)
South West Beach	--	H	hatch, 2 Feb 1992 (CFD)
SEAL DOG ISLANDS			
No beaches suitable for nesting			
TORTOLA			
5. Lloyd's Beach	--	H	B. Lettsome
6. Little Bay Lambert	0.5	G	WATS I (aerial survey)
		H, L	WATS I
		L	crawl, 22 May 1992 (CFD)
7. Long Bay Lambert	1.4	L	nester killed, May 1986
		L	B. Lettsome: 2 crawls (21 Apr, 22 May 1986
		L	B. Lettsome, N. Clarke: crawls (Apr-May 1987)
		L	nest, 17 May 1988 (Lettsome, 1988)
		L	A. Freeman: 2 nests (3, 7 Apr 1991)
		L	1 nest, 15 Apr 1991 (Hastings, 1991)
		L	nester killed, 28 Apr 1991
		G, H	WATS I (ECNAMP)
8. Josiahs Bay	0.9	L	B. Lettsome, K. Pickering: crawls (Apr-Jun 1987)
		L	nester killed, May(?) 1987
		L	crawl, 26 May 1992 (CFD)
		G, H	WATS I (ECNAMP)
9. Cooten Bay	--	H	Halstead Lima, pers. obs.

Table 1, *continued*.

Beach	Length	Species	Source
10. Rogues Bay	--	L	B. Lettsome: 2 crawls (3, 12 May 1986)
		L	B. Lettsome, N. Clarke: 2 crawls, May 1987
		L	A. Freeman: 1 nest, 28 Mar 1991
		L	nest poached, 15 May 1992; crawl 25 May 1992 (CFD data)
11. Trunk Bay	0.8	L	B. Lettsome: 3 crawls (7 Apr; 3, 15 May 1986)
		L	B. Lettsome, N. Clarke: crawls, Apr-May 1987
		L	3 crawls: 15, 22 May; 14 Jun 1990 (Morris, 1990)
		L	1 nest: 28 March 1991 (Hastings, 1991)
		L	nester killed, 26 Apr 1991
		L	A. Freeman: 1 crawl, 18 Apr 1991
		L	crawl, 30 June 1992 (CFD)
12. Cooper Bay	0.7	G/H	WATS I (fishermen)
13. Larmer's Bay	1.2	H	A. Freeman: 1 nest, early Sept 1990
		G, H	WATS I
14. Brewer's Bay	--	H	hatch, Jan 1986 (NPT data)
15. Cane Garden Bay	1.8	G/H	WATS I (ECNAMP)
16. Capoon's Bay	--	G/H	B. Lettsome, pers. obs.
		L	29 Apr 1991, nester caught for killing; turtle released after public outcry
17. Long Bay/ Belmont Bay	2.2	H	4 crawls, 1 Sept-10 Nov; 2 hatches (M. Booth in Hastings, 1992)
		L	H. Cuff: 1 crawl, 8 April 1991; M. Booth later reported hatchlings
		L	M. Booth: 3 crawls, 14-15 April 1991; hatching, 23 Jun 1991 (Hastings, 1991)

Table 1, *continued*.

Beach	Length	Species	Source
18. Smuggler's Cove	--	G, H	C. Arneborg, pers. comm.
19. Sophie Bay	--	G/H	ECNAMP
		G	L. Blok: adults nesting
		G	G. Blok: hatch, June 1984
		G	nest, 6 Sep 1991 (Hastings, 1992)
20. Brandywine Beach	0.6	G/H	WATS I (fishermen, ECNAMP)
21. Halfmoon Bay	0.8	G/H	residents
22. Hodges Bay (=Money Bay/Bar Bay)	0.8	G/H	WATS I (fishermen)
23. Fat Hogs Bay	--	L	fishermen; nester killed, 1982
			comment: beach has been lost to dredging, mining
"north coast"	--	L	nester killed (?), May 1990
VIRGIN GORDA			
1. Crook's Bay	1.1	G/H	ECNAMP
2. Little Trunk Bay	--	G/H	ECNAMP
3. St. Thomas Bay	1.3	G, (H)	WATS I (aerial survey)
4. Savannah Bay	1.1	(?)	WATS I
5. Tetor/ Mt. Trunk Bay	1.0	L	WATS I (fishermen)
6. Long Bay/ Mt. Point	--	G/H	ECNAMP
7. Deep Bay	0.3	(?)	WATS I
		L	nest, Aug 1990; hatch, Oct (Morris, 1990)
8. Oil Nut Bay	--	G/H	*ibid*.
9. Bercher's Bay	--	L	C. Preece: 2 nests, Sept 1990 (hatch, mid-Oct)
		H	nests, 12 Sept 1990 (Hastings, 1992)
		H	nest, 9 Aug 1992 (CFD)
		G	2 nests, 7 & 21 Aug 1992 (CFD data)

Editor's Note -- Numbered beaches are indicated in Figure 3.

Table 2. The results of 1990-1992 (as of 8 December 1992) field surveys for green (Chelonia mydas) and hawksbill (Eretmochelys imbricata) sea turtle nests. Eighteen (18) beaches on six islands were surveyed in 1990, 23 beaches on 10 islands in 1991, and 14 beaches on 11 islands, in addition to November surveys of Anegada, in 1992. Data were collected for the Conservation and Fisheries Department (Ministry of Natural Resources and Labour) by volunteers. Dates are survey dates, not nesting dates.

Beach	Date	Observer	Activity	Species
ANEGADA				
Ruffling Pt	12 Jun 1992	S. Davies	1 nest	green
West End/Soldier Pt	20 Nov 1992	B. Bailey	5 nests	hawksbill
Soldier Pt/Loblolly Pt	Jul-Aug 1992	*Footloose*	2 crawls	green
	06 Nov	K. Eckert	4 crawls	green
	21 Nov	B. Bailey	1 crawl	green
	21 Nov	"	3 nests	hawksbill
	04 Dec	"	4 nests	hawksbill
Loblolly Pt/East Pt	20 Nov 1992	"	15 nests	green
	20 Nov	"	24 nests	hawksbill
	05 Dec	"	4 nests	hawksbill
BEEF ISLAND				
Well Bay	08 Sept 1990	R. Evans	nest	hawksbill
	30 Sept	E. Evans	none	--
Bluff Bay	25 Aug 1990	"	"	--
	08 Sept	"	"	--
Trellis Bay	20 Oct 1991	R. Jacobs	crawl	hawksbill
	30 Oct	"	none	--
	15 Nov	"	"	--
Long Bay	22 Aug 1990	R. Evans	crawl	hawksbill
	25 Aug	"	none	--
	07 Sept	"	"	--
	30 Sept	E. Evans	"	--
	19 Oct 1991	R. Evans	none	--
	23 Oct	"	"	--
	03 Nov	"	"	--
	13 Mar 1992	E. Evans	poached nest	hawksbill
	08 Aug	R. Evans	none	--
	16 Aug	"	"	--

Table 2, *continued*.

Beach	Date	Observer	Activity	Species
EUSTATIA				
North End Beach	01 Nov 1991	F.&D. Woods	none	--
	04 Nov	B.&D. Woods	"	--
	22 Nov	B.&F. Woods	"	--
	25 Nov	F.&D. Woods	"	--
FALLEN JERUSALEM				
North Side	07 Oct 1992	F. Woods	crawl	hawksbill
GINGER ISLAND				
Wedgeo Bay	06 Oct 1991	B. Bailey	none	--
The Sound	06 Oct 1991	"	"	--
GREAT CAMANOE				
Cam Bay	30 Sept 1990	B. Bailey	none	--
	07 Oct	"	"	--
	13 Oct	"	"	--
	22 Oct	"	"	--
	01 Sept 1991	"	"	--
	08 Sept	"	"	--
	14 Sept	"	"	--
	19 Sept	"	"	--
	22 Sept	"	"	--
	25 Sept	"	"	--
	30 Sept	"	"	--
	03 Oct	"	"	--
	22 Oct	"	"	--
	09 Oct 1992	CFD staff	2 nests (both poached)	hawksbill
	02 Nov	B. Bailey	3 nests (1 poached)	--
GUANA ISLAND				
North Beach	23 Jun 1992	W. Plachta	nest	hawksbill
	09 Jul	"	nest	hawksbill
	24 Jul	"	nest	hawksbill

Table 2, *continued*.

