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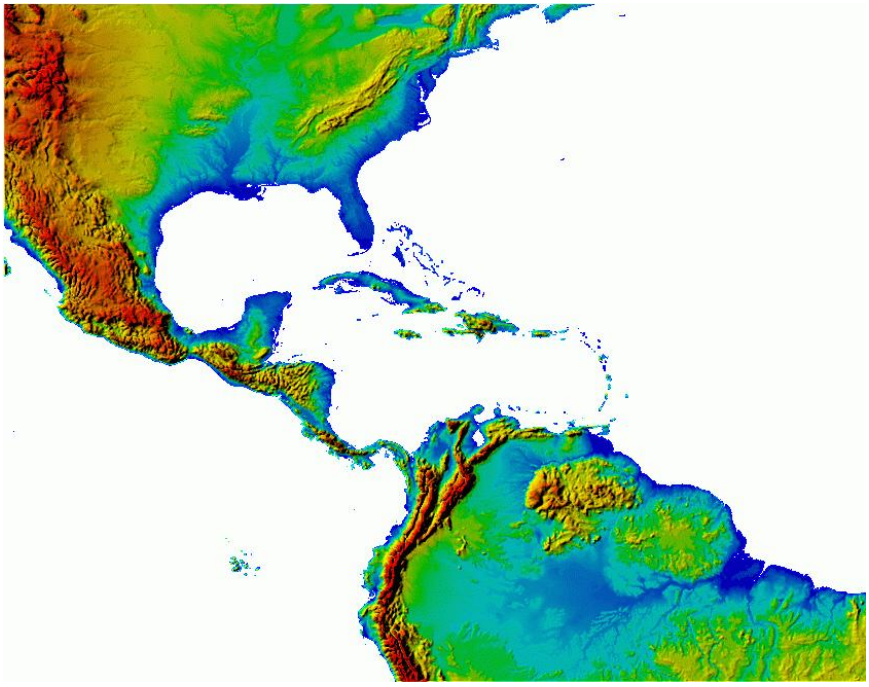
CEP Technical Report 50

Sea Turtle Recovery Action Plan for Jamaica



Prepared by:

WIDECAST

Wider Caribbean Sea Turtle Conservation Network

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Caribbean Environment Programme
United Nations Environment Programme

Sea Turtle Recovery Action Plan for Jamaica

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WIDECAST
Wider Caribbean Sea Turtle Conservation Network

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PREFACE

Of the six species of sea turtle that inhabit the Caribbean Sea, all are classified as Critically Endangered, Endangered, or Vulnerable on the IUCN *Red List of Threatened Specie*s. In addition to centuries of regulated but largely unmonitored exploitation, sea turtles are accidentally captured and often drowned in active and abandoned fishing gear, resulting in death to uncounted tens (perhaps hundreds) of thousands annually. Coral reef and seagrass 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 local. Sea turtles are migratory at all life stages, meaning that what appears as a decline in a local population may be a direct consequence of the activities of people many hundreds of kilometers away. Thus, while local conservation is crucial, action is also called for at the regional level.

To adequately protect migratory sea turtles and achieve the objectives of the UNEP/CEP Regional Programme for Specially Protected Areas and Wildlife, *The Strategy for the Development of the Caribbean Environment Programme (1990-1995)* called 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 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 14th in a series of Sea Turtle Recovery Action Plans prepared by the Wider Caribbean Sea Turtle Conservation Network (WIDECAST[1]), a coalition of Caribbean sea turtle specialists, natural resource managers, and community-based organisations. The objectives of the Recovery Action Plan series are to assist Caribbean governments in the discharge of their obligations under the SPAW Protocol, to promote a regional capability to implement scientifically sound sea turtle management and conservation programs, and to encourage a unified approach among range States.

Each Recovery Action Plan summarises the known distribution of sea turtles, discusses major causes of mortality, evaluates the effectiveness of existing conservation laws, and prioritises implementing measures for stock recovery. This document was developed and thoroughly peer-reviewed by national stakeholder-led processes, with WIDECAST serving as scientific advisor, and upon completion was submitted to the UNEP-CEP Regional Coordinating Unit (Kingston, Jamaica) and the CEP Focal Point in Jamaica for approval and permission to publish.

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[1] WIDECAST is a nonprofit organization 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 comprised of Country Coordinators in more than 40 States and territories, and has served the CEP for more than a quarter-century in support of a shared vision to "protecting the marine environment of the wider Caribbean region for the benefit and enjoyment of present and future generations" and to ensure "coordinated and comprehensive development without environmental damage" (*Preamble*, Cartagena Convention). WIDECAST embraces an extensive network of interested citizens – including scientists, conservationists, resource managers, educators and policy-makers – working together to reverse the declining trend in Wider Caribbean sea turtle populations by promoting a region-wide capability to design and implement science-based conservation and management measures. Financial support comes from both private and public (Government) sources, and includes the UNEP Caribbean Environment Programme.

ACKNOWLEDGMENTS

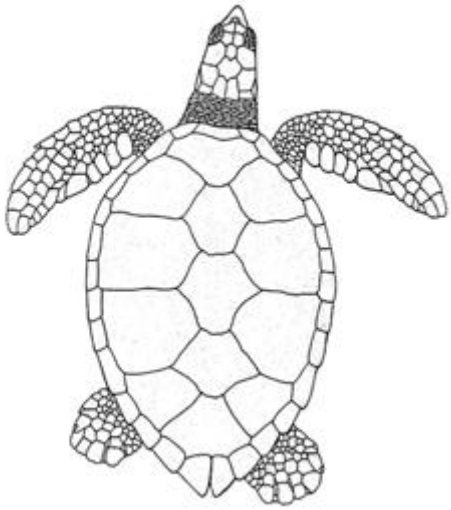
The authors gratefully acknowledge the assistance of all those persons who have contributed to the preparation of this Sea Turtle Recovery Action Plan for Jamaica. We are indebted to the Ministry of Agriculture and Fisheries for consistent support and staff involvement in the national consultative processes that were integral to the development of this landmark document, the first for sea turtles in Jamaica.

Our very special thanks, as well, to the Environmental Fund of Jamaica (EFJ) for funding the nesting beach surveys, the consultative processes that supported the development of this action plan, and technical assistance in writing the document. The U.S. National Marine Fisheries Service and the UNEP Caribbean Environment Programme (UNEP-CEP) also provided support and encouragement for research and for development of this landmark national document. The Center for Marine Conservation at Duke University generously provided a grant for printing.

We would like to thank the many members of the Jamaican Sea Turtle Recovery Network (STRN) – including NGOs, Fisheries Division, Jamaica Defense Force, Coast Guard, Marine Police, University of the West Indies, and many, many fishers, divers, landowners and other interested individuals – who have patrolled nesting beaches, given freely of their time and expertise, and critically reviewed the document in its various incarnations.

We are particularly grateful for the support given to the project by the Natural Resources Conservation Authority (NRCA), now integrated within the National Environment and Planning Agency (NEPA), and especially the staff of the National Parks, Protected Areas and Wildlife Branch and the Technical Support and Electronic Information System. These colleagues have been invaluable in providing facilities and technical support in the production of this document. We would also like to acknowledge Ms. Christine O'Sullivan (UNEP-CEP) for her thorough review and helpful comments on the final draft.

Finally, to our editors Dr. Ronald Bjorkland and Dr. Karen Eckert, the authors extend our deep appreciation for your thorough and thoughtful editing. Our special thanks to Karen Eckert for her unwavering support and commitment to the project, and to our valued colleagues and mentors throughout the region who, through our collective involvement in the Wider Caribbean Sea Turtle Conservation Network (WIDECAST), nurture our efforts in Jamaica, share educational and technical resources with us, and in so many ways assist us in reaching our shared objective of a sustainable future.



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LIST OF ACRONYMS

CCAM	Caribbean Coastal Area Management Foundation
CCC	Caribbean Conservation Corporation
CDC-J	Conservation Data Centre-Jamaica
CMS	Centre for Marine Sciences
CEP	UNEP Caribbean Environment Programme
CITES	Convention on International Trade in Endangered Species of Wild Fauna & Flora
CZM	Coastal Zone Management
ECD	Environmental Control Division
EEZ	Exclusive Economic Zone
FAO	U. N. Food and Agriculture Organisation
GOJ	Government of Jamaica
IUCN/SSC	World Conservation Union/Species Survival Commission
JCDT	Jamaica Conservation and Development Trust
JCRMN	Jamaica Coral Reef Monitoring Network
JDFCG	Jamaica Defence Force Coast Guard
JET	Jamaica Environment Trust
JPS	Jamaica Public Service Company
MARPOL	International Convention for the Prevention of Pollution from Ships
MTN	Marine Turtle Newsletter
NCRPS	Negril Coral Reef Preservation Society
NEPA	National Environment and Planning Agency
NEPT	Negril Area Environment Protection Trust
NGO	Non-Government Organisation
NRCA [now NEPA]	Natural Resources Conservation Authority
NRCD	Natural Resources Conservation Department
OECS	Organisation of Eastern Caribbean States
PCJ	Petroleum Corporation of Jamaica
PEPA	Portland Environment Protection Association
SCCF [now CCAM]	South Coast Conservation Foundation
SEEA	St. Elizabeth Environment Association
SPAW Protocol	Protocol Concerning Specially Protected Areas and Wildlife (UNEP)
STEPA	St. Thomas Environment Protection Association
STRAP	Sea Turtle Recovery Action Plan
STRN	Sea Turtle Recovery Network
TCPD	Town and Country Planning Department
TED	Turtle Excluder Device
TPDCo	Tourism Product Development Company
UDC	Urban Development Corporation
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UWI	University of the West Indies
WATS	Western Atlantic Turtle Symposium
WIDECAST	Wider Caribbean Sea Turtle Conservation Network
WLPA	Wild Life Protection Act

ABSTRACT

Once abundant in Jamaican waters, sea turtles have declined catastrophically. Four species – the green turtle, hawksbill, leatherback, and loggerhead – once occurred regularly in Jamaica, and sightings of the Kemp's ridley are persistent but unconfirmed. A century ago, the green turtle was the most abundant species; today, hawksbills are more frequently encountered. The other species are very rare.

Declines are attributed to over-exploitation of females and eggs on nesting beaches, combined with destruction and disturbance of nesting and foraging (seagrass, coral) habitat. Population declines are evident in landing data showing, for example, decreasing catches between 1963 and 1982 despite an increase in fishing effort, and decreasing numbers of nests laid since records were first collated for WATS I in 1983. Survey results indicate that nesting by three (of an original four) species has all but vanished from the country and that, of the remaining hawksbill nesting effort, few beaches boast more than 10 nests (perhaps 2-3 females) per year. Egg collection remains widespread, with some residents reporting that it has been more than a decade since a nest in their area successfully produced hatchlings.

Ironically, efforts to conserve turtle stocks began early in Jamaica. The first statute protecting sea turtle eggs on the mainland was enacted in 1711. Various regulations and laws followed, none with any marked success. Complete protection of all life stages was achieved by the Wild Life Protection Act (1945) in 1982, but the protection of habitat is poorly developed. Although trade in turtle products has been reduced since 1982, it has not been eliminated; similarly, an active fishery, mostly spear-fishermen taking hawksbills, continues unabated in nearshore waters as well as on the more distant Pedro Bank. The illegal activity has been attributed to a large number of inter-connected factors, which can be summarised as lack of resources to enforce regulations and to educate the various stakeholders in the importance of protecting turtles and their habitats.

In an attempt to redress this imbalance, the Sea Turtle Recovery Network (STRN) was founded in 1991 with the assistance and support of WIDECAST. STRN is a pioneering organisation dedicated to developing a cooperative national structure to promote sea turtle conservation. The organisation has successfully mobilised support for sea turtle conservation among government and NGOs, carried out pilot surveys, and produced the present document. Priorities include research and monitoring at Index sites representing the most important areas for nesting and foraging by the various species; eliminating the illegal take and marketing of sea turtles and their products; quantifying and mitigating bycatch mortality; strengthening law enforcement and management capacity; improving compliance; promoting a deeper public commitment to conservation; and protecting sea turtle habitats, specifically in protected areas and generally through better control of pollution and development.

This Sea Turtle Recovery Action Plan provides the framework and direction for a much-needed campaign to save Jamaica's sea turtle populations from extinction. Specifically, the document describes a five-year national Sea Turtle Conservation Programme to achieve, inter alia, national consultations on STRAP implementation, an inventory of active sea turtle nesting beaches, a national network of long-term monitoring at Index sites (nesting, foraging), genetic 'fingerprinting' of domestic populations (nesting, foraging), professional training in sea turtle research and monitoring techniques for at least 20 'trainers' and supervisors within the STRN, an assessment and report of sea turtle products in Jamaica (including measures in place to eliminate the sale of worked shell products), an inventory of threats to sea turtle survival (nesting, foraging) in Jamaica, an assessment and report on sea turtle bycatch in Jamaica, development of best practices and handbooks on "Turtle-friendly Beach Development and Management" and "Recommended Regulations and Guidelines for Sea Turtle Conservation in Protected Areas", inclusion within the national system plan for protected areas a minimum of 75% of habitat important to sea turtle nesting and foraging, a minimum of three workshops on the development of area-specific sea turtle management plans (with intent to fund and implement at least three projects arising from these plans), and certain benchmarks related to public education and awareness (e.g., posters printed, brochures distributed, airport displays established, website developed, lesson plans produced). The target result of the Programme is a 50% (or more) reduction in illegal take and sales of sea turtles, a clearer understanding of the distribution and success of the annual reproductive effort, and greater public awareness of conservation issues. For further information, please contact the STRN through the National Environment and Planning Agency's toll-free number (888) 991-5005, or contact the Fisheries Division at 923-8811/13.