Beach	Date	Observer	Activity	Species
North Beach (continued)	16 Aug	J. Overing	hatching	hawksbill
	18 Aug	W. Plachta	nest	hawksbill
	26 Aug	"	nest	hawksbill
	31 Aug	"	nest	hawksbill
	15 Sep	J. Overing	crawl	hawksbill
	03 Oct	W. Plachta	nest	green
	11 Oct	"	crawl	hawksbill
	12 Oct	"	2 nests	hawksbill
	25 Oct	"	nest	hawksbill
	26 Oct	"	nest	hawksbill
JOST VAN DYKE				
White Bay	13 Oct 1991	K. Klein	nest	hawksbill
	21 Oct	"	none	--
	22 Oct	"	"	--
	23 Oct	"	"	--
	19 Jul 1992	A. Venner	nesting	hawksbill
LITTLE CAMANOE				
South Beach	03 Oct 1991	B. Bailey	poached nest	hawksbill
	07 Oct	"	nest	hawksbill
East End Bay	08 Jun 1992	"	nest	hawksbill (?)
MARINA CAY				
Jetty Beach	30 Oct 1992	C. Petrovic	hatchling found on beach, washed ashore?	hawksbill
PETER ISLAND				
Reef Bay	21 Sept 1991	B. Hull	none	--
Deadman's Bay	21 Sept 1991	"	"	--
White Bay	21 Sept 1991	"	"	--
PRICKLY PEAR				
Opuntia Pt	02 Sept 1990	J. Overing	none	--
	21 Sept	"	nest	green turtle

Table 2, *continued*.

Beach	Date	Observer	Activity	Species
Opuntia Pt	25 Oct 1991	B.&F. Woods	none	--
(continued)	28 Oct	B.&D. Woods	"	--
SANDY CAY				
Sandy Cay Beach	02 Jun 1992	H. Lima	nest	hawksbill
	09 Jun	S. Davies	nest	hawksbill
	26 Jun	"	crawl	unknown
SCRUB ISLAND				
North Bay	21 Aug 1990	B. Bailey	crawl	hawksbill
	30 Sept	"	none	--
	07 Oct	"	"	--
	13 Oct	"	"	--
	22 Oct	"	"	--
	01 Sept 1991	"	"	--
	08 Sept	"	"	--
	14 Sept	"	"	--
	19 Sept	"	"	--
	25 Sept	"	poached nest	hawksbill
	12 Nov	"	crawl	hawksbill
	20 Nov	"	none	--
	19 Jan 1992	"	hatching	hawksbill
West End Bay	07 Oct 1990	"	none	--
	13 Oct	"	"	--
	19 Sept 1991	"	"	--
	08 Oct	"	"	--
	19 Sept	"	"	--
	17 Feb 1992	"	"	--
	12 Mar	"	"	--
North West Beach	22 Oct	"	nest	hawksbill
	12 Nov 1991	"	crawl	hawksbill
	20 Nov	"	crawl	hawksbill
	09 Jan 1992	"	nest	hawksbill
	14 Jan	"	crawl	hawksbill
	03 Mar	"	hatching	hawksbill
	09 Mar	"	hatching	hawksbill
	14 Mar	"	hatching	hawksbill
	16 Mar	"	hatching	hawksbill

Table 2, *continued*.

Beach	Date	Observer	Activity	Species
North West Beach (continued)	29 Mar 1992	B. Bailey	hatching	hawksbill
	05 Nov	"	nest	hawksbill
West Corner Beach	01 Sept 1991	B. Bailey	none	--
	08 Sept	"	"	--
	14 Sept	"	"	--
	19 Sept	"	nest	hawksbill
	01 Oct	"	none	--
	03 Oct	"	crawl	hawksbill
	08 Oct	"	nest	hawksbill
	22 Oct	"	none	--
	12 Nov	"	2 nests	hawksbill
	15 Nov	"	crawl	hawksbill
	17 Nov	"	none	--
	18 Nov	"	"	--
	20 Nov	"	"	--
	17 Feb 1992	"	hatching	hawksbill
	12 Mar	"	hatching	hawksbill
TORTOLA				
Trunk Bay	01 Sept 1990	J. Queern	none	--
	05 Sept	"	"	--
	08 Sept	"	"	--
	19 Sept	"	"	--
	24 Sept	"	"	--
	28 Sept	"	"	--
	16 Oct	"	"	--
Brewer's Bay	22 Aug 1990	F. Dugdale	"	--
	29 Aug	"	"	--
	11 Sept	"	"	--
	18 Sept	"	"	--
	21 Sept 1991	"	"	--
	28 Sept	"	"	--
	05 Oct	"	"	--
	21 Aug 1992	D. Dugdale	"	--
	08 Sep	"	"	--
	12 Sep	"	"	--
	24 Sep	"	"	--
	01 Oct	"	"	--

Table 2, *continued*.

Beach	Date	Observer	Activity	Species
Cane Garden Bay	21 Sept 1991	F. Dugdale	none	--
	28 Sept	"	"	--
	05 Oct	"	"	--
Capoon's Bay	04 Sept 1990	J. Green	none	--
	11 Sept	"	"	--
	25 Sept	"	"	--
	02 Oct	"	"	--
Sebastin's	21 Sept 1991	R. Kiel	"	--
Long Bay Belmont	01 Sept 1991	M. Booth	nest	hawksbill
	13 Sept	"	nest	hawksbill
	19 Sept	"	crawl	hawksbill
	27 Oct	"	hatching	hawksbill
	10 Nov	"	hatching	hawksbill
Smuggler's Cove	13 Sept 1991	R. Young	none	--
	20 Sept	"	"	--
	08 Oct	"	"	--
	16 Oct	"	"	--
	21 Oct	"	"	--
	30 Oct	"	"	--
	10 Nov	"	"	--
Sophie Bay	06 Sept 1991	M. Starkey	nest	green turtle
Brandywine Bay	04 Sept 1990	P. Rogers	none	--
	09 Sept	"	"	--
	16 Sept	"	"	--
	23 Sept	"	"	--
	30 Sept	"	"	--
Hodges Bay	04 Sept 1990	"	"	--
	09 Sept	"	"	--
Fat Hogs Bay	09 Sept 1990	"	"	--
	16 Sept	"	"	--
	23 Sept	"	"	--
	30 Sept	"	"	--
Witches Brew	09 Sept 1990	P. Rogers	"	--
	13 Sept	V. Morris	"	--
	16 Sept	P. Rogers	"	--
	18 Sept	W. Morris	"	--
	22 Sept	V. Morris	"	--
	23 Sept	P. Rogers	"	--
	26 Sept	W. Morris	"	--
	29 Sept	V. Morris	"	--
	30 Sept	P. Rogers	"	--

Table 2, *continued*.

Beach	Date	Observer	Activity	Species
Witches Brew (continued)	06 Oct 1990	V. Morris	none	--
	13 Oct	"	"	--
VIRGIN GORDA				
St. Thomas Bay	24 Aug 1990	J. Queern	none	--
	01 Sept	"	"	--
	05 Sept	"	"	--
	08 Sept	"	"	--
	19 Sept	"	"	--
	24 Sept	"	"	--
	28 Sept	"	"	--
	02 Oct	"	"	--
	16 Oct	"	"	--
Savannah Bay	24 Aug 1990	"	"	--
	08 Dec 1992	B. Bailey	nest	hawksbill
Oil Nut Bay	26 Aug 1990	J. Overing	none	--
Bercher's Bay	12 Sept 1990	"	2 nests	hawksbill
	07 Aug 1992	R. George	nest	green
	09 Aug	"	nest	hawksbill
	21 Aug	"	nest	green

Table 3. Results of April-June field surveys for leatherback sea turtle (Dermochelys coriacea) nesting, 1986-1992, and other relevant observations. Data are from B. Lettsome and N. Clarke (1986-1987, unpubl.), Lettsome (1988), Cambers and Lima (1989), Morris (1990), Hastings (1991), and Conservation and Fisheries Department (1992, unpubl. data). Confirmation of egg-laying was not possible (unless hatchlings were observed), but it is assumed that eggs were laid in the majority of cases.