RESUMEN

Las poblaciones de tortugas marinas en aguas jamaiquinas, antiguamente abundantes, se han desplomado catastróficamente. Las cuatro especies – la tortuga verde (*Chelonia*), carey (*Eretmochelys*), laúd (*Dermochelys*) y cabezona (*Caretta*) – eran observadas regularmente en Jamaica, incluso los avistamientos de la tortuga lora (*Lepidochelys kempii*) son constantes aunque no confirmados. Hace cien años, la tortuga verde era la especie más abundante, actualmente la tortuga carey se observa con mayor frecuencia y las otras especies son muy raras.

Las disminuciones se atribuyen a la sobre explotación de hembras y huevos en playas de anidación, sumado a la destrucción y modificación de sus hábitats de anidación y alimentación (pastos marinos y corales). La disminución de las poblaciones se evidencía en las estadísticas de pesca en las que, por ejemplo, es notable una disminución de capturas de tortugas entre 1963 y 1982, a pesar del incremento en el esfuerzo de pesca, y la disminución del registro de número de nidos desde el inicio de los censos con WATS I en 1983. Los resultados de censos indican que la anidación de tres especies (de las cuatro que existían aquí) han prácticamente desaparecido, y de las que quedan de la tortuga carey, apenas se registran pocas playas que reciben no mas de 10 nidos (equivalente a 2-3 hembras) al año. La extracción de huevos en playa es aún común, con algunos lugareños reportando que ha pasado más de una década desde que se vió algún nido exitosamente producir neonatos.

Irónicamente, los esfuerzos para conservar las colonias comenzaron tempranamente en Jamaica. La primera normativa para la protección de huevos de tortuga marina en tierra se realizo en 1711. Varias regulaciones y leyes fueron emitidas posteriormente pero ninguna fue exitosa. La protección completa de todos los estadios de vida fue lograda con el Acta para la Protección de la Vida Silvestre (1945) en 1982, pero la protección de los hábitats fue pobremente desarrollada. Aunque el comercio de productos de tortuga se ha reducido desde 1982, este no ha sido eliminado. De igual forma, una pesquería activa, principalmente constituida por pescadores con arpones que capturan tortugas carey, continúa sin disminuir en aguas costeras e incluso en el distante banco Pedro. La actividad ilegal ha sido atribuida a una serie de factores interconectados, los cuales pueden resumirse en la falta de recursos para hacer cumplir las regulaciones y educar los diversos actores clave sobre la importancia de proteger las tortugas y sus hábitats.

En un intento por corregir este desequilibrio, la Red para la Recuperación de Tortugas Marinas (*Sea Turtle Recovery Network*, STRN) fue fundada en 1991 con el apoyo de WIDECAST. La STRN es una organización pionera dedicada a desarrollar una estructura de cooperación nacional para promover la conservación de tortugas marinas. Esta organización ha movilizado exitosamente apoyo para la conservación de las tortugas marinas en el gobierno y en organizaciones no gubernamentales, ha llevado a cabo estudios piloto de monitoreo, y producido el presente documento. Las prioridades incluyen la investigación y el monitoreo de sitios índices que reflejan las áreas de mayor importancia para anidación y alimentación de varias especies; la eliminación de la extracción y comercialización de tortugas y sus productos; cuantificación y mitigación de la mortalidad asociada a la pesca incidental; reforzamiento del cumplimiento de las leyes y de la capacidad de manejo, promoción de un mayor compromiso para la conservación en la sociedad civil; y la protección de los hábitats de las tortugas marinas, particularmente por medio de áreas protegidas y, en general, a través de un control de la contaminación y el desarrollo.

Este Plan para la Recuperación de Tortugas Marinas provee una marco de referencia y orientación para la realización de una muy necesaria campaña para evitar la extinción de las poblaciones de tortugas marinas en Jamaica. Específicamente, el documento describe un Programa Nacional de Conservación de Tortugas Marinas a cinco años que persigue alcanzar, *inter alia*, consultas nacionales sobre la puesta en marcha del STRAP, un inventario sobre las playas de anidamiento activas, una red nacional a largo plazo de sitios índice de monitoreo (anidamiento, forrageo), “huellas digitales” genéticas de poblaciones domésticas (anidamiento, forrageo), capacitación profesional en técnicas de investigación y monitoreo de tortugas marinas para por lo menos 20 ‘capacitadores’ y supervisores dentro de la STRN, un evaluación e informe sobre los productos de tortugas marinas en Jamaica (inclusive medidas en marcha para eliminar la venta de todos los productos elaborados de los caparazones), un inventario de las amenazas a la supervivencia de las tortugas marinas (anidamiento, forrageo) en Jamaica, una evaluación e infome

de la pesca accidental en Jamaica, desarrollo de mejores prácticas y guías educativas sobre “Desarrollo y Manejo ‘amigable a las tortugas’ en las Playas” y “Directrices y Regulaciones recomendables para la conservación de tortugas marinas en Areas Protegidas”, inclusión dentro del plan de sistema nacional para las areas protegidas un mínimo de 75% del hábitat importante para el anidamiento y forrageo de las tortugas marinas, un mínimo de tres talleres para el desarrollo de planes de manejo de tortugas marinas en áreas específicas (con el propósito de financiar y ejecutar por lo menos tres proyectos que resulten de estos planes), y metas relativas a la educación y concientización públicas (ej. impresión de afiches, distribución de panfletos, exhibiciones en aeropuertos, desarrollo de sitio Web, producción de planes de lecciones). El resultado esperado del programa es una reducción del 50% (o más) de la captura y venta ilegales de tortugas marinas, tener un mayor conocimiento sobre la distribución y el éxito del esfuerzo anual de reproducción, y una mayor conciencia pública sobre los temas de conservación. Para mayores informes, por favor contacte el STRN a través de la Agencia Nacional de Planeación y Ambiente, al teléfono gratuito: (888) 991 5005, o contacte la División de Pesca a los teléfonos: 923-8811 / 13.

RESUME

Autrefois abondantes dans les eaux de la Jamaïque, les tortues marines ont connu un déclin catastrophique. Quatre espèces de tortues – verte, imbriquée, luth, caouanne – étaient auparavant régulièrement présentes en Jamaïque, et des observations de tortues de Kemp sont rapportées, sans être confirmées. Il y a un siècle, la tortue verte était l'espèce la plus abondante; aujourd'hui, les tortues imbriquées sont plus fréquemment rencontrées. Les autres espèces sont très rares.

Leur déclin est attribué à la sur-exploitation des femelles et des œufs sur les plages de ponte, combinée avec la destruction et la perturbation des zones de nidification et de nourrissage (herbiers marins, coraux). Les données de débarquement (pêche) révèlent clairement un déclin des populations; elles montrent par exemple une diminution des captures entre 1963 et 1982 malgré une augmentation de l'effort de pêche, et une diminution du nombre de nids depuis les premiers récoltes de données réalisés pour WATS I en 1983. Les résultats des suivis indiquent que la nidification de trois espèces (pour un total de quatre espèces à l'origine) a presque cessé et que, en ce qui concerne l'effort de ponte des tortues imbriquées restantes, peu de plages peuvent se glorifier d'avoir plus de dix nids (peut-être deux ou trois femelles) par an. La récolte des œufs demeure une pratique largement répandue, certaines résidents rapportant qu'il s'est écoulé plus de dix ans depuis la dernière fois où un nid dans la zone qu'ils fréquentent a produit des éclosions avec succès.

Ironiquement, les efforts pour conserver les populations de tortues ont commencé tôt en Jamaïque. Le premier acte protégeant les œufs de tortues marines sur la terre ferme a été pris en 1711. Plusieurs réglementations et lois ont suivis, sans qu'aucune ait rencontrée un succès sensible. Une protection complète de tous les stades de développement des tortues a été mise en place dans le cadre de la loi de protection de la vie sauvage (Wildlife Protection Act – 1945) en 1982, mais la protection des habitats est peu développée. Bien que le commerce des produits issus des tortues ait été réduit depuis 1982, il n'a pas été éliminé; de même, une pêche active, constituée principalement de pêcheurs au harpon capturant des tortues, continue avec la même intensité dans les eaux côtières ainsi que sur la Pedro Bank plus distante. Cette activité illégale a été attribuée à un grand nombre de facteurs interconnectés, qui peuvent être résumés par le manque de ressources pour faire appliquer la réglementation et pour sensibiliser les différents acteurs à l'importance de la protection des tortues de leurs habitats.

Dans une tentative pour palier ce déséquilibre, le Réseau de restauration des tortues marines (*Sea Turtle Recovery Network* - STRN) a été fondé en 1991 avec l'appui et le soutien de WIDECAST. STRN est une organisation pionnière, dédiée au développement d'une structure de coopération nationale afin de promouvoir la conservation des tortues marines. L'organisation a mobilisé, avec succès, des soutiens pour la conservation des tortues marines auprès du gouvernement et des ONG, a mené à bien des suivis pilotes, et a élaboré le présent document. Les priorités comprennent la recherche et le suivi de sites index qui représentent les zones les plus importantes pour la nidification et l'alimentation des différentes espèces; l'élimination de la récolte illégale et du commerce des tortues marines et de leurs produits; la quantification et la réduction de la mortalité due aux captures accidentelles; la promotion d'un engagement plus fort du grand public pour la conservation; et la protection des habitats des tortues marines, en particulier dans les aires protégées, ainsi que plus généralement à travers un meilleur contrôle des pollutions et du développement.

Ce plan d'action pour la restauration des tortues marines (Sea Turtle Recovery Action Plan, STRAP) offre le cadre et les orientations pour une campagne très nécessaire pour sauver les populations de tortues marines de la Jamaïque de l'extinction. Plus précisément, le document décrit un Programme national quinquennal de conservation des tortues marines pour faciliter, entre autres, des consultations nationales pour la mise en oeuvre des plans nationaux, un inventaire des plages de nidification des tortues marines, un réseau national de surveillance sur le long terme avec les sites indexés (de nidification, pour l'alimentation), les empreintes “génétiques” des populations domestiques (nidification, alimentation), de la formation pour la recherche sur les tortues marines et les techniques de surveillance pour au moins 20 formateurs et superviseurs au sein de la STRN, une évaluation et le rapport des prises de tortues marines en Jamaïque (y compris les mesures en place pour éliminer la vente de produits à partir des carapaces travaillées), un inventaire des menaces à la survie des tortues marines (nidification, alimentation) en Jamaïque, une évaluation et un rapport sur les prises accidentelles de tortues de mer dans la

Jamaïque, le développement des meilleures pratiques et des manuels sur le “La gestion et le développement de plages pour accueillir les tortues marines” et “Les lignes directrices pour la conservation des tortues marines dans les aires protégées”, l'inclusion dans le système de réseau national des aires protégées d'un minimum de 75% d'habitats importants pour la nidification et l’alimentation des tortues marines, au moins trois ateliers pour l'élaboration de plans de gestion d'aires spécifiques pour les tortues marines (avec la volonté de financer et mettre en œuvre au moins trois projets découlant de ces plans), et certains critères liés à l'éducation et à la sensibilisation du public (affiches, brochures distribuées, panneaux dans les aéroports, mise en place d'un site internet dédié, plans de cours produits). L'objectif résultant du Programme: 50% (ou plus) de réduction des prises illégales et de vente des tortues marines, une compréhension plus claire de la distribution et des succès des efforts pendant la saison de reproduction, et une plus grande sensibilisation du public aux questions de conservation. Pour plus d'informations, merci de contacter le STRN par l'intermédiaire du numéro gratuit de l'Agence nationale pour l'environnement et la planification (National Environment and Planning Agency) : (888) 991 5005, ou contacter la Division des pêches au 923-8811/13.

I. INTRODUCTION

The island nation of Jamaica (18º N, 177º W) lies in the Greater Antilles 145 km south of Cuba and 161 km west of Haiti (Figure 1). It is the third largest island in the Caribbean, with a total land area of 10,981 km². The mainland coastline of Jamaica is about 891 km in length (NEPA, 2003) and its varied features include white and black sand beaches, sand spits and bars, cliffs, salinas, swamps, lagoons, shallow reef flats, and bays (Figure 2). At least 164 km of "white" or "brown" sandy beach are potentially suitable for sea turtle nesting (GOJ, 2001). The Exclusive Economic Zone Act of 1991 established a 200 mile exclusive economic zone offshore (Aiken, 1998).

The Maritime Areas Bill of 1995 recognized Jamaica as an archipelagic State and established a larger area of territorial sea encompassing 275,000 km², including the Morant Bank to the east and most of the Pedro Bank to the south. The total area of the island shelf and its nine proximal banks is 4,170 km². On the north, east and west coasts, the shelf is less than 2.5 km wide in most places and then drops off into the east-west oriented Cayman Trench, which extends to depths exceeding 1,700 m. The shelf is characterised by fringing reefs, clear waters, and white sand beaches. On the south-facing shore, the shelf is wide and shallow, generally less than 37 m deep, and extends offshore to a maximum width of 24 km (Figure 3).

There are several large harbours and estuaries with extensive wetlands on the south coast. Sixteen bays around Jamaica are used as commercial harbours. Kingston Harbour is located on the south coast and is enclosed by the 13 km long Palisadoes sand spit – with 20 km² of navigable water, it is one of the largest and best sheltered ports in the Caribbean (Goodbody, 2003). There are two groups of inshore cays on the south shore: the Port Royal Cays which lie to the south of the Palisadoes, and the Portland Bight Cays in Portland Bight.