Date	Turtle Activity	Location
1986		
07 April	1 crawl	Trunk Bay, Tortola
21 April	1 crawl	Long Bay Lambert
03 May	1 crawl	east end of Rogues Bay
03 May	1 crawl	Trunk Bay, Tortola
09 May	no crawls	
12 May	1 crawl	Rogues Bay
15 May	1 crawl	west end Trunk Bay, Tortola
17 May	no crawls	
22 May	1 crawl	east end of Long Bay Lambert
(May?)	nester killed	Long Bay Lambert
1987		
April	2 crawls	Josiahs Bay
12 May	1 crawl	middle of Rogues Bay
15 May	1 crawl	west end of Trunk Bay
19 May	no crawls	
22 May	1 crawl	east end of Long Bay Lambert
27 May	no crawls	
29 May	no crawls	
	nester killed	Josiahs Bay
1988«		
14 May	nester disoriented by light and found dead	southwest coast, Anegada
17 May	1 crawl	Long Bay Lambert

N.B. Cambers and Lima (1989) reported 9 nests; the reason for the discrepancy is not known.

N.B. Beach surveys were conducted mid-March to mid-June 1988; exact dates unknown.

Table 3, *continued*.

Date	Turtle Activity	Location
1989		
19 April	no crawls	N.B. Each survey included:
25 April	no crawls	
04 May	no crawls	Little Bay Lambert, Long Bay
10 May	no crawls	Lambert, Josiahs, Rogues and
19 May	no crawls	Trunk Bays (Tortola); Dig-a-Low Bay (Guana Island); and Long Bay (Beef Island), except 19 April; in addition, White, Muskmellon and North Bays (Guana Island) and Pull-and-Be-Damn Pt and South Bay (Little Camanoe) were periodically surveyed; Sandy Spit and Sandy Cay were surveyed on 19 April
1990		
02 February	hatchlings	Long Bay (Beef Island)
15 May	1 crawl	Trunk Bay, Tortola
22 May	1 crawl	Trunk Bay, Tortola
(May?)	nester killed	north coast Tortola, unconfirmed
14 June	1 crawl	Trunk Bay, Tortola
August	1 nest	Biras Creek (Virgin Gorda) -- hatchlings observed in October
N.B. In March, ground surveys were conducted of the following beaches:		Josiahs Bay and Long Bay Lambert (Tortola); Long Bay (Beef Island); the west coast of Virgin Gorda; the west (around Pomato Pt) and north coasts of Anegada
In addition, beach walks were conducted 2-3 times/week, April-June, on:		Josiahs Bay and Long Bay Lambert, Tortola; Long Bay, Beef Island
Aerial surveys were carried out twice weekly during April-July of:		Tortola, Beef Island, Peter Island Sandy Cay, Sandy Spit, Virgin Gorda, and Anegada

Table 3, *continued*.

Date	Turtle Activity	Location
1991		
16 January	hatchlings	Trellis Bay, Beef Island (leather-back hatchlings washed ashore)
28 March	nest (eggs seen)	Rogues Bay
08 April	crawl	Long Bay Belmont
14 April	crawl	Long Bay Belmont
15 April	2 crawls	Long Bay Belmont
26 April	nester killed	Trunk Bay, Tortola
28 April	nester killed	Long Bay Lambert
29 April	nester captured for killing, then released	Sebastin's, Capoon's Bay
23 June	hatchlings	Long Bay Belmont
N.B. Aerial surveys were carried out twice weekly, mid-March to mid-May, of:		Tortola, Beef Island, Peter Island Virgin Gorda and Anegada
Boat surveys were conducted weekly mid-May to mid-July of:		Tortola, Beef Island, Jost Van Dyke
Beach surveys of Long Bay Belmont, Tortola, were carried out by residents, during the nesting season (March-July)		
1992		
15 May	hatchlings	Long Bay, Beef Island
15 May	nest (poached)	Rogues Bay
22 May	crawl	Little Bay Lambert
25 May	crawl	Rogues Bay
26 May	crawl	Josiahs Bay
30 June	crawl	Trunk Bay, Tortola
N.B. Aerial surveys were carried out twice weekly, 8 May-12 June, of:		Tortola, Beef Island, Peter Island Sandy Cay, Sandy Spit, Virgin Gorda, and Anegada
Boat surveys were conducted twice weekly, 14 April-5 May and 16-30 June, of:		Tortola, Beef Island, Jost Van Dyke, and Guana Island

Table 4. Weights (lb) of sea turtles captured during two hunting trips off the western coast of Anegada, 1991-1992 open season. Data courtesy of fisherman Kenneth Faulkner.

Date	**Green turtles**	**Hawksbill turtles**
10 December 1991	84	27
	32	31
	28	31
	27	75
	41	51
	111	25
		25
9 January 1992	28	41
	53	28
	24	25
	28	
	43	

Table 5. Details obtained from 18 part-time turtle fishermen interviewed in a Fisheries Frame Survey during June-July 1991. Data courtesy of Steve Alimoso, CFD Fisheries Officer.

Location	Age	Occupation	Nets Owned	Condition
Tortola	52	fisherman	2	used
Tortola	54	fisherman	5	used
Tortola	69	fisherman	2	used
Tortola	61	farmer	4	unused
Tortola	80	fisherman	1	used
Tortola	79	shopkeeper	2	used
Tortola	64	farmer	7	unused
Tortola	33	painter	5	used
Tortola	65	fisherman	3	used
Anegada	65	fisherman	1	used
Anegada	28	fisherman	1	unused
Anegada	30	fisherman	1	used
Virgin Gorda	54	fisherman	6	used
Virgin Gorda	31	fisherman	4	used
Virgin Gorda	60	fisherman	1	used
Salt Island	65	fisherman	1	used
Peter Island	73	fisherman	2	used
Cooper Island	62	farmer	2	used

Table 6. The estimated number of leatherback (trunk) sea turtles nesting in Tortola during survey years 1987-1992 and the number known to have been killed whilst on the nesting beach.

Census year	**Crawls recorded**	**Locations (Tortola)**	**Females nesting 1/**	**Females killed**
1986	7	Trunk Bay Long Bay Lambert Rogues Bay	3	1
1987	6	Long Bay Lambert Josiahs Bay Rogues Bay Trunk Bay	4	1
1988	1	Long Bay Lambert	1	0 2/
1989	0	--	0	0
1990	5	Trunk Bay Long Bay, Beef Is "north coast"	3 3/	(1?)
1991	9	Trellis Bay, Beef Is Rogues Bay Long Bay Belmont Trunk Bay Sebastin's	2-4	2
1992	6	Long Bay, Beef Is Rogues Bay Little Bay Lambert Josiahs Bay Trunk Bay	4-5	0

1/ Estimated number of females nesting on Tortola during the year indicated. The average number of nests laid per female per year is 6, but because not all nests were recorded, determining the annual nesting population is more complicated than simply dividing the number of crawls by 6. To arrive at the estimate, the number and location of crawls were taken into account, as well as the time lapsed (females lay eggs at intervals of 9-10 days).
2/ No females were killed, but one died in Anegada after being disoriented by a security light and crawling inland.
3/ In addition to nesting reported from Tortola, a hatch was observed at Biras Creek, Virgin Gorda.

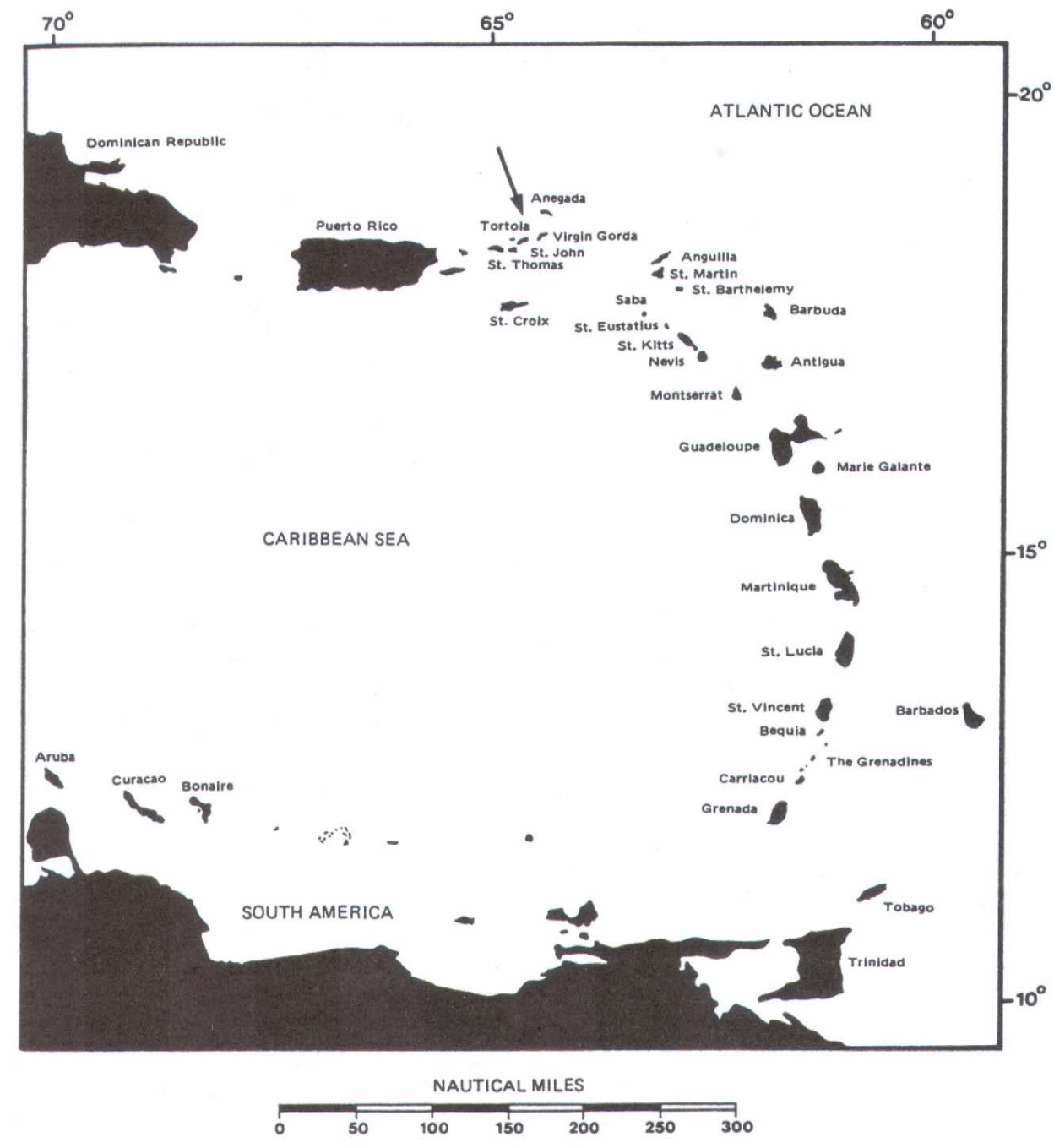

Figure 1. The British Virgin Islands are composed of more than 40 islands, islets and rocks in the northeastern Caribbean Sea.

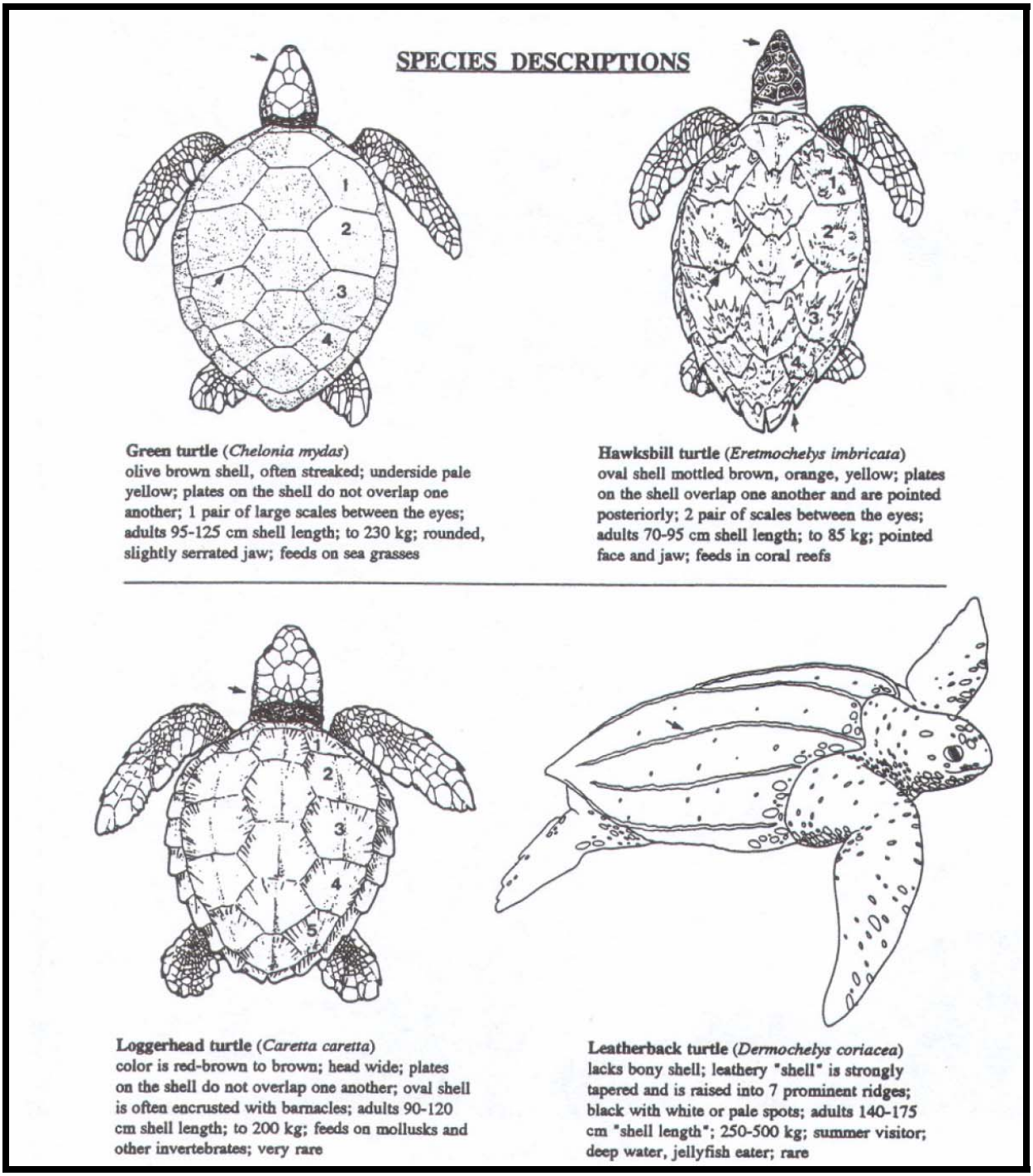

Figure 2. A guide to the sea turtles of the British Virgin Islands. Green and hawksbill turtles of various sizes are encountered year-round. The leatherback is a seasonal visitor, arriving in March or April for a four-month nesting season. The loggerhead is occasionally observed.