Many south coast beaches are composed mainly of black sand derived primarily from river sediments. These sediments make waters off the south coast less clear than waters off the north coast, and tend to discourage the formation of reefs, especially near major estuaries. Nevertheless, there are extensive reefs in some south coast areas, particularly around Morant Point and Morant Bay in the southeast, areas east of Yallahs, around Port Royal and Portland Bight Cays, at Alligator Reef, and near Black River and Savanna-la-Mar (Figure 3). Seagrass beds occur in most shallow bays around the island, with the largest beds located along the south coast in and near Portland Bight, and between Negril and the Black River.

Offshore there are two major banks, Morant and Pedro, with their associated cays and numerous smaller banks (Figure 3). Like the island of Jamaica itself, these banks rise abruptly from depths greater than 500 m. Pedro Bank, the larger of the two, encompasses an area of 8,040 km² (Nicholson and Hartsuijker, 1982), equal to about two thirds of the land area of Jamaica; a portion of it extends beyond Jamaica's territorial seas. Pedro Bank is a submerged plateau about 20-30 m below the surface. There are reefs all along the edges, but they are most extensive on the southeastern, southern and southwestern margins. The less productive centre of the Pedro Bank is dominated by silt and sand and has scattered coral heads. The four cays of the Pedro group lie about 100 km offshore; two of them are inhabited by fishermen.

Further offshore to the south, Jamaica and Colombia have established a "Joint Regime Area" around the Baja Nuevo and Seranilla Banks and Alice Shoal. Both parties have the right to exploit marine resources and to conduct marine scientific research and conservation activities on living resources in this area. The much smaller Morant Bank lies to the southeast of Jamaica, includes an area of about 100 km², and contains four small cays, one of which is inhabited by fishermen on a seasonal basis.

Historically, Jamaica's largely coastal population has relied heavily on marine resources, and this dependence continues to the present day despite declining catches of all types of fishable resources surveyed in recent decades (e.g., Chuck, 1963; Nembhard, 1970; Sahney, 1983). Sea turtles were regarded as an important component of the marine fishery for many years.

The relationship between humans and sea turtles in Jamaica dates back more than 1,000 years. The first documented inhabitants of Jamaica, the Tainos (locally known as Arawaks) were animists and may have considered turtles to be sacred (R. Ebanks, NHT, pers. comm.). Sea turtles were commonly modeled as ornaments on the handles of some Tainos implements, especially near Great Bay, St. Elizabeth, where turtles were commonly caught at least until the 1960s (Tyndale-Biscoe, 1962). Four species of sea turtle occurred regularly and were hunted in Jamaican waters: the green turtle (*Chelonia mydas*) was, historically, the most common; the hawksbill or carey (*Eretmochelys imbricata*) is the most common species today; and the loggerhead (*Caretta caretta*) and leatherback or "three-keel" (*Dermochelys coriacea*) are the least common species. There are a few unverified reports of the highly endangered Kemp's ridley (*Lepidochelys kempii*), and one confirmed occurrence of an olive ridley (*L. olivacea*) in Jamaican waters (see sections 2.5 and 2.6).

There is very little information about the use of sea turtles in Jamaica during the Spanish occupation (1494-1655); however, the early Spanish invaders took a heavy toll on sea turtles in Barbados (Watts, 1987) and there is no reason to assume their actions were different in Jamaica. Nevertheless, sea turtles were still plentiful in Jamaica shortly after the British invasion in 1655. They were exported to other parts of the Caribbean as "victuals." According to Blome (1672), "... the principal sort is the Tortoise, which they take plentifully on the coast; and about 20 or 30 leagues to the leeward of port Negril, by the isles of Camavos in the months of May, June and July, do resort great store of ships from the Caribbee Isles to vitual and load with this Fish, it being reputed to be the wholesomest and best provision in all the Indies."

The history of sea turtle exploitation in Jamaica is difficult to separate from the history of sea turtles in the Cayman Islands after the British conquest. The Cayman Islands, historically the most important regional centre for sea turtle nesting, harvesting, and product trade (Lewis, 1940; Williams, 1995; Bell et al., 2007), were administered by the British as part of Jamaica. This political and historical relationship continued until Jamaica's independence in 1962. Consequently, trade and fisheries statistics for the two territories were not always maintained separately. Caymanians fished and sold their turtles in Jamaica and other parts of the adjacent Caribbean (Sloane, 1725) as far away as Nicaragua; Jamaicans also fished in the Cayman territory.

Sea turtle meat was an important component of the Jamaican diet well into the twentieth century. In the seventeenth and eighteenth centuries it was as common in the markets of Jamaica as beef was in Britain (Catesby, 1731-43 *in* Rebel, 1974). Some people ate so much green turtle that ". . . their Shirts are yellow, their skin and face of the same colour, and their shirts under the Armpits stained prodigiously" (Sloane, 1725). Turtle was so routinely served at banquets at the end of the eighteenth century that Lady Nugent noted in her diary when it did not appear (Wright, 1966). Turtle was a domestic staple and, in 1883, one of the first Jamaican cookery books to be printed featured six sea turtle recipes (Sullivan, 1893). Even into the late twentieth century many local cookery books included a variety of recipes for sea turtle (e.g., Slater, 1965; Grey, 1965; Benghiat, 1985).

By the mid-1970s, sea turtle harvests had declined to the point that there were no longer any specialist turtle fishermen in the country (Kerr, 1984). By this time sea turtle meat was rare in Jamaican markets, although it was occasionally sold at the roadside and a number of restaurants throughout the island routinely offered it to a primarily local clientele (A. Haynes-Sutton, pers. observ.). Sea turtle products were sold on the streets of Old Harbour, with vendors using a bell to announce their availability for sale at a prescribed time and place. By the 1990s, sea turtle was a subsistence food and not publicly offered, but still available (Tambiah, 1995) – the situation remains much the same today.

Worked and raw turtle shells historically had economic importance, and the commercial fashioning of shell into jewelry, household items, comb cases, powder boxes and trinkets has spanned two centuries. Raw shell was imported to and exported from Jamaica (Hart, 1983). Edwards (1793) noted that 655 lb of tortoiseshell was imported in 1787. By the 1980s, there was only one commercial enterprise producing turtle shell jewelry. A few self-employed artisans used the shell when it was available. Although illegal, turtle shell jewelry was still sold in many parts of Negril (P. Harrison, pers. comm.; Buchanan, 1996) and

other tourist markets along the south coast (Buchanan, 1996) as recently as 1995. According to baseline surveys conducted for this review in the mid-1990s, tortoiseshell products were rarely seen in other tourist areas (H. Smit, JCDT, pers. comm.; R. van Barneveld, TPDCO, pers. comm.; M. Gauron, PEPA, pers. comm.). Today these items are still available at selected locations (e.g., Negril and Ocho Rios: see section 3.3).

Over the centuries, some fishers specialized in sea turtle fishing using special nets and decoys. For other fishers, sea turtles were an incidental (unintentional) catch at sea. Not all turtles were captured offshore – sea turtles seasonally come ashore to lay their eggs, and during the nesting season hunters built small lean-to shelters on selected nesting beaches where they spent nights watching for the arrival of the gravid (egg-bearing) females. Popular superstition claims that turtles are most likely to come ashore to nest when there is summer lightning, which is said to be the male turtles "shining the light" to attract females.

Concern over the effects of an unregulated take was expressed at a very early stage in Jamaica's history, and the first law controlling the collection of eggs was introduced in 1711. No further legislation was enacted until 1907 when the Morant and Pedro Cays Law regulated harvest of both sea turtles and their eggs on the cays and within territorial waters. This action was followed by the Birds and Fish Protection Law in 1914, the Wild Life Protection Act (WLPA) in 1945, and the Trade Law 4 in 1955 (see Appendix II).

Unfortunately, none of these laws provided protection to all life stages, and this lack of full protection and enforcement made the laws ineffective in that sea turtle populations continued to decline. Between 1962 and 1968, the reported annual harvest declined from 143,861 kg for the 12 month 1962-1963 period (Chuck, 1963) to 63,377 kg in 1968 (Nembhard, 1970). The 1981 estimated harvest was 57,114 kg (Sahney, 1983) and, by 1982, an estimated 190-521 turtles (equivalent to about 42,025 kg) were landed (Kerr, 1984). In the same period, overall fishing effort for sea turtles increased, with more fishers using more modern boats and nets over greater distances – thus we conclude that the declining harvest reflected a decline in the turtle population.

In an attempt to bolster depleted stocks, the U.S.-based Caribbean Conservation Corporation (CCC) organized "Operation Green Turtle". More than 4,000 green sea turtle hatchlings and several hundred eggs were sent to Jamaica's offshore cays between 1959 and 1967 from Tortuguero, Costa Rica (Carr, 1967). The programme was discontinued in 1968 because the project could not demonstrate any re-establishment of nesting colonies on the cays.

While the 1982 legislation protected all sea turtle life stages (and species), it left an important gap in the regulatory framework; namely, while the killing and possession of sea turtles was illegal, the offering and act of sale, *per se*, was not (see section 4.211). Despite the efforts of the (then) Natural Resources Conservation Department (NRCD) to develop a new cadre of enforcement officers (Conservation Wardens), the 1982 strengthening of the WLPA was not accompanied by any meaningful improvement in enforcement effort. Posters and leaflets were distributed to inform the public about the changes to the WLPA and a "head-starting" (captive-rearing) programme was considered, but never implemented (see section 4.253).

Government responsibility for sea turtle management and conservation currently lies with the National Environment and Planning Agency (NEPA), an Executive Agency of the Government of Jamaica (GOJ) which currently resides within the Office of the Prime Minister. NEPA, like its predecessor agencies, has steadily developed the technical and institutional capacity to implement its mandate concerning sea turtle protection, which has been a priority conservation effort since the early 1980s.

To assist in information-gathering, priority-setting and recovery action, Ms. Rhema Kerr (then WIDECAST Country Coordinator) formed the Jamaican Sea Turtle Recovery Network (STRN) in 1991. Through collaboration with government agencies, non-government organisations (NGOs), individuals, and the private sector, the activities of the STRN led to greatly increased awareness of the importance of sea turtle conservation, generated public support and volunteerism, and collected information that now forms

the basis for many of the recommendations of this Sea Turtle Recovery Action Plan (STRAP). Many volunteers have assisted by participating in turtle watches and local businesses have provided in-kind support and services.

The primary objective of this STRAP is to present a strategy for a national effort to ensure sustained recovery of depleted sea turtle stocks. To reach this objective, the authors of this document, with the assistance of the STRN and WIDECAST experts, have compiled data on the status and distribution of sea turtles in Jamaica, assessed the role played by sea turtles in Jamaica's culture and economy, and identified factors threatening turtles and their habitats. Much of this information was collected directly through field work and interviews because no baseline data were available, and it now forms the basis for specific management recommendations for population monitoring, habitat protection, community involvement, public awareness, legislation, and law enforcement.

While sea turtles have been fully protected in Jamaica for a quarter-century, their numbers in Territorial Waters and on most Jamaican beaches and offshore cays are believed to be very low compared to historical values. They still are subject to intense illegal fishing pressure in the sea, and opportunistic take at nesting beaches. Three of the four species that historically nested in Jamaica have almost been extirpated. The remaining species, the hawksbill, is heavily poached and prospects for its recovery are complicated by widespread loss of feeding habitat (coral reefs) and coastal nesting grounds (sandy beaches). A more robust and effective protection of sea turtles at the inception of the 1982 moratorium may have resulted in healthier stocks today, but this has not been the case. Indeed, despite the presence of a strong regulatory framework, the question for our generation is whether sea turtles will survive in Jamaica for the foreseeable future.

Among the country's most serious and widely recognised challenges are law enforcement and compliance. The inefficacy of laws, which is partially rooted in historical patterns of lack of respect for the law, renders legislation almost meaningless. To address these challenges, it is essential to integrate resource users into the management process. If sea turtle conservation is to be effective in Jamaica, resource users should be given an opportunity to participate meaningfully in decision-making, conservation, and compliance processes. The STRN has attempted to take a lead in this process by encouraging fishers, community development groups, and youth organisations to be actively involved in conservation actions such as the Sea Turtle Summer Nights Programme, which involves volunteers in nesting beach surveys (see section 4.41).

Since 1991 the STRN has also been involved in community development efforts in key coastal towns. It has organised public meetings, arranged beach cleanups, distributed educational materials, promoted outreach activities, and encouraged media coverage. It has championed recognition of the important role which can be played by fishing communities in sea turtle recovery. However, much remains to be done. Rebuilding the momentum that the STRN has brought to conservation is vital to sea turtle survival in Jamaica, and the STRN anticipates taking the lead in full implementation of this Sea Turtle Recovery Action Plan. If successful, it will lead to increased sea turtle populations in Jamaican waters and throughout their international ranges. Additionally, through STRN's work and the models it provides, other programmes may arise to address equally urgent needs of other endangered species in Jamaica.

II. STATUS AND DISTRIBUTION OF SEA TURTLES IN JAMAICA

On a global scale, including the Wider Caribbean Region, three species of sea turtle – hawksbill, leatherback, Kemp's ridley – are classified as "Critically Endangered" in the IUCN Red List of Threatened Species, whereas the loggerhead and green turtle are "Endangered" and the olive ridley "Vulnerable" (see http://www.iucnredlist.org/). Causal factors include centuries of intense harvesting for meat, shell, oil, and skins; serious degradation of nesting and foraging habitats; accidental capture and drowning in active or abandoned fishing gear; and pollution of habitats by oil spills, dumping of chemical waste, and persistent plastic debris at sea (Caribbean reviews are available in Groombridge and Luxmoore, 1989; NRC, 1990;

Fleming, 2001; Reichart, 2003; Reichart et al., 2003; Seminoff, 2004; Godley et al., 2004; UNEP/GPA, 2006; Bräutigam and Eckert, 2006; Mortimer and Donnelly, 2007).