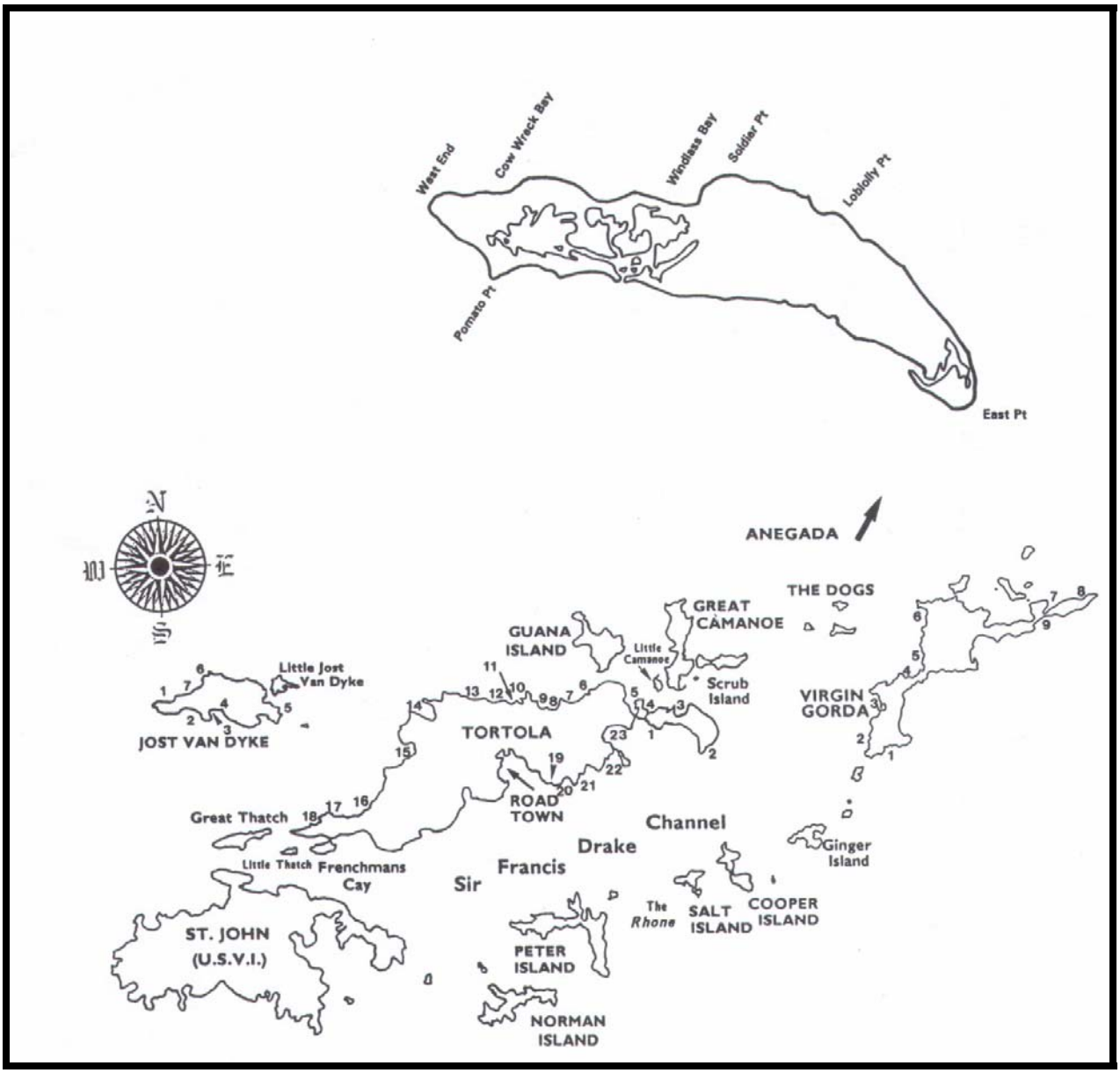

Figure 3. Potential nesting beaches on the major islands of the BVI (numbers correspond to Table 1). The northeast coast of Tortola (3-16) supports most of the leatherback nesting. Less is known about green and hawksbill nesting; Anegada is probably the most important area. Anegada is not drawn to scale.

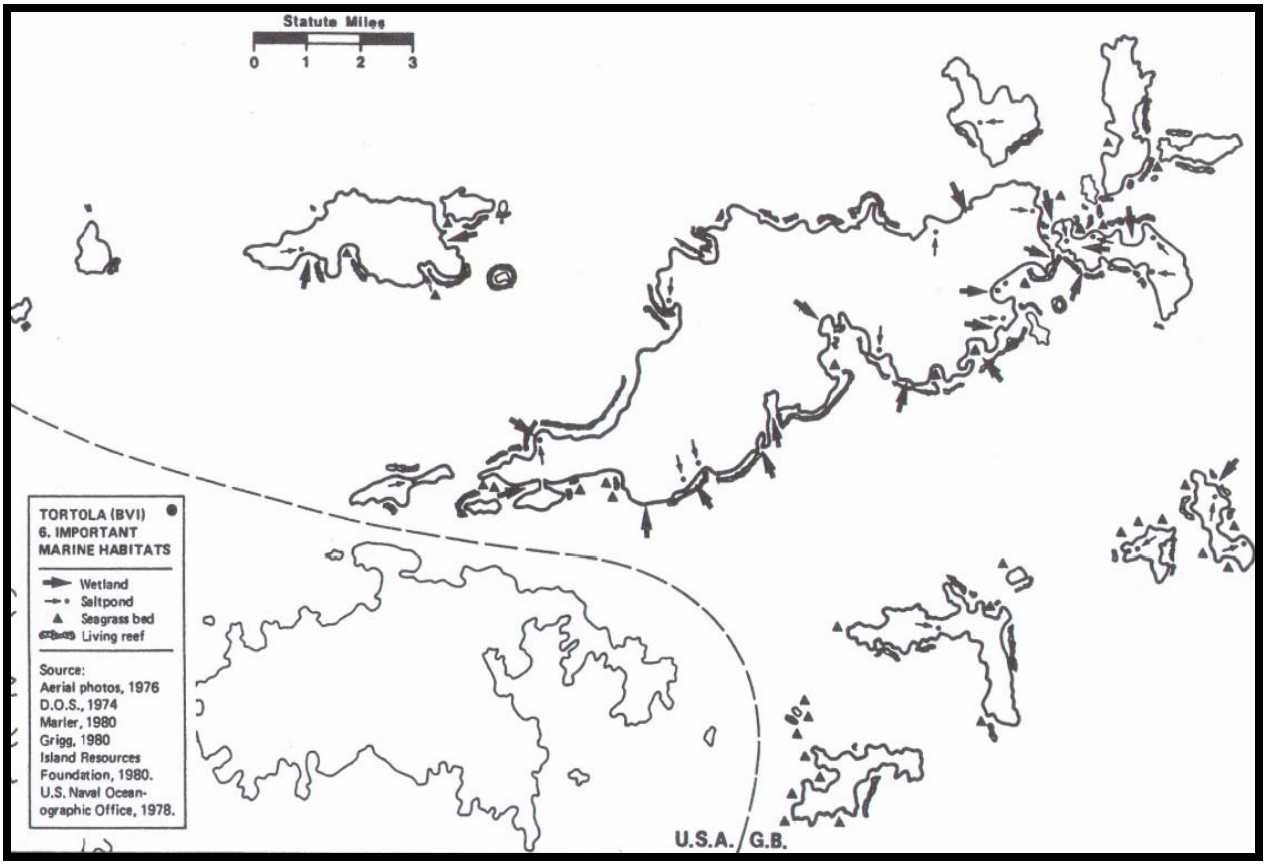

Figure 4. Sea grass and reefs around Tortola, BVI (source: ECNAMP, 1980).

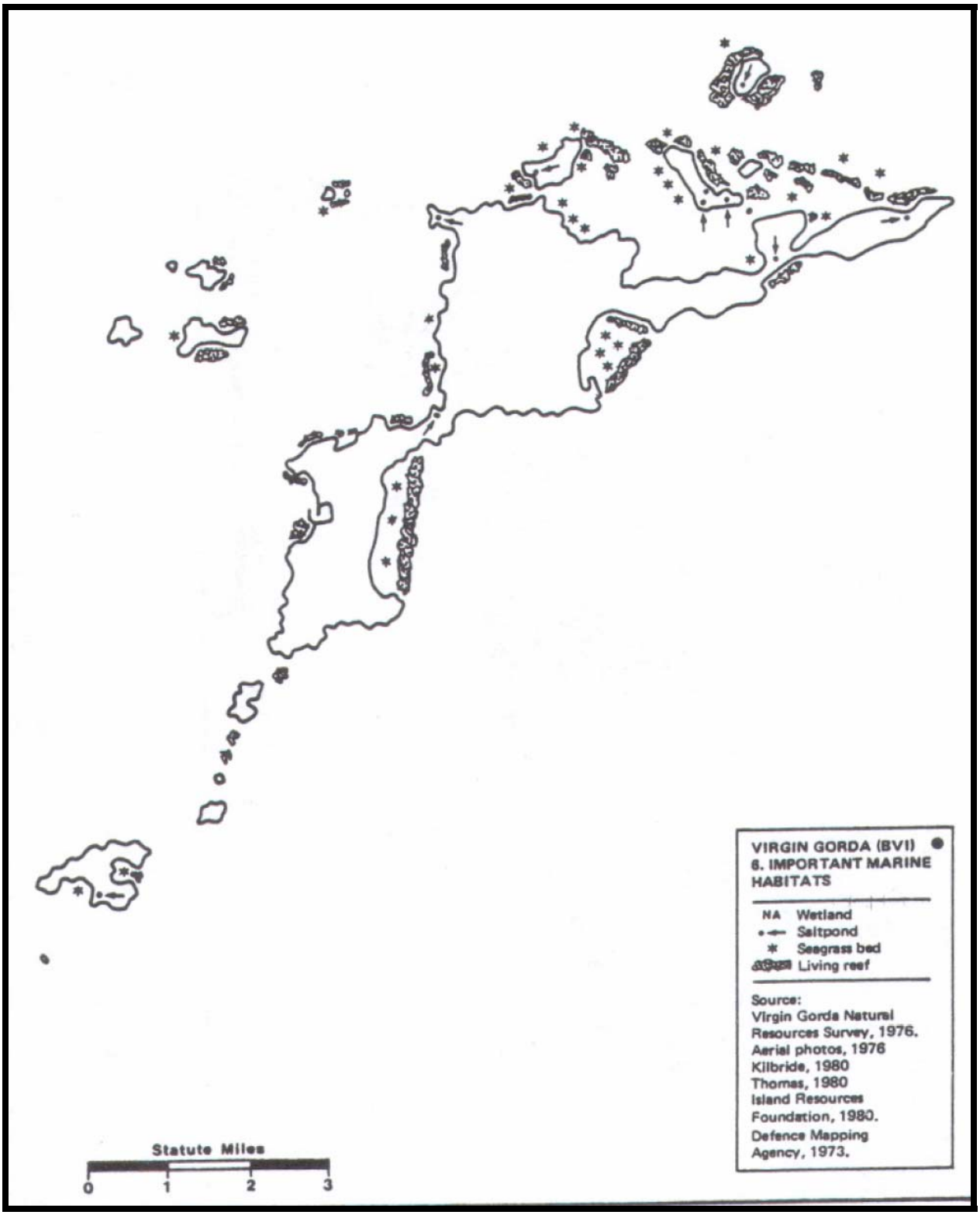

Figure 5. Sea grass and reefs around Virgin Gorda, BVI (source: ECNAMP, 1980).

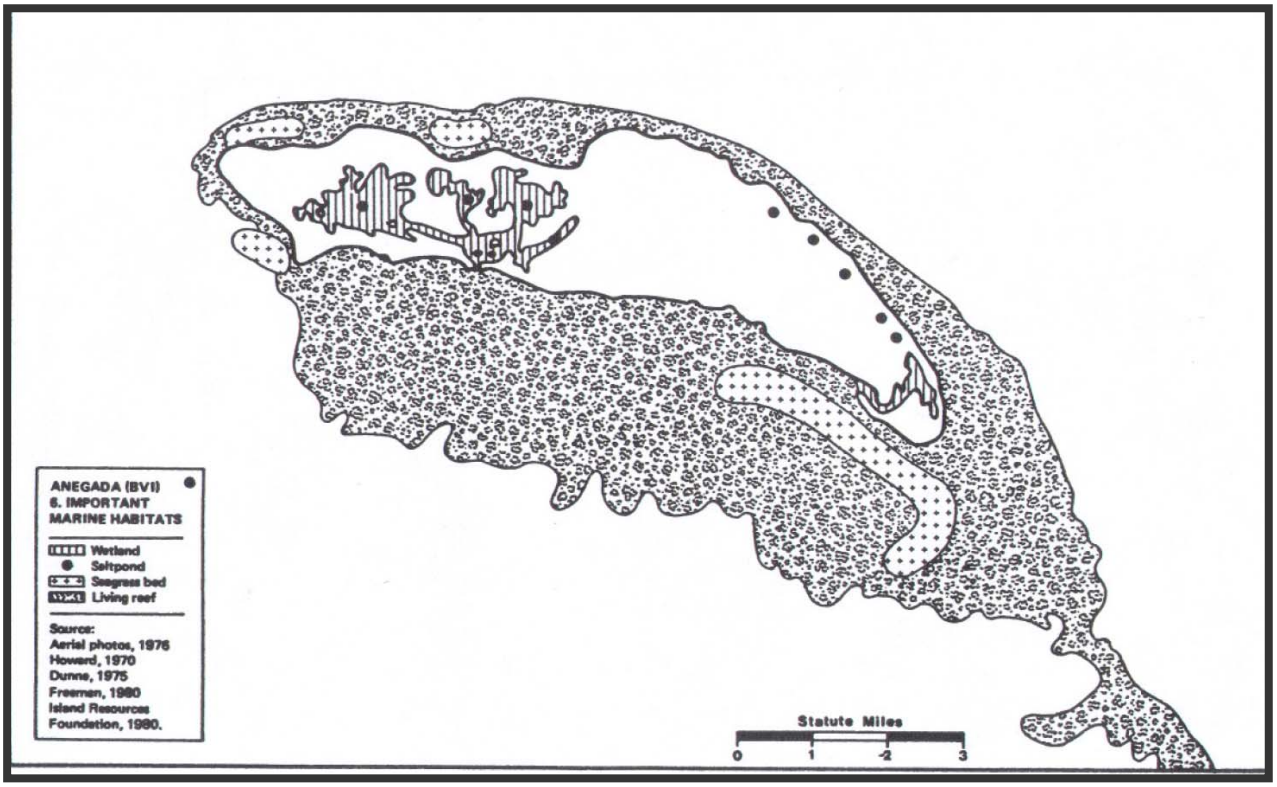

Figure 6. Sea grass and coral reefs around Anegada, BVI (source: ECNAMP, 1980).