Historically, four species of sea turtle have nested in Jamaica: the green turtle (*Chelonia mydas*), the hawksbill or "carey" (*Eretmochelys imbricata*), the loggerhead (*Caretta caretta*), and the leatherback or "three-keel" (*Dermochelys coriacea*) (Figure 4). Available data suggest that Jamaica may already have lost three of its four breeding species, only the hawksbill continues to nest in any appreciable numbers. Hawksbills and green turtles of varying sizes forage in Jamaica's waters, while loggerheads and leatherbacks are encountered occasionally at sea. There are unconfirmed accounts of Kemp's ridleys (*Lepidochelys kempii*) in Jamaican waters.

This STRAP relies on multiple sources of information to construct the status and distribution of sea turtles in Jamaican and regional waters. Before work began on this Action Plan, very little information had been collated or analysed with the exception of the 1982 fisher interview survey results (Kerr, 1984) which indicated that nesting occurred on 104 mainland beaches and more than two dozen offshore cays (Table 1). In addition to these early surveys, the authors have researched and summarized information recorded in the following sources:

- **1981-1982**: Aerial survey of manatees and other wildlife conducted by the NRCD (locations of turtles seen at sea during monthly manatee surveys).
- **1982**: Interview survey of fishermen conducted in preparation for the 1983 Western Atlantic Turtle Symposium (WATS I) on locations of nesting beaches and the estimated numbers of nests per year (Kerr, 1984).
- **1987**: Interview, habitat and market surveys conducted in preparation for the 1987 Western Atlantic Turtle Symposium (WATS II) on distribution of nesting beaches, reports of slaughter, and sale of turtles and turtle products.
- **1993**: Aerial survey of manatees, including locations of turtles at sea and nests seen in aerial surveys (Carr, 1993).
- **1992-1995**: "Sea Turtle Summer Nights": annual beach surveys by volunteers during June-October (numbers of nests and false crawls, records of damaged/ poached nests).
- **1992-1995**: Reports of turtle sightings from commercial dive operators (locations of turtles at sea, reports of nests and the killing of turtles).
- **1995**: STRN survey (by foot and boat) of potential nesting habitat between Portland Bight and Negril (numbers of nests and false crawls, species identification, nest fate).
- **1982-1995**: Compilation of public reports of turtle sightings, mostly killings or nestings (e.g., from NRCA files, newspaper reports); 1991-1995 survey results are summarised in Table 2.
- **1996**: Survey of Middle Cay, Morant Cays (University of Newcastle).
- **2001-2002**: Mainland and cay beaches of Portland Bight (by NEPA, conducted by fisher Charles Moodie).
- **2001**: Mapping of the Portland Bight Cays (by NEPA).
- **2003**: Nesting survey in Negril (by NEPA/STRN, in partnership with local NGOs).
- **2003**: Nesting survey in Portland (by NEPA, conducted by Ivor Pennycooke of the Portland Environment and Protection Association).
- **2005-present**: Survey and assessment of the Pedro Cays (by The Nature Conservancy).
- **2005**: Reconfirmation of historical nesting beaches across the island (by NEPA).
- **2005-present**: Nesting beach survey on Gibraltar Beach in Oracabessa, St. Mary (by Melvyn Tennant).
- **2006-present**: University of West Indies, Department of Life Sciences (Mona).
- **2007**: Nesting beach survey of Malcolm Bay (by NEPA); Hope Bay, Portland and Reggae Beach, St. Mary (by NEPA); Gibraltar Beach, St. Mary (by Melvyn Tennant); Harvey's Beach, White Sand Beach and Black Springs in St. Elizabeth (by local residents).
- **2007-present:** Nesting beach survey in the Palisadoes-Port Royal Protected Area (by NEPA).

2.1 *Caretta caretta*, Loggerhead Turtle

The common English name, "loggerhead", is used in Jamaica. Adults are recognised by a large head, thick, somewhat tapered carapace, and characteristically heavy encrustation of invertebrate epifauna (especially barnacles). There are five pairs of lateral carapace plates (scutes) (Figure 4). The large head and strong jaws, for which the species was named, are essential adaptations to a diet of mollusks and hard-shelled crabs. Tunicates, fishes, and plants are also eaten (summarized by Dodd, 1988). Nesting females in Florida (USA) average 92 cm in straight shell length (range 81-110 cm; n = 194) and 116 kg (71.7-180.7 kg; n = 261) (Ehrhart and Yoder, 1978), but adults can weigh up to 200 kg (Pritchard et al., 1983). Juveniles and adults are red-brown to brown in colour, and hatchlings are sometimes gray.

Loggerheads have a wide oceanic distribution. In the Atlantic they are seen as far north as Newfoundland (Squires, 1954) and northern Europe (Brongersma, 1972) and as far south as Argentina (Frazier, 1984). Nesting grounds are often in temperate latitudes, with the greatest numbers of nesting females recorded in Florida (USA) and Masirah Island (Oman). As recently as the last quarter of the twentieth century an estimated 14,150 females nested annually on the Atlantic coast of Florida (Murphy and Hopkins, 1984; Ehrhart, 1989; NMFS and USFWS, 2007a), but today this colony, the largest in the Western Hemisphere, is declining (NMFS and FWS, 2008). Moderate nesting populations are also found in Mexico, the Bahamas, and Cuba, with occasional nesting on Eastern Caribbean islands (Ehrhart, 1984, 1989, 2003; Dodd, 1988; Dow et al., 2007).

In Jamaica, loggerhead nesting has been reported at different times on about one third of the known turtle nesting beaches, mainly on the northeast and southwest coasts (Kerr, 1984; STRN 1995 survey, unpubl. data). In the past, it appears that this species nested regularly on the Morant and Pedro Cays between April and July (Lewis, 1940, 1947), but no nesting attempts were observed at the Morant Cays during the months of April to June, 1982-1987 (A. Haynes-Sutton, pers. observ.) and there has been only one unconfirmed report of egg-laying since that time (STRN, unpubl. data).

The species' juvenile years are characterized by trans-Atlantic movement. According to the current theory, hatchlings from beaches in the southeastern USA leave their natal beaches and are carried passively on the North Atlantic subtropical gyre in *Sargassum* seaweed rafts to areas of the eastern North Atlantic, including the Azores. After several years of pelagic (=open ocean) existence, juveniles, typically 50-65 cm (20-25 inches) shell length, return or are returned by currents to the western North Atlantic to become resident benthic (=bottom) feeders on the continental shelf (Bolten, 2003). Early studies of Florida loggerheads suggested that individuals reached sexual maturity at 12-30 years old, but as our understanding of this species has advanced, the estimate has been extended to “closer to 30 years” (Frazer and Ehrhart, 1985) and then 32-35 years (NMFS and USFWS, 2008).

Data from the Atlantic coast of the USA suggest that loggerheads lay up to 7 clutches of eggs per year (Addison 1996a,b), averaging 48-159 eggs each (Frazer and Richardson, 1985; Ferris, 1986). The main nesting season in the USA is May to July, and nests in Jamaica have been reported from April through August. Females arrive at their nesting beaches asynchronously and nest independently of one another, returning to nest along the same shore at intervals of (typically) 14 days (Dodd, 1988). Well-studied populations in the USA indicate that loggerheads nest every 2.5-3.5 years (summarized by Schroeder et al., 2003); the same periodicity would be expected to characterize individuals nesting in Jamaica.

Quantitative data are scarce, but it appears that the decline in nesting populations of loggerheads in Jamaica since the 1940s has been so serious that it is uncertain whether loggerheads can still be counted among the breeding herpetofauna of Jamaica. Historically, loggerheads were killed for meat and their eggs were taken (Lewis, 1947). However, despite the many beaches where loggerheads nested in the past (see Kerr, 1984), there is no evidence – beyond an unconfirmed report to STRN from Guts River, Manchester, on the south coast in 1993 – that the species nests in Jamaica today.

Corresponding declines in observations and catches of loggerheads have occurred in Jamaica's territorial waters. In 1982, fishermen reported seeing and catching loggerheads throughout Jamaica's coastal shelf (Kerr, 1984; Figure 5), yet there were only four confirmed observations in the 1990s. Two of these were in April 1992 at the Port Royal Cays, a third at Spanish Anchor reef, Runaway Bay in August 1994 (STRN, unpubl. data), and a fourth is an undated report of a loggerhead reportedly maliciously blinded by fishermen in Portland Bight and then killed two weeks later (C. Blount, pers. comm. to T. Williams, 1992). According to local residents, there were predictable seasonal observations of loggerheads in Old Harbour Bay until recent times; today such sightings are extremely rare.

2.2 *Chelonia mydas*, Green Turtle

The green sea turtle is recognized by its round, blunt beak with slightly serrated cutting edges, a single pair of large prefrontal scales between the eyes, and four pairs of lateral carapace scutes that do not overlap one another (Figure 4). The shell is light to dark brown in colour, sometimes shaded with olive, and has radiating wavy or mottled markings of darker colour or with large blotches of dark brown. The plastron or belly plate is whitish or light yellow (Carr, 1952). The carapace is generally devoid of barnacles. Adults can attain weights of 230 kg (Pritchard et al., 1983) and generally measure 95-120 cm in straight carapace length. A mean carapace size of 100.2 cm (n = 2107) is reported from the Caribbean nesting beach at Tortuguero, Costa Rica (Bjorndal and Carr, 1989).

Of the two species (hawksbill and green) most frequently reported in Jamaica, the green turtle is much less abundant at the present time. There are far fewer green turtles in the water and using the nesting beaches than in years past (see section 3.3).

Based on studies elsewhere in the Caribbean and other regions of the world, it is unlikely that individual green turtles remain in local waters throughout their lives. Hatchlings emerge from their nests, scurry to the sea, orient offshore in a swimming frenzy that persists for several days (Wyneken and Salmon, 1992; Okuyama et al., 2009), and ultimately enter an offshore convergence or weed line. The *Sargassum* seaweed rafts shelter hatchling green turtles and harbour a diverse, specialized fauna, including many kinds of small fishes, crustaceans, worms, mollusks, tunicates, and coelenterates which may provide food for the young turtles (Carr, 1987). The turtles remain epipelagic (surface dwelling in the open sea) for an unknown period of time (perhaps 1 to 7 years) before taking up residence in continental shelf habitats.

Green sea turtles return to coastal waters as young juveniles and become herbivorous (Bjorndal, 1985). In the Caribbean, they feed primarily on the seagrass *Thalassia testudinum* (Bjorndal, 1980, 1982), commonly referred to as “turtle grass.” Field studies indicate that individual turtles maintain feeding “scars” by returning to the same area of seagrass bed to forage each day. These scars, or grazing plots, are maintained by regular cropping for several months and the more digestible newer growth (rich in nutrients and lower in lignin) is preferred. When the cropped grasses show signs of stress (blade thinning, increased inter-nodal distance), the turtles apparently abandons the scar and moves on to form another.

Evidence suggests that turtle grazing increases the productivity of seagrass (which in turn provides critical habitat for commercially important fishes and mollusks), thus green turtles play an important ecological role in this community (Thayer et al., 1984). Within Jamaica waters, green turtles have been reported throughout the year in seagrass beds all around the coast, but there are few confirmed observations of feeding. Preliminary examination of data from dive operators suggests that turtle sightings are most frequently reported in January; however, these sightings may be correlated with the frequency of divers during the winter tourist season (STRN, unpubl. data).

Juvenile green turtles travel extensively and in the years and decades preceding reproductive maturity take up temporary residence in many locations (Carr et al., 1978). Upon reaching maturity, they migrate to mating and nesting grounds, the latter presumed to be their natal (birth) beach. Caribbean green turtles reach sexual maturity at an estimated 18-36 years of age (reviewed by Frazer and Ladner, 1986; Bjorndal et al., 2000). There is evidence that adults return to resident foraging grounds after nesting

(e.g., Troëng et al., 2005). Therefore, the movements of adults are likely to be less extensive than those of juveniles, since adults move seasonally between relatively fixed feeding and breeding areas. Nevertheless the distances traveled by adults between feeding and breeding areas can be several hundreds of kilometers (Ogren, 1984; Hays et al., 2002).

Historical accounts describe annual migrations from breeding grounds on the Cayman Islands to feeding grounds around the southern cays of Cuba and then to the gulfs of Honduras and Mexico and adjacent coasts in the western Caribbean (Sloane, 1725; Leslie, 1740). Recoveries of tagged green turtles tend to support these accounts. A green turtle tagged in Nicaragua in the 1960's was recovered on the Morant Cays, Jamaica (Carr, 1967). Duerden, (1901 *in* Rebel, 1974) cited evidence of marked turtles (species not recorded) traveling from Jamaica to the Miskito Coast, Nicaragua. A green turtle tagged while nesting at Aves Island, Venezuela, was later killed by a fisherman in Jamaican waters (G. Solé, FUDENA, pers. comm., 1995). A series of banks which span the Caribbean between Jamaica and Nicaragua could provide a chain of suitable feeding habitats to support this migration.

In the 1850s, green turtles were the most common sea turtle species in Jamaica (Hill, 1855) but, by the 1940s, nests were rare (Lewis, 1940). In a 1982 interview survey of fishermen, nesting was reported to occur on only seven beaches (Kerr, 1984), mostly on the northeast and southwest coasts (Table 1, Figure 6), and since then there have been only three reports of nesting on the mainland. A green turtle with partially developed eggs washed ashore dead at Southsea Park, Westmoreland, on 24 April 1996 (P. Marra, Dartmouth College, pers. comm.), but comprehensive surveys of selected cays in Portland Bight in 1995, 2002 and 2003 failed to confirm any green turtle nesting (STRN, unpubl. data). Since then, rare but confirmed nests have been observed or located on Malcolm's Bay, St. Elizabeth; Pedro Cays on the Pedro Banks and Reggae Beach and Oracabessa, St. Mary (A. Donaldson, NEPA, pers. observ.)

The nesting season as reported by Jamaican fishermen varies, but typically it is cited as "May – September" or "May - December" and some reports suggest a peak in June - August (Kerr, 1984). Data from other parts of the Caribbean Sea indicate that a female typically lays 2-6 clutches of eggs every 2-4 years (for a global summary, see Hirth, 1997). Clutches (typically consisting of 125-130 eggs, but with variation among sites: Hirth, 1980) are laid at 9-15 day intervals during the nesting season (Hirth, 1997). By the end of the twentieth century, breeding populations of the green turtle in Jamaica have been virtually extirpated, and the biology and ecology of this historically prominent species in our waters may never be known. Systematic beach surveys are needed to determine if any green turtles still nest on the shores of Jamaica or the offshore cays (section 4.112).

2.3 *Dermochelys coriacea*, Leatherback Turtle

This species is referred to as "leatherback" or "three-keel" and is the largest of all the sea turtles. The largest leatherback on record was a 916 kg (2015 lb) male that washed ashore dead on the coast of Wales, U.K. (Morgan, 1989). Females nesting in the Caribbean typically weigh 250-500 kg. Leatherbacks lack a bony shell as adults (hence their common name) and the smooth black skin is mottled with pale spots. The carapace is strongly tapered, measures 130-165 cm in straight length, and is raised into seven prominent ridges. Powerful foreflippers extend to nearly the length of the body (Figure 4). Leatherbacks are found in the tropics, as well as in cold Canadian and European waters; they have the most extensive range of any reptile. Females depart seasonally from northern latitudes and arrive asynchronously at their Caribbean nesting beaches (Eckert and Eckert, 1988). Virtually nothing is known of the distribution or habits of adult males (but see James et al., 2005) or juveniles of either sex (Eckert, 2002).

Although nesting by leatherbacks is apparently very rare in Jamaica, the species is known to fishermen, and Portland fishermen interviewed in 1995 consistently identified the species correctly (Fisheries Division, 1995). Data collected at the well-studied nesting beach at Sandy Point National Wildlife Refuge (St. Croix, U. S. Virgin Islands) indicate that each female deposits an average of 6-7 clutches of eggs at 10-day intervals (range 7-13 days) during the nesting season. Females generally return to nest every 2-3 years, but on rare occasions individuals may nest in consecutive years and sometimes females return

after intervals longer than three years. Clutch size is typically 60-100 yolked eggs, averaging 85; a variable number of smaller, yolkless eggs is also deposited (Maros et al., 2003). The eggs incubate in the sand at a depth of 60-70 cm. Hatchlings emerge from the nest, generally at dusk, 60-65 days after egg-laying (e.g., McDonald et al., 1991; Hilterman and Goverse, 2005).

There have been only 12 reports of leatherback nesting in Jamaica since 1851 (Figure 7). Even accounting for the absence of consistent monitoring or reporting, the fact that only six published records exist emphasises the historical rarity of this species in Jamaica. No beaches with leatherback nesting activity were identified by fishers in a 1982 national survey (Kerr, 1984). In 1983, a leatherback was reportedly killed offshore at Goat Island. A decade later, a possible nesting attempt was reported from Parottee Beach, St. Elizabeth, on 20 April 1993; fishermen reported (to R. Kerr) killing and taking the eggs from a nesting leatherback on Northeast Cay (Morant Group) in September 1995; and a nest which was probably a leatherback's was seen on Southeast Cay (Morant Group) on 20 October 1995 (R. Kerr, pers. observ., 1995). A single nest was laid at Rose Hall, St. James, during each of the years 2003 and 2004, based on hatchlings observed by park security staff. Finally, over the course of 15-20 years, fishers have brought three or four leatherbacks ashore that were entangled in buoy lines (from fish traps) in Old Harbour (C. Moodie, fisherman, pers. comm., 2005).

Studies deploying time-depth recorders on gravid females nesting in St. Croix have shown that individuals routinely spend the inter-nesting interval diving to an average depth of about 60 m, and have attained maximum depths exceeding 1000 m (Eckert et al., 1986, 1989). 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 dive behaviour may reflect nocturnal feeding on vertically migrating zooplankton, chiefly siphonophore and salp colonies. No one has ever reported seeing leatherbacks foraging in Jamaica (STRN, unpublished data) and little is known of their inter-nesting range or behavior.

No subsistence or commercial markets are recorded. Despite historically well-developed markets for leatherback oil in some Eastern Caribbean islands (e.g., Grenada, Tortola, St. Kitts), no such commerce emerged in Jamaica.

2.4 *Eretmochelys imbricata*, Hawksbill Turtle

The hawksbill or “carey” is the most common turtle in Jamaican waters, particularly in areas with coral reefs where it can be observed swimming, feeding, and resting. The species is identified by a narrow, pointed beak and two pairs of prefrontal scales between the eyes. The carapace is often posteriorly serrated and the scutes overlap like shingles on a roof (Figure 4). Adults rarely exceed 80 kg (175 lb) with a straight-line carapace length of about 90 cm (Pritchard et al., 1983). Bright, mottled, colouration (brown, orange, gold) is common.

Recent studies suggest that while hawksbills in the Caribbean consume a wide variety of food, they feed mainly on sponges especially two orders of *Demospongea sp.* (see Witzell, 1983). Meylan (1988) found that sponges contributed 95.3% of the total dry mass of food in samples from the digestive tracts of 61 hawksbills from seven Caribbean countries. In the same study, 10 sponge species accounted for 79.1% of the dry mass of all sponges identified in the stomachs of these animals, suggesting some dietary selectivity. Healthy coral reef habitats have decreased by more than 90% since 1980, and this dramatic loss of live coral in Jamaican waters is likely to emerge as a serious impediment to the recovery of this species of sea turtle (see section 3.11).

High-density nesting is relatively rare in the Caribbean Sea (Dow et al., 2007), making this species difficult to study. Population assessment is confounded by the nesting location; gravid females often nest on isolated beaches, including those flanked by exposed coral and rock, and some that are very small, making them difficult to monitor on a consistent basis. Nests are typically (though not always) made

under thickets of beach vegetation. Often there is little evidence of the nest, but for a faint asymmetrical crawl (about 0.7 m wide) leading to and from the sea.

Available data indicate that newly emerged hatchlings enter the sea and are carried by offshore currents into major gyre systems where they remain until reaching a carapace length of some 20 to 30 cm. At that point they recruit into a neritic developmental foraging habitat that may comprise coral reefs or other hard bottom habitats, seagrass, algal beds, or mangrove bays and creeks (Musick and Limpus, 1997). As they increase in size, immature hawksbills typically inhabit a series of developmental habitats, with some tendency for larger turtles to inhabit deeper sites (van Dam and Diez, 1997; Bowen et al., 2007). Once sexually mature, they undertake breeding migrations between foraging grounds and breeding areas at intervals of several years (e.g., Witzell, 1983; Mortimer and Bresson, 1999). Global population genetic studies have demonstrated the tendency of female sea turtles to return to breed at their natal rookery (Bowen and Karl, 1997), though as juveniles they may have foraged at developmental habitats located hundreds or thousands of kilometers from the natal beach (summarized by Mortimer and Donnelly, 2007).

One of the best known West Indian nesting beaches is Pasture Bay Beach (Jumby Bay Resort) on Long Island, Antigua. Data collected there indicate that over the course of the main nesting season (mid-June to mid-November) hawksbills nest at intervals of 13-18 days and make an average of five nests per season. After 2-3 years they return to the same beach to nest again (Corliss et al., 1989; Hoyle and Richardson, 1993). Lewis (1940) reported that, in Jamaica, hawksbills nested 3 or 4 times per year at 15 day intervals. In the Western Atlantic the average clutch size for hawksbills ranges from 120-160 eggs, with a typical incubation period of 60-75 days (Witzell, 1983). For hatchling hawksbills, like other species of sea turtle, sand temperature plays an important role in determining sex. Warmer incubation temperatures favour females, whereas cooler temperatures favour males (summarized by Carthy et al., 2003).

Hawksbills are the most common local nesting species, with nesting reported from many beaches around the island (Figure 8). According to residents, hawksbill nesting on Jamaican beaches was much more frequent in the past than it is currently (see section 3.3). All beaches surveyed by Kerr (1984) were described as hawksbill nesting beaches, but only about 12% have supported more than 10 females (ca. 50 nests) per year in recent memory. Hawksbills are less strongly seasonal in their nesting habits than the other species in Jamaica (Lewis, 1940). Nesting occurs throughout most of the year, but the main season seems to be mid-June to October (interpreted from Below, 1995). Twenty-five years ago the maximum number of nests per night was estimated to range from 1-5 per beach and the estimated number of nests per season ranged from fewer than 20 to as many as 150 on selected cays in the Portland Bight area (Kerr, 1984). In 1995, the maximum number of total crawls reported from a single cay in Portland Bight was 61 (interpreted from Below, 1995). A report of 500 nests per season at Malcolm Bay, St. Elizabeth (Kerr, 1984) seems likely to have been an exaggeration.

It is difficult to estimate the total number of hawksbills nesting on Jamaican beaches, but the best available information suggests that the tally is not likely to exceed 100 turtles per year. Based on the STRN's "Sea Turtle Summer Nights" surveys (1992-1995), the main nesting beaches are found on the Portland Bight cays, where 75 nests were made between July and October 1993, representing an estimated 15 females. Between May and November 1995, 163 possible nests and 59 known false crawls were counted on the cays which were intensively surveyed. Fifteen more possible nests and eight false crawls were counted on other cays. Based on these data, the nesting population of hawksbills in Portland Bight in 1995 was estimated at 25-30 nesting females (Below, 1995). Other important areas identified through the "Sea Turtle Summer Nights" and subsequent surveys include: the Palisadoes (Kingston) (where most nests are destroyed by dogs; Kerr, 1987); Portland Bight (selected beaches between Hellshire and Miller Bay); Rocky Cay/Sand Bank (the least accessible of the Portland Bight cays); Guts River to Old Womans Point (Manchester); Great Bay and Font Hill (St. Elizabeth) to Negril (Hanover); Boscobel (St. Mary); Holland Bay (St. Thomas); and the Morant and Pedro Cays (Figure 8). The “Sea Turtle Summer Nights” programme ended in 1996.

Early data on hawksbill distribution at sea in Jamaica were reported to WATS (see Figure 9), and are also available from aerial survey sightings, reports from the public, and information solicited from dive operators (STRN, unpubl. data), but most of these data are geographically and chronologically biased and difficult to interpret. For example, the 1982 aerial survey (see Figure 10) did not distinguish hawksbill turtles from other turtles observed at sea and reports from dive operators come only from selected dive sites. Nevertheless, the data do illustrate a broad distribution, with hawksbills observed at sea all around the island. The largest numbers of observations from aerial surveys were made along the south coast, especially Portland Bight, south St. Elizabeth and St. Mary. Most reports by dive operators were from Runaway Bay, Discovery Bay and Negril (STRN, unpubl. data), which correspond roughly with the distribution of dive shops participating in the programme. The majority of sightings were made between July and December and most of the turtles observed were small, estimated at 10-50 cm in carapace length (STRN, unpubl. data).

Nests are vulnerable to depredation by dogs, wild pigs, feral cats, rats, mongooses (*Herpestes auropunctatus*), and ghost crabs (*Ocypode* sp.) (STRN, unpubl. data). There are reports of nest destruction by mongooses (Below, 1995) and depredation by feral pigs (B. Wilson, pers. comm.) at Manatee Bay, St. Catherine.

2.5 *Lepidochelys kempii*, Kemp's Ridley Turtle

It is possible that the Kemp's ridley occasionally ventures into Jamaican waters, but all reports (Dunn, 1918; Underwood, 1951; A. Haynes-Sutton, pers. observ., 1982; P. Bacon, UWI, pers. comm., 1993; C. Moodie, pers. comm., 1995) are ambiguous and thus the occurrence of this species remains to be confirmed.

Some local fishermen can identify a Kemp's ridley from photographs (Tambiah, 1995), referring to it as "malatta" or "mulatta." A cranium belonging to this species was traded in Port Antonio in 1894 (Dunn, 1918 cited *in* Greenfield, 1984) and Underwood (1951) included this species in his list of Jamaican reptiles. In April 1982, there were two sightings of a group of about 200 small, round pale gray-green turtles resembling this species in Galleon Harbour in Portland Bight on the south coast during an aerial survey for manatees. However, from a height of about 300 m it was not possible to determine the species, only to observe that they were noticeably lighter in color and less than one-half the size of the other turtles observed during the survey (P. W. Fairbairn and A. Haynes-Sutton, pers. observ., 1982).

The Kemp's ridley is gray in colour when immature and primarily olive green as an adult (Pritchard et al., 1983). According to Ross et al. (1989), adults weigh 27-41 kg and have a shell length of 58-76 cm. The carapace is round, often as wide as it is long, and there are typically five pairs of lateral scutes (those on either side of the median of the shell) (Figure 4). The species is carnivorous and eats mostly crabs, but also preys upon other crustaceans, shellfish, jellyfish, sea urchins, starfish, and fish (Burke et al., 1993).

This species nests exclusively in the northern latitudes of the Wider Caribbean Region, primarily in Mexico and secondarily in the USA (Texas, Florida). Only three sites (all located in the state of Tamaulipas, Mexico) receive more than 1,000 nesting crawls per year (Dow et al., 2007) and the largest of these – Rancho Nuevo – received approximately 7,866 nests in 2006 (NOAA and USFWS, 2007b). This depleted population boasted more than 42,000 adult females nesting during *one day* in 1947 (Ross et al., 1989), but excessive commercial exploitation on the nesting beach and incidental catch (and drowning) in shrimp trawls plying the Gulf of Mexico eventually reduced the species to fewer than 500 nesting females per year.