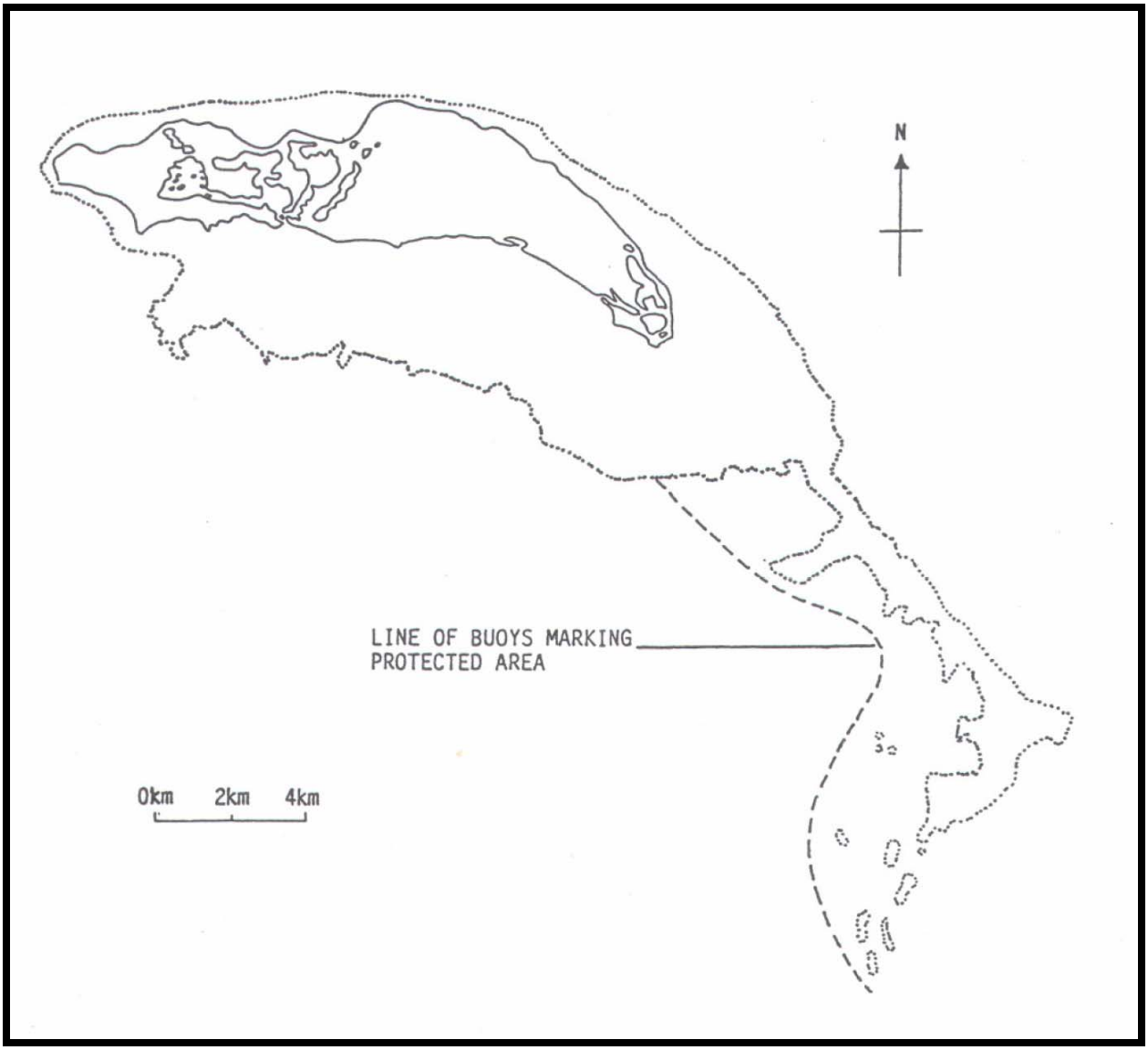

Figure 7. The Horseshoe Reef Protected Area (Anegada, BVI) was established in May 1990.

APPENDIX I

SUMMARY OF RECOMMENDATIONS

This summary is not intended to be a substitute for reading and studying the body of the text, where methodology, supporting literature, action alternatives, and other details are presented. Rather, the following synopsis is offered as a quick-reference guide to priority actions recommended by this Recovery Action Plan. The synopsis is intended to assist policy-makers and others who need an abridged presentation of proposed solutions to stresses on BVI sea turtles.

4.1 Manage and Protect Habitat

4.11 Identify essential habitat

Important habitat includes sea grass (feeding), coral reefs (feeding, refuge), and sandy beaches (egg-laying). In order to identify important or high-use areas, it is a recommendation of this Recovery Action Plan that (1) relevant survey and monitoring programmes, such as those ongoing for coral reefs and proposed for sea grass meadows, incorporate sea turtle sightings and behavioural patterns into the database, (2) fishermen, divers, and charter boat captains be provided with sightings forms and encouraged to report at-sea observations and patterns of habitat use by turtles, (3) the CFD hire and train seasonal employees to systematically monitor a subsample of important nesting beaches, (4) trained community volunteers continue to monitor nesting activity, (5) as soon as practicable, the entire BVI be surveyed as a single management unit so that decisions regarding the most efficient use of limited human and monetary resources can be made based on an overview of important sea turtle habitat.

4.12 Develop area-specific management plans

In order to preserve essential habitat, it is a recommendation of this Recovery Action Plan that (1) site specific management plans be developed and implemented for important nesting and foraging habitats, (2) Marine Parks or other protected areas be designated to safeguard sensitive marine habitat, and to provide food and refuge to endangered sea turtles, (3) Sea Turtle Reserves be declared that encompass the most important nesting areas and can serve as focal points for conservation, management, and monitoring of sea turtle populations, (4) enforcement personnel be hired and provided with training, surveillance equipment, and transport in order to ensure compliance with guidelines and regulations, and (5) education materials be produced to alert visitors to regulations governing Sea Turtle Reserves, Marine Parks, and other management areas.

Management plans should prohibit (1) sand mining on sandy beaches, (2) beach-front construction without ample setbacks, (3) beach-front lighting that attracts and disorients sea turtles and their hatchlings away from the sea, (4) impermeable engineering structures (breakwaters, jetties, groynes, seawalls) likely to promote erosion or loss of adjoining sandy beaches, (5) the destruction of beach vegetation, (6) vehicular driving on sandy beaches, (7) beach fires,

(8) waste disposal in nearshore, beach, and beach forest environments, (9) beach cleaning methods which employ heavy machinery and/or tools that deeply incise the sand, (10) at-sea disposal of solid waste and sewage, (11) the physical destruction of healthy coral reefs and sea grasses by anchoring, explosives, chemicals, specimen collecting, or sedimentation, (12) the disturbance and/or capture of any sea turtle or their eggs or hatchlings.

In addition to site-specific management planning for Sea Turtle Reserves, Marine Parks, and other conservation or management areas, the regulatory guidelines summarized above should be incorporated into all coastal usage plans, including zones of commercial or residential development, Government-owned recreation areas (e.g., Long Bay Belmont, Long Bay-Beef Island, Josiahs Bay), etc. The conservation of endangered sea turtles does not automatically exclude coastal development or recreation, but it requires forethought and an awareness of actions which can threaten the survival of local turtle populations. Conservation guidelines should be implemented in all areas that adjoin sandy beaches suitable for sea turtle nesting and/or coral reefs and sea grass meadows utilized by sea turtles for feeding.

4.2 Manage and Protect all Life Stages

4.23 Propose new regulations where needed

In addition to long-term stewardship of the marine and coastal environments of the BVI, it is a recommendation of this Recovery Action Plan that an indefinite moratorium on the harvest of endangered sea turtles and their eggs be declared, as recommended by the Organization of Eastern Caribbean States and required by the Protocol to the Cartagena Convention concerning Specially Protected Areas and Wildlife. Revised legislation should make it an offence to (1) slaughter, catch or take (or attempt or cause same) any species of sea turtle encountered in the BVI, be the turtle on land or at sea, (2) to collect any turtle eggs, and (3) buy, sell, offer or expose for sale, or possess the whole or any part of the meat, shell, oil, or eggs of any turtle. Penalties should include a maximum fine of $2000, confiscation of equipment used (including boats and other vehicles), and forfeiture of illegally obtained wildlife or wildlife products.