Today the population is increasing, primarily due to intensive bilateral conservation efforts between the U.S. and Mexico, and is estimated at some 6,000 adults (Donna Shaver, U.S. National Park Service, pers. comm., 2005).

2.6 *Lepidochelys olivacea*, Olive Ridley Turtle

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 45 kg (Pritchard et al., 1983). Shell length of females nesting in Suriname, South America, ranges between 63 cm and 75 cm (Schulz, 1975). Each front flipper bears a single claw, the horny beak may be finely serrated, and carapace scutes do not overlap one another (cf. hawksbill turtle, section 2.4). The species can be distinguished from the other sea turtles by a relatively high and often asymmetrical number of lateral carapace scutes, mostly six or seven on each side and sometimes eight or nine (Schulz, 1975) (Figure 4). Other sea turtle species typically have 4-5 pairs of lateral scutes.

Olive ridley sea turtles nest primarily in the Guianas, with comparatively minor nesting reported from Trinidad and Tobago, Curaçao, and other southern Caribbean locations (Dow et al., 2007). A decline of more than 90% in the number of breeding-age adults in Suriname, until recently the region's largest olive ridley nesting colony, is attributed primarily to fisheries interactions (summarized by Reichart and Fretey 1993, Reichart et al. 2003). The number of nests laid in French Guiana was recently reported to be rising (Kelle et al., 2009). In 2007, an injured olive ridley was brought ashore in St. James; the animal was entangled in fishing gear.

III. STRESSES ON SEA TURTLES IN JAMAICA

Information based on historical literature suggests that local populations of sea turtles have declined severely since the fifteenth century (see sections I, II), together with interviews with Jamaicans who can recall the conditions of the sea life prior to World War II, indicate that populations have deteriorated further since the 1940s. The absence of baseline data makes it impossible to assess the relative importance of many possible contributions to the decline, but both direct exploitation and loss of habitat are implicated in the extirpation of three of Jamaica's four breeding species of sea turtle and the depleted status of the fourth (hawksbill). Despite a moratorium on sea turtle capture established under the Wild Life Protection Act in 1982, exploitation continues, periodically making national news (e.g., Anonymous, 1989). An overview of stresses to sea turtles in Jamaica is presented below and expanded in sections 4.13 and 4.14.

3.1 Destruction or Modification of Habitat

According to the Country Environmental Profile (GOJ, 1987), "habitat destruction is the single biggest contributor to the continuing decline of Jamaica's unique plant and animal communities." All qualitative and quantitative evidence suggest that nesting and foraging areas are under increasing stress from development, disturbance and pollution. Many beaches that once supported sea turtle nesting have been so heavily developed that successful nesting is no longer possible. Other threats are equally pervasive – e.g., more than 60% of 26 Jamaican beaches included in a recent survey showed signs of oil pollution (Jones and Bacon, 1990; Siung-Chang, 1997). Similarly, increasing levels of pollution in the Caribbean region generally (e.g., UNEP, 1989a; IOC/UNESCO, 1992) are likely to have an effect on sea turtles during the pelagic phases of their life cycle.

3.11 Foraging habitat

Destructive activities in coastal mangroves, forests, and other woodlands contribute to the deterioration of coastal water quality. Sea turtles depend largely on seagrass beds and living coral reefs for food and shelter. There has been no nationwide assessment of the health and status of seagrass beds, but studies within and near Kingston Harbour illustrate that they are negatively affected by pollution (Greenway, 1977; Green and Webber, 2003). Moreover, seagrass is often uprooted during dredging, hotel development, or beach improvement projects (see section 4.135). There was some interest in replanting sea-

grass beds in the 1980s (Thorhaug et al., 1983), but large-scale projects were never undertaken, probably because they had little chance of achieving their objectives until the underlying environmental problems were addressed satisfactorily. NEPA has taken a "no net loss of seagrass" policy nationally, and there have been attempts to mandate seagrass replanting to replace areas lost to development; e.g., development licences granted to Riu Jamaicotel Ltd. and Sandals Whitehouse. In the case of Riu Jamaicotel, replanting was undertaken but the success of the effort has not yet been documented.

Coral reefs and other habitats used by sea turtles for food and refuge are generally declining in quality and extent in Jamaica and throughout the Caribbean (UNEP, 1989a; Burke and Maidens, 2004). Despite evidence of recovery in some areas, Jamaica's coral reefs prior to 2005 showed that hard coral cover had declined from 50% in the 1970s to less than 5% by the 1990s due to hurricanes, urchin die-offs, coral diseases, and over-fishing (Wilkinson, 2008).

One estimate suggests that the roughly 400 km of reef in Jamaica provide a net value of billions of US dollars per year in derived goods and services – suggesting that coral reefs are the most valuable of Jamaica's marine ecosystems, perhaps even be more valuable per unit area than any terrestrial ecosystem in Jamaica (Goreau, 1992) – highlighting the fact that the nation has much at stake in maintaining the ecological health and economic value of coral reefs. Coral reef losses are a significant problem negatively affecting many important aspects of the national economy, including tourism, fisheries, and the built infrastructure that is protected by the reefs. Wilkinson (2008) concluded that the impact of coral reef degradation "will ripple throughout the fabric of the socio-economic environment in Jamaica" and that such degradation is likely to have contributed already to the ongoing decline of Jamaica's landed fish resources.

Physical damage (e.g., indiscriminant anchoring, dropping fish pots, dynamiting), disease, coral reef "bleaching", severe storm events (e.g., Hurricanes Alan in 1980, Gilbert in 1988, Ivan in 2004), pollution, and the input of sediment, nutrients and agrochemicals from the high rate of deforestation (World Resources Institute, 1994) are implicated in the deterioration of Jamaica's reefs. In addition, both chronic over-fishing and a disease which destroyed the majority of black sea urchins (*Diadema antillarum*) have led to a serious species diversity imbalance within the reefs and the smothering of corals by uncontrolled algal growth (Hughes, 1994). Finally, a decline in the health of reefs around Hellshire (1970-1984) is attributed in part to pollution from the metropolitan Kingston area (Goodbody, 1989).

Pollution and dredging of Jamaica's coastal waters have negatively impacted sea turtle foraging habitats. Fish kills and "red tides" in Kingston Harbour and along the northeastern and southeastern coasts are indicative of serious problems in the coastal marine environment. Major sources of pollution are industrial and agricultural effluent, garbage dumps and solid waste, and household sewage. Solid waste disposal is a persistent problem throughout the island, and many people dispose of their wastes by dumping it in gullies, riverbanks, and along roadsides. Plastic bags and packaging are ubiquitous components of the waste stream; they are particularly troublesome to marine fauna because they may be lethal when ingested by sea turtles that mistake them for jellyfish (e.g., Mrosovsky, 1981; Bjorndal, et al., 1994). Some of the waste is carried into coastal waters by rainwater, and by rivers and creeks. Partly as a result of this practice, Kingston Harbour is heavily littered by solid waste migrating from the landscape; the mangroves of adjacent Port Royal have nearly 50 cm of garbage around their roots (Green and Webber, 1996).

Additional sources of pollution are garbage sites and inadequately treated sewage. Garbage dumps of many large coastal towns are situated in mangrove swamps and the refuse is transported into coastal water systems by surface run-off. While efforts are made to ensure that environmental standards and regulations governing household sewage are observed for new resort areas, most coastal communities and towns still lack central sewage treatment facilities (Nangle, 2007).

Since the mid-1990s, there have been some efforts to address the issues contributing to degraded sea turtle foraging areas. A long-term plan to clean up Kingston Harbour began in 1996 with a Global Environment Facility of the United Nations Development Programme (GEF/UNDP) project to control land-

based sources of pollution. This “Heavily Contaminated Bays and Harbours in the Wider Caribbean” project sought to develop an integrated investment proposal for rehabilitation work in the Kingston Harbour – the result was the Soapberry Wastewater Treatment Plan, which resulted in a treatment facility constructed in the St. Catherine parish (adjacent to the Kingston Harbour) to service the communities of Kingston and St. Catherine (GOJ, 2007).

There is an ongoing programme to develop a database of the conditions of reefs in Jamaican waters. Initial efforts (2001-2005) of the Global Coral Reef Monitoring Network (GCRMN) focused on pilot sites, including Portland Bight, Port Royal Cays, and Negril, and they concluded that reefs were generally recovering. However, Portland Bight suffered major damage during Hurricane Ivan in 2004, in part because much of the re-growth had occurred on dynamite-blasted coral rubble. The NRCA Coastal Zone Management Project has mapped coastal resources and assessed the scale and nature of historical and contemporary threats to improve the framework for managing marine systems. In a related effort, NEPA collaborated with WIDECAST and The Nature Conservancy (TNC) to characterise and map beaches nationwide (Dow et al., 2007).

While it is important to consider the stresses faced by sea turtles in non-Jamaican foraging habitats when developing conservation plans (see section 4.33), the extent to which Jamaican-born sea turtles depend on feeding grounds in other countries is not well known. All sea turtle species are highly migratory, but migration and foraging patterns are not well understood for any population in Jamaica. There is evidence that green turtles from Jamaica and the Cayman Islands historically migrated to Cuba and Central America (see section 2.2), and hawksbills observed in Jamaica migrated from Nicaragua (Nietschmann, 1981). A collaborative project between NRCA, STRN, and the U.S. National Marine Fisheries Service deployed satellite transmitters on two hawksbills nesting at Half Moon Cay, Portland Bight, in 1999 and two hawksbills nesting at Tower Isle, St. Mary, in 2000. Data was transmitted for up to six months and indicated that two animals took up residence in foraging grounds in Jamaica (one off the coast of St. Elizabeth, and one on the Pedro Bank), and two migrated to Central America (R.K. Bjorkland, Duke University, unpubl. data).

3.12 Nesting habitat

Suitable nesting areas are critical to the reproductive cycle of sea turtles. Nevertheless, lack of public awareness of the ecological importance of sandy beaches to sea turtle survival and the low economic importance of sea turtles in terms of a direct connection to the Jamaican economy appear to have conspired to create a lack of safeguards to protect important sea turtle habitat during the planning and implementation of coastal projects. Research (summarized for the Caribbean region by Choi and Eckert, 2009) shows that some of the most important factors contributing to the destruction and degradation of nesting beaches are:

- *coastal developments*: siting of hotels, villas, and industrial complexes and the associated removal of coastal vegetation (e.g., mangroves, seagrasses); expansion of garbage dumps; increased artificial beachfront lighting; and assorted types of pollution associated with human populations
- *physical barriers* to sea turtle nesting and hatching: beachfront fencing of private property; sunbeds, cabanas, umbrellas, sail boats and other recreational equipment parked or left on sandy beaches
- *anthropogenic changes* in beach topography: construction of groynes and other structures to "stabilise" the shoreline; coastal roads; sand mining; commercial and residential beachfront development; and the disturbance of coastal wetlands
- *natural changes* in beach topography: hurricanes, storms and other natural processes. The effects of these events have been exacerbated where natural beach processes have been disrupted and natural protective barriers (e.g., coral reefs, mangroves) removed. These effects are expected to increase with global climate change (McGregor, 1995; Fish et al., 2005, 2008, 2009)

- *human presence* on the beaches and cays: more potentially disruptive activity from tourists and residents; extraction of resources from mangroves and coastal wetlands; and illegal fishing camps, especially on the cays
- *exotic predators*: mongooses, rats, and feral dogs, cats and pigs which generally are associated with increased human presence
- *pollution*: oil, solid waste, agro-chemicals, sewage seeps, and pesticides
- *compaction of beach sand*: by pedestrians, horses, cattle, donkeys and vehicles on the beach (e.g., motorcycles, sand mining trucks, and recreational vehicles).

New interest in developing the relatively unexploited south coast for tourism is a potential threat to the beaches and coastal wetlands that have been relatively safe havens for sea turtles. Despite recommenddations in the Master Plan for Sustainable Tourism Development (GOJ, 2001) and the South Coast Development Plan (Sir William Halcrow and Partners Ltd. 1999; Wilson, 2002) to conserve nesting habitat on sensitive beaches for sea turtles and crocodiles, the GOJ has permitted some construction activity (e.g., Sandals Whitehouse) resulting in the destruction of significant segments of pristine beach and coastal wetland. With major hotels proposed for most remaining sandy beaches, it is crucial that lessons learned from poorly conceived beachfront development along the west and north coasts be applied to the planning process for the south coast. See section 4.13 for relevant recommendations.

3.2 Disease or Predation

There are no data on the extent to which disease affects sea turtles in Jamaica. However, diseases are unlikely to be detected because there have been few reports of turtle strandings and there is no systematic monitoring of local populations. Green turtle fibropapillomatosis disease has been reported throughout the Western Atlantic (e.g., Jacobson, 1990; Guada et al., 1991; Ehrhart, 1991; Williams, et al. 1994; Aguirre, et. al., 2000; Greenblatt, et al., 2005), but it has not been confirmed in Jamaican waters. However, this lack of confirmation does not exclude the possibility that it is present. This debilitating and potentially fatal disease is caused by a herpesvirus-like infection that burdens the turtle with internal and/or external tumours which may cause, inter alia, blindness and starvation. Scientists do not yet know the mechanism of transmission. WIDECAST has provided photographs of afflicted turtles and other relevant information to the Fisheries Division. Suspicious cases should be reported to the Fisheries Division (tel: 923-8811) or the NEPA (tel: 888-991-5005). Under no circumstances should diseased turtles be offered for human consumption.

Natural predators of Caribbean sea turtles differ among life stages. Eggs and hatchlings are mostly taken by birds (e.g., frigate birds, *Fregata magnificens*; vultures, *Cathartes aura*; gulls, *Larus atricilla*), crabs, especially the ghost crab (*Ocypode* sp.), and, once the hatchlings enter the sea, a variety of predatory fishes. Populations of some large predatory fish are declining in Jamaica as a result of over-fishing (Aiken and Haughton, 1985), so fewer hatchlings and young juveniles may be lost to this source of predation at present than in the past. On the other hand, the number of hatchlings coming off Jamaica's beaches is so vastly reduced from previous decades that “safety in numbers” may no longer be an option for the small, vulnerable turtles. Larger juveniles and adults occasionally fall prey to sharks. Tiger sharks (*Galeocerdo cuvieri*), for example, are known to consume hawksbills in the Caribbean (e.g., Boulon, 1984; Young, 1992; Fuller et al., 1992).

Exotic mammals, such as mongoose, dogs and rats are important nest predators in some parts of the Caribbean, including Jamaica. Boulon (1984) estimated that 50-60% of hawksbill nests laid on Buck Island (St. Croix) in 1980-1981 were lost to mongoose. In Jamaica, a nest at Gut River was destroyed by a mongoose (J. Voordouw, UNEP, pers. comm., 1993), and there are several reports from the “Sea Turtle Summer Nights” programme of rats eating hatchlings in the Portland Bight area (e.g., A. Donaldson, NRCA [now NEPA], pers. observ., 1993). Five nests found along 1 km of the Palisadoes peninsula were dug up by dogs in 1983 (R. Kerr, pers. observ.), and a nest was reportedly attacked by a cat at Half Moon Hotel, St. James, in 1993 (M. Miller, Montego Bay Marine Park, pers. comm., 1993). Below (1995) noted that mongooses, rats, “birds”, ghost crabs (*Ocypode* sp.), and a feral cat preyed on hawksbill nests in

Portland Bight in 1995, and wild pigs were suspected of destroying nests at Manatee Bay on the Hellshire coast (Byron Wilson, UWI, pers. comm.). The proportion of nests lost to these predators is unknown, but the numbers of dogs, cats, rats, and mongooses grow with human populations and may pose increasing problems, even on relatively remote beaches and cays.

3.3 Over-utilisation

Historical overview: Sea turtles probably have been hunted by humans since the first people arrived in Jamaica and Central America. The middens in Jamaica reveal that sea turtles were an important part of the diet of early inhabitants, such as the Tainos, in part because of the paucity of large land mammals (e.g., Johnston, 1976; Wing, 1977). Many Taino settlements were located in coastal areas known to have been important to sea turtles, and turtles featured prominently in their art (Tyndale-Biscoe, 1962). Lewis (1940) noted, “The turtle population of West Indian waters has been ruthlessly preyed upon without respite for hundreds of years. The most serious phase of the destruction is the taking of eggs from nests and the killing of females when they are at the top of the beach for egg-laying.”

Sea turtles from Cayman were harvested to feed the occupying British forces following their occupation of Jamaica in 1655. The supply of sea turtles from the Cayman Islands seemed infinite and the “new” inhabitants benefited from "this never-failing resource of turtle, or their eggs, conducted annually as it were into their very hands" (Sloane, 1725). Once landed, turtles were impounded in turtle crawls or palisadoes until they were sold. Remnants of these palisadoes have been found in excavations of the sunken city of Port Royal (Sloane, 1725; Radcliffe, 1972), and several places in Jamaica have names which suggest they were used for this purpose.

The early colonists considered only the green sea turtle to be edible (Sloane, 1725), but the eggs of all species were readily consumed. Later occupants ate all sea turtle species. In the early 18th century, turtles were a major part of the local diet, “especially of the poorer sort of the Island” (Sloane, 1725), and annually, ships came to the Cayman Islands (administered as part of Jamaica until 1962) from all over the Caribbean to obtain supplies of turtle meat from May to July (Blome, 1672). Turtle meat was still commonly eaten in the early twentieth century; Mandeville resident, Mr. Arthur W. Sutton, remembered turtle meat vendors routinely walked the 32 km from Alligator Pond (where the turtles had been landed) to Mandeville. Shells were generally considered waste (A.W. Sutton, pers. comm., 1995); however, very small pieces used to make salt spoons were prized because they would not corrode.

In addition to supplying the market for local consumption, green turtles were shipped live from Jamaica and the Cayman Islands to England for use in turtle soup. The soup was considered a delicacy and a traditional feature at the annual Lord Mayor's Banquet in the London. Live green turtles were shipped from Jamaica to England in casks or turned and lashed to the decks (Beckford, 1790), and this practice continued until the twentieth century. Mr. Sutton of Mandeville (see preceding paragraph) remembers seeing green turtles lying on their backs on the deck during his 1927 voyage to England from Jamaica. He recalls that there were about ten very large turtles on board and that they were sprinkled with water “quite often” to keep them alive (A.W. Sutton, pers. comm., 1995).

Historical data for Jamaican turtle exports are difficult to interpret because they include all products shipped through Jamaica and collected in waters administered by Jamaica such as the Cayman Islands. Records show a decline in exports since the beginning of the twentieth century. In 1900, Jamaica exported green turtles worth £7,248 and hawksbills worth £1,693; the 1929 export of 1,834 green turtles were worth £3,668 and 1,850 hawksbill turtles worth £5,982. Only 348 green turtles were exported in 1934, and, in 1945, an estimated 300-600 turtles (mostly hawksbills) were exported (summarized by Rebel, 1974). By WWII, green turtles (once the most abundant nesting species on the Morant and Pedro Cays), had been extirpated by commercial hunters and only hawksbills and loggerheads remained (Lewis, 1940). Turtles of the Cayman Islands apparently had been so exhausted by 1940 that part of the Cayman Brac turtle fishing fleet was stationed at the Morant and Pedro Cays annually during July and August. Fishers took every hawksbill weighing more than 4.5 kg, thereby eliminating a large portion of

the pre-breeding population. Considering this level of exploitation, "it seems remarkable that any turtle exists in our waters today" (Lewis, 1940).

Fishing industry surveys in 1962-1963 (Chuck, 1963) and 1968-1969 (Nembhard, 1970) show a decline in the annual numbers of turtles caught (reflected in landed weight) (Figure 11). Kerr (1984) reported that, in 1982, out of approximately 9,000 Jamaican fishermen, most had probably participated in the sea turtle fishery at some time: 2,187 were actively involved in the turtle fishing effort, 50 were involved in its processing, and 926 in selling turtle meat. Additionally, the 100-150 people reported to be involved in taking eggs disturbed at least 100-150 nests and collected about 30,000 eggs annually (Kerr, 1984).

Migratory species are affected by hunting pressures throughout their range, and the decline of the green turtles is a good example. Green turtles on the coasts of Nicaragua (one of the largest feeding grounds in the Western Hemisphere) have been subjected to intense hunting pressure since the 1960s when subsistence hunting was replaced by commercial enterprises (Nietschmann, 1971). Between 1969-1976, up to 10,000 green turtles were exported annually, significantly reducing the population (Nietschmannn, 1979). Although data suggest that the last large decline in Jamaican populations of green turtles occurred at least 20 years earlier, intense hunting of turtles in their foraging grounds portend the difficulty of re-establishing viable populations in Jamaica.

Historically, the egg harvest has been relentless and impossible to accurately quantify. Following an inspection of the Pedro and Morant Cays (to verify the harvest of sea bird eggs), Lewis (1947) noted, "The turtles, especially in the vicinity of the Pedro Cays, have increased in number", presumably because World War II (WWII) created shortages of fuel and other supplies needed by the fishermen for their long journeys. Lewis added, "Many nests were dug (on the Pedro Cays) during the (bird) egg collecting season. Probably most of these were Loggerhead nests. I believe that the lessee made a sincere effort to protect the turtle. I also believe that many of the nests were left untouched but certainly not all of them. It must be pointed out, however, that without very careful and conscientious supervision, it is very difficult to control the illegal capture of turtle which is always in great demand in Kingston. It is even more difficult to protect turtle nests!"

Contemporary situation: There are indications turtle harvesting in Jamaica is still widespread. It is impossible to quantify the full extent of this activity because of the illegal nature of the fishery and the dispersed coastal population. Charles Moodie, a former turtle fisherman from Old Harbour, recalls "vast numbers" of sea turtles in the West Harbour area of Portland Bight, especially near Anne's Reef and Conneyfish Shoals. In the early 1990s, a trip to the area would include sightings of 50-60 turtles; five years later sightings would fall to half that number (ca. 25) and, by the end of the twentieth century, to about five. Today, sightings of 1-2 turtles would be "a lot" and the animals are noticeably more "nervous". Moodie also notes the peculiar situation where "mid-size" turtles have disappeared from traditional fishing grounds, and at the present time one is likely to encounter only newly recruited (3-4 kg) turtles or adults. The reason for this unique demographic composition appears to be the routine targeting of juveniles, which provide only what a single family can consume because possession of the meat is illegal.

Mr. Moodie remembers loggerhead populations "so vast" in the 1960s that fishermen caught them by hook and line (using various species of fish as bait) in Galleon Harbour and Portland Bight (the largest of the 'mud harbours' on the south coast and favoured loggerhead habitat). Subsequent use of long gillnets extirpated them, and coastal gillnets were so effective at capturing green turtles journeying between seagrass beds and mangrove coasts that they are rarely seen today.

Fishermen have increasingly turned to spear-fishing techniques in part because of the damage to nets resulting from increased motorboat traffic and because of the wider availability of compressed air tanks. With increased spearfishing, some boats contribute 3-4 sea turtles per day to the informal market (C. Moodie, pers. comm., 2005). The more effective noose and hook-and-stick methods of spear-fishing was learned from immigrant Honduran and Nicaraguan fishers who were hired to crew lobster and conch

boats in Jamaica. Hawksbills are the most common species landed by spear-fishermen and they are more at risk because of the increased use of this technique to illegally harvest them.

Sea turtles are taken illegally at sea, as well as on nesting beaches. Despite periodic reports from concerned residents of turtle killings, the majority of incidents go unreported. Few nests found by human or other predators are left undisturbed unless they occur on hotel, private, remote or inaccessible beaches. A survey indicated that at least 30 turtles were killed illegally between Alligator Pond and Negril (STRN, unpubl. data) and at least five adults and five juveniles were poached in Portland Bight in 1995 (these are the most recent data available to the authors).

While there are no longer any specialized turtle fishermen and the use of traditional gear, such as turtle nets and decoys, is seldom practiced, interviews conducted during the development of this action plan confirm that fishermen travel to the Portland Bight Cays "regularly" to collect eggs and to kill adult turtles on the nesting beaches. In areas where nesting is most frequent, including Portland and St. Thomas, men spend nights on the beaches waiting for nesting turtles to come ashore. Although statistics on incidents of sea turtle killings and egg poachings are lacking, anecdotal evidence suggests that this practice continues in Portland Bight and on the Pedro Cays although most fishers are aware that it is illegal. It is hoped that the newly-declared Fish Sanctuaries will, once they are operationalised, help to protect some nesting beaches.

Even though the presence of beach patrollers, nest monitors, and other interested par-ties on the beach at night may discourage poaching, conservation volunteers still report incidents of defending nesting turtles from hunters. These volunteers suspect that the poachers persist in their efforts to take turtles and eggs, and that they monitor the beach in order to know when the turtle returns to nest again. It is important for enforcement personnel to recognise the need to employ strategies to target groups using different turtle harvesting methods. For example, between Savanna-la-Mar and Negril, most turtles are taken by spear-fishermen, whereas from east of Savanna-la-Mar to Alligator Pond, many sea turtles are poached from nesting beaches, including from the Pedro Cays (C. Moodie, pers. comm., 1995 and reaffirmed 2005).

Faced with declines in fish catches, turtles have been reported as an important supple-mental source of meat and income for some fishermen (Tambiah, 1995). Turtles are caught as bycatch by many fishermen; Portland Bight fishermen claimed to Tambiah (1995) that 99% of turtles caught were incidental catches. Sport divers, too, occasionally take turtles using spearguns with little intervention on the part of the operators. Additionally, there is very little known about the extent of the harvest in the open waters of the EEZ and beyond, but larger fishing vessels traveling between the Miskito Cays and the mainland are known to have sea turtles among their catch (C. Moodie, pers. comm., 2005). Currently the Pedro and Morant Cays are vulnerable to continuous hunting pressure for sea turtles and other protected resources; however, some reports suggest that fishers do not intentionally bother turtles on the main nesting cay (A. Donaldson, NEPA, per. observ., 2007).

While the extent of the illegal sale is not known, there is documented evidence of sea turtle products available in selected markets. As a result of the illegal nature of the trade, sea turtle products are available only through informal networks of fishermen and consumers. All parts of the turtle are used, and the majority of turtle meat is consumed by the fishermen and their families as observed in the Portland Bight area (Tambiah, 1995). Often a turtle is brought ashore and kept alive, sometimes secured in a net along an inland river bank to avoid detection until a buyer can be found. The meat is used for stew or soup and the shell may be sold to tourists or residents as souvenirs or ornaments. Turtle soup and meat were openly advertised in 1995 in restaurants in Rocky Point (Clarendon parish) (A. Haynes-Sutton, pers. observ., 1995), Negril, and in a market in Black River. Reports of turtle consumption in restaurants in Old Harbour have been reported to NEPA as recently as 2009 (A. Donaldson, pers. comm., 2010).

Turtle eggs traditionally have been used in an "aphrodisiac" punch known as a "front end lifter" (P. Espeut, SCCF, pers. comm., 1995). This concoction, which included raw turtle eggs, stout, wine and condensed milk, remains on the menu at a restaurant in Savanna-la-Mar (C. Moodie, pers. comm., 1995 and reconfirmed 2005). The stretched skin of the turtle penis, known locally as "turtle pride", or "cod" was sold as a sexual inducer for J$70 (about US$10) per 2.5 cm in 1992 (T. Williams, SCCF, pers. comm., 1992; STRN, unpubl. data) or added to drinks (D. Hudson, pers. comm., 1992). More current information was not available to the authors. It is a recommendation of this Recovery Action Plan that a comprehensive market survey be designed and implemented to determine the extent to which sea turtle parts and products continue to be available through formal and informal markets in Jamaica.

Tortoiseshell: Hawksbill turtle shell (tortoiseshell) was important in Jamaica's early trading history (Long, 1774). Raw shell was imported (Edwards, 1793) and both raw shell and tortoiseshell products were exported (primarily to England) (Long, 1774; Hart, 1983). In writing about early tortoiseshell products, Hart (1983) noted that "of the many and varied collections owned by the Institute of Jamaica, one of the most immediately appealing and interesting must surely be the 17th century tortoiseshell [including] wig comb cases (many complete with combs) and boxes." The cases, boxes and related items were often intricately engraved with Coat of Arms designs, locking mechanisms, and sterling silver adornments (Cundall, 1929, 1936) and probably represented some of the earliest art objects made in the British West Indies displaying European influence.

International trade in un-worked (raw shell) turtle products was banned in 1955 under Trade Law 4, but no regulations existed that covered the export of finished products until the year 2000 when Jamaica passed the Endangered Species (Protection, Conservation and Regulation of Trade) Act to implement the Convention on International Trade in Endangered Species (CITES, see section 4.311). In 1987, five years after turtles were protected under national law (see section 4.211), TRAFFIC (an international wildlife trade monitoring authority) has reported the export of turtle shell from Jamaica; however, it is not clear the reported shell originated in Jamaica (see section 4.31 for details).

The amount of sale of tortoiseshell products in the open retail markets varies geographically, but it appears to be concentrated in tourist destinations, especially Negril. Kerr (1994) reported tortoiseshell jewelry on sale in public markets in Oracabessa, St. Mary (bracelets for J$300), Savanna-la-Mar, Trelawny, and the craft market in Negril. A 1995 market survey undertaken in support of this Recovery Action Plan revealed nearly every shop on the beach in Negril had a small amount of tortoiseshell jewelry for sale at prices ranging from US$ 5-50. While tortoiseshell products were not openly sold in Montego Bay (H. Smidt, JCDT, pers. comm., 1995) or Port Antonio (M. Gauron, PEPA, pers. comm., 1995), an itinerant vendor in Ocho Rios had items for sale (R. van Barnevelt, TPDCo., pers. comm., 1995).

As recently as 1980, the Larman family, which controlled much of Jamaica's indigenous tortoiseshell finishing business, processed 455 kg of shell (P. Fairbairn, Norman Deau Assoc., unpubl. data). When the sea turtle protection law was adopted in 1982, the Larman business had a large stock of raw shell and expressed an interest in modifying their operations to use cow horn and other suitable substitutes. The NRCA explored mechanisms to allow the Larman business to use existing stocks (e.g., licensing the approved use of inventoried stocks collected before the ban came into effect). Larman's stocks were weighed and placed into sealed bags, and Larman was allowed to draw on this stockpile for use or export. Products made using these stocks were verified by NRCA.

NRCA made an assessment of the Larman stockpile of raw shell in 1990, and a 2002 reassessment by NEPA (NRCA's successor agency) concluded that no material had been removed and that the stockpile remained intact during that period. The lack of change in the stockpile is an apparent contradiction, however, because the Larman business continued to make and sell tortoiseshell jewelry for the local market at least until 1996. These sales may represent processed shell and finished jewelry which were never included in stockpile inventory; therefore, Larman products reportedly in trade between 1990 and 1996 may be from pre-moratorium (1982) stock. Larman and sons are no longer in business, but members of the family are in dialogue with NEPA about the fate of the company's stockpile. Another

merchant, Mr. Ivan Depass, initially refused to have his tortoiseshell stocks assessed (in 1982), but later agreed to participate. However, this assessment was never undertaken and the amount of shell in his possession remains unknown.

It is a recommendation of this Recovery Action Plan that Jamaican authorities take a decision to confiscate (with negotiated compensation) the remaining inventories and/or certify the inventory and resulting products in a way that ensures the products can be legally manufactured and sold for a limited period with no restocking of raw material. If the latter option is followed, a mechanism for certification must be identified and successfully implemented. Manufacturers will be held to detailed reporting protocols, and all remaining stocks of all parties must be regularly assessed by NEPA. Until these actions are taken, there can be no effective control of the (albeit now nearly non-existent) tortoiseshell market in Jamaica which is an otherwise illegal enterprise under national and international law.

In the meanwhile, the domestic sale of tortoiseshell from unknown sources does continue at low levels in Jamaica, as evidenced by the recent sale of items in Negril, Ocho Rios and Treasure Beach (A. Haynes-Sutton, pers. observ. 2003; W. Lee, pers. comm., 2005; A. Haynes-Sutton pers. observ. 2010) and it is, therefore, a recommendation of this Recovery Action Plan that there be an organised programme for public awareness and education and for the prosecution of offenders. Craft vendors in the main tourist areas should be monitored and no sales of tortoiseshell products to departing tourists can be allowed, as mandated by CITES (see section 4.311). Efforts to make tourists aware of CITES regulations should be increased.

It is noteworthy that there was no attempt to inform tourists and other visitors that trade in tortoiseshell was prohibited until the CITES-sponsored leaflet ("Buyer Beware") and poster campaigns ("Wild Treasures of the Caribbean") in the mid-1990s featured the illegal trade in wildlife products. This informational material was distributed widely to private businesses and public sector organisations involved with or affected by sea turtle conservation at that time. NEPA also developed two CITES-related posters to inform residents and visitors about the importance of sea turtles and penalties associated with illegal wildlife trade. Finally, the Canada/Jamaica Green Fund Project and NRCA sponsored a conservation-oriented wildlife display in the Norman Manley International airport (Kingston), and there were plans to include a billboard display in Montego Bay featuring sea turtles.

It is a recommendation of this Recovery Action Plan that signs or other information be placed prominently at all points of entry (airport, cruise ship), informing visitors not to purchase sea turtle products.

3.4 Inadequate Regulatory Mechanisms

Jamaica has not been fully successful in providing effective conservation and management of its natural resources and wildlife, despite the many laws and institutions intended for this purpose (see Table 4). The reasons for this include the complexity of institutional interactions; inconsistencies between past and present legislation; a generally low level of respect for the law; and insufficient resources for environmental activities, including enforcement (GOJ, 1995a).

3.41 National legislation

Jamaica has a long history of ineffective legislation governing management and protection of sea turtles. The 1711 law which specified "that no person shall destroy any turtle eggs upon any island or quays belonging to Jamaica" did not apply to the Cayman Islands (then administered as part of Jamaica), where most of the turtles were harvested (Sloane, 1725). The regulatory framework with regard to sea turtle protection did not change until 1907 when the Morant and Pedro Cays Law was introduced to regulate the harvest of turtle and turtle eggs on the offshore cays. Its provisions were not easy to enforce primarily because of the remoteness of the area (Lewis, 1940).

In 1919, a five-month closed season for turtles (1 April to 31 August) was imposed under the Birds and Fish Protection Law 33 of 1914. The 1973 amendment of the Wild Life Protection Act (WLPA), which replaced the Birds and Fish Protection Law in 1945, effectively repealed the closed season. Only the year-round protection of eggs remained in force; it prohibited the taking, attempt to take, sale, or having in one's possession for the purpose of sale, turtle eggs. It was not until 1982 that all species of sea turtles were included under Schedule III of the WLPA and all life stages were fully protected throughout the year. Under the WLPA it became illegal to "have in one's possession the whole or any part" of a hawksbill, loggerhead, green, leatherback or Kemps ridley turtle "living or dead." Current penalties include fines of up to J$100,000 or 12 months in prison and, potentially, forfeiture of vehicles, boats and equipment. The forfeiture provision has never been exercised.

Contrary to the conclusions of some published interpretations of the law (including Fleming, 2001: p.88), the act of offering for sale a turtle or parts of a turtle is not illegal. An individual or individuals cannot be prosecuted for advertising turtle products for sale and the burden of proof that products sold contain sea turtle parts is placed on enforcement agencies. Additionally, there has been little willingness on the part of authorities to more fully investigate suspected violations. Recent cases of citizen reports on local restaurants advertising sea turtle menu items have not produced any arrests or prosecutions because of lack of direct evidence of possession (W. Lee, pers. comm., 2005).

It is a recommendation of this Recovery Action Plan that action be taken as a matter of urgency to close this loophole in the WLPA. Revised text should explicitly prohibit the taking, attempt to take, sale, attempt to purchase or sell, or possession of any sea turtle, egg, part or product. Moreover, it is a recommendation of this Recovery Action Plan that law enforcement agents be trained in the identification of sea turtle parts and products, including DNA testing, so that cases of poaching can be confirmed and prosecuted (see also sections 4.212 and 4.213).

The judicial system has a history of inconsistent support of environmental protection issues (see section 4.212), a stance which likely reflects prevalent social values. However, there have been notable exceptions. For example, a man arrested in Negril for catching and killing a hawksbill turtle in 1993 was fined J$10,000 and spent seven days in jail. A decade later, in January 2002, a Resident Magistrate awarded the highest-ever fines for environmental offenses in Jamaica. Fines exceeding J$1 Million (charged under the Aquaculture, Inland and Marine Products and By-products (Inspection, Licensing and Export) Act 1999) and J$80,000 for charges under the Wild Life Protection Act (WLPA) involving protected species, including a hawksbill turtle, were levied against the captain and chief mate of the Honduran vessel "Thunder Ridge" (NEPA, 2002). That same year, a similar offense by another Honduran vessel received the maximum penalty under the WLPA. It is the expectation that this Recovery Action Plan will provide an important tool in helping the judiciary to understand the ecological and social benefits of full enforcement and prosecution of environmental protection laws.

3.42 Institutional arrangements

Reaching consensus and implementing conservation initiatives is an essential but difficult process because of the many stakeholders who may be affected by sea turtle management actions (see Table 4). Current weaknesses in the enforcement of wildlife, fisheries, and coastal zone legislation in Jamaica are common among Caribbean nations and are primarily resource-related (human, financial). They also reflect a general lack of involvement by resource users in resource management decision-making. Contributing factors include: (i) the relatively low priority given (by Government) to biodiversity issues, including coastal and marine issues; (ii) serious limitations in operating capabilities of environmental agencies; (iii) a generally low level of public awareness; and (iv) insufficient public and private support for enforcement of environmental laws in general and addressing related and often complex socio-economic issues.

Vanzella-Khouri (1998) summarised the main factors contributing to the degradation of the marine environment as follows:

- Lack of integrated coastal area management plans,
- Lack of integrated and concerted approach towards land use and maritime planning,
- Inappropriate management of solid waste and sewage,
- Destruction or alteration of habitats,
- Over-exploitation of natural resources (mainly fisheries, mangroves and forests),
- Weak and conflicting policies, legislation and regulatory frameworks, often developed with a sectarian approach, and
- Insufficient human and financial resources to address institutional weaknesses and lack of law enforcement.

Despite institutional limitations, Jamaica is fortunate that there are no regulatory and administrative overlaps that result from sea turtles being considered both protected wildlife and a fishable resource.

The Fisheries Division potentially still controls activities involving exploitation of turtles under the Morant and Pedro Cays Act of 1907 and the Fishing Industry Act of 1975. The latter Act allows the Minister to issue a licence, and, in the case of the Morant and Pedro Cays, only for exploitation "on these cays or inside the outer limits of the territorial sea thereof." However, given the over-exploited nature of Jamaica's sea turtle resource, lack of stock assessment data to determine a sustainable level of take, and difficulties inherent in monitoring and enforcing a fishery focused on a threatened species, especially on the distant cays, it is highly unlikely that such a license would be granted.

As administrator of the Wild Life Protection Act (WLPA) of 1945 (and amended in 1973 and 1982 to protect sea turtles), NEPA has primary responsibility for wildlife species conservation and traditionally has taken the lead in sea turtle management issues, including research, conservation and law enforcement. NEPA continues the work of the NRCA, which was established to: (i) take such steps as are necessary for the effective management of the physical environment of Jamaica to ensure the conservation, protection and proper use of its natural resources; (ii) promote public awareness of the ecological systems of Jamaica and their importance to the social and economic life of the island; (iii) manage such national parks, marine parks, protected areas and public recreational facilities as prescribed; (iv) advise the Minister on matters of general policy relating to the management, development or conservation and care of the environment; and (v) perform such other functions pertaining to the natural resources of Jamaica assigned to it by the Minister under this Act or any other enactment (NRCA Act, 1991, section 4[1]).

NEPA also administers the NRCA Act under which marine protected areas can be declared, including the Beach Control Act and The Endangered Species (Protection, Conservation and Regulation of Trade) Act 2000. In addition, the Fisheries Division has authority to declare and manage Fish Sanctuaries (under the Fishing Industry Act). The NRCA Act is potentially of paramount importance because it binds the Crown and other government agencies to obey it.

Pollution is regulated under a number of laws and by a variety of agencies. However, lack of coordination among government agencies at the planning level has been identified as a major problem in environmental law enforcement (McCalla, 1993). For example, even though both NEPA and the Environmental Health Unit of the Ministry of Health develop and regulate environmental standards and monitor pollution, there is no mechanism for them to work together to address the same or overlapping problems. Although some of these agencies are represented on each others' Boards, there is no forum at which agencies with similar responsibilities meet regularly. However, NEPA meets with its partner agencies about those projects and activities for which NEPA has regulatory responsibility.

Since the 1980s, resource management in Jamaica has taken a more inclusive approach in which users and special interest groups, often represented