4.24 Augment existing law enforcement efforts

It is a recommendation of this Recovery Action Plan that (1) a Division of Enforcement be created within the MNRL/CFD to promote administrative continuity and more efficient use of enforcement personnel, training, time, and equipment, (2) Division Officers be trained in environmental law and enforcement procedures and be responsible for regulations concerning mining and minerals, pollution, protected species, fisheries and marine resources, boater safety, game and hunting, and relevant coastal zone permits and construction conditions [N.B. NPT Park Wardens are responsible for enforcement within the NPT system), and (3) Division Officers be stationed in Tortola, Virgin Gorda, and Anegada and have access to marine and other essential transport. In the interim, (4) provisions of the Fisheries, National Parks Trust, Public Health, and Marine Ordinances providing for the deputizing of Officers, Wardens, and other enforcement personnel to enforce conservation legislation should be exercised. Finally, in order to enhance the effectiveness of law enforcement personnel, (5) divers, boaters, fishermen, and beachfront property owners should be encouraged to report illegal harvest and habitat damage.

4.26 Investigate alternative livelihoods for turtle fishermen

It is a recommendation of this Recovery Action Plan that the Fisheries Division conduct a Sea Turtle Fishery Frame Survey. The following should be determined: (1) number of men active in the turtle fishery, (2) species and size classes caught, (3) number caught per year, (4) capture methods, (5) gear in possession, (6) gear used and frequency of use, (7) catch per unit effort and, especially for older fishermen, long-term trends in CPUE, (8) market price, (9) income (including proportion of total income) derived from turtle products, and (10) capture/ landing sites. The Survey will also provide a one-on-one opportunity for Fisheries personnel to talk with fishermen about the endangered status of sea turtles, emphasize the importance of a region-wide moratorium on these migratory species, and solicit comments on a moratorium in the BVI. Frame Survey data will reveal the economic impact of a moratorium on sea turtle harvest and enable the CFD to explore credible scenarios for enhancing alternative sources of income, such as Fish Attracting Devices (FADs) and other technologies that will enable local fishermen to make a better living from fishes.

4.27 Determine incidental catch and promote the use of TEDs

In addition to direct harvest by turtle fishermen, sea turtles are also captured incidental to other fishing enterprises. It is a recommendation of this Recovery Action Plan that the CFD determine the full extent of the incidental catch of sea turtles, such as by the longline industry. Turtle Excluder Devices (TEDs) are incorporated into commercial trawls in order to release captured sea turtles before they drown. Trawling is not done in the BVI; TEDs are not relevant.

4.28 Supplement reduced populations using management techniques

It is the view of this Recovery Action Plan that hands-on sea turtle management with the objective of enhancing productivity is important, but is not a high priority at the present time. The reason for this is that threats which lend themselves well to specific management action, such as excessive predation or beach erosion at major rookeries, have not been documented. Rather, (1) adopting a moratorium on sea turtle harvest, (2) passing a strong Coast Conservation and Management Act, (3) creating a Division of Enforcement under the aegis of the CFD, (4) establishing a comprehensive system of protected areas, and (5) enhancing public awareness of and participation in sea turtle conservation are seen as the best ways to promote sea turtle survival. This notwithstanding, protecting individual nests from erosion and predators is sometimes necessary. Any decision to relocate eggs to safer incubation sites should be made at the time of egg-laying to avoid causing harm to developing embryos. The new nest should be constructed in the same type of habitat as the original nest and be dug to the same depth in the sand. The hatchlings should be allowed to hatch and crawl to the sea unassisted.

4.29 Monitor stocks

It is a recommendation of this Recovery Action Plan that breeding populations be monitored to determine (1) species, (2) distribution and timing of the breeding effort, (3) nest fate, (4) annual reproductive success (nests laid *vs.* nests lost to erosion, dogs, crabs, mongooses, birds, poachers, etc.) and (5) the success of specific beach management programmes. In addition,

sea turtles in Territorial waters should be monitored using bio-telemetry or other means to determine (6) residency and movement patterns and (7) habitat use. The CFD should (8) design and implement a programme for the proper statistical evaluation of existing numbers of sea turtles, (9) establish a data-gathering system and training protocol to ensure that data are comparable among locations, turtle species, and observers, (10) encourage research that will provide statistical estimates of stocks and develop a long-term stock assessment program to identify trends over periods of decades, and (11) identify index beaches to serve as a focus for intensive monitoring and trend analysis.

4.3 Encourage and Support International Cooperation

Sea turtles are amongst the most migratory of all Caribbean fauna. The cooperation of all nations is needed if Caribbean basin populations are to survive. It is a recommendation of this Recovery Action Plan that relevant international treaties to which the UK is a party be fully implemented and enforced in the BVI, especially the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the 1983 Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (Cartagena Convention).

4.4 Develop Public Education

It a recommendation of this Recovery Action Plan that (1) public awareness programmes be available territory-wide, (2) CFD-designed environmental studies units (including a unit on sea turtles) be transferred to the Department of Education as a standard part of BVI primary school curricula, (3) the availability and use of audio-visual materials be increased, (4) the WIDECAST *Sea Turtles of the British Virgin Islands* brochure be updated and reprinted, (5) sea turtle conservation and biology information be made available to the fishing community through the CFD staff, the Fisherman's Association, and the media, (6) informal Town Meetings be convened on each major island to focus specifically on the subject of sea turtle biology and the need for sea turtle protection (these are intended primarily for an audience of fishermen and other marine users), (7) tourists be alerted to the endangered status of sea turtles by airport/ cruiseport displays and leaflets available from Customs, rental car agencies, dive operators, NPT, hoteliers, etc., and (8) the electronic and print media be encouraged to provide visible and regular coverage of sea turtle conservation issues.

4.5 Increase Information Exchange

It is a recommendation of this Recovery Action Plan that (1) residents be alerted to the existence of the internationally distributed Marine Turtle Newsletter, (2) the BVI be represented in future Western Atlantic Turtle Symposia, (3) the BVI continue its active participation in the regional WIDECAST project, taking advantage of the WIDECAST network to keep abreast of the latest information regarding sea turtle biology and conservation, (4) CFD staff attend international sea turtle scientific meetings and training opportunities, (5) workshops on research and management techniques be convened at appropriate intervals for Sea Turtle Survey staff and volunteers, (6) full advantage be taken of the media, NGO newsletters, yacht and other local marine shows, and all other avenues for the exchange of information among local groups.

4.6 Implement Sea Turtle Conservation Programme

It is clear from the information provided in this Recovery Action Plan that three species of endangered sea turtle nest (and at least two regularly feed) in the BVI. Extensive harvest (legal and illegal) combined with the destruction of nesting and foraging habitats has resulted in the depletion of local stocks. The leatherback (trunk) turtle has plunged from an estimated six females per night on some Tortola beaches during peak season in the 1920's to fewer than ten turtles per year on all beaches combined during the last decade. The goals of the proposed Sea Turtle Conservation Programme are (1) to obtain comprehensive and accurate data on the distribution of sea turtle nesting and foraging, (2) to implement an integrated, scientifically sound conservation programme based on the information and recommendations assembled in this Recovery Action Plan, and (3) to promote the survival and sustained recovery of remaining sea turtle stocks. Several specific objectives, as well as activities, results, outputs, and a budget are presented in section 4.6 of the Recovery Action Plan. The cost of the Programme is estimated to be $40,000-$80,000 per year for the next five years.

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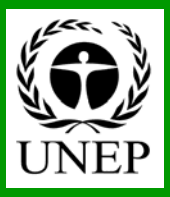

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The major legal instrument of CEP was adopted at the Second Intergovernmental Meeting, convened at Cartagena de Indias, in 1983: the Convention for the Protection and Development of the Marine Environment in the Wider Caribbean Region. The Cartagena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

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

*

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

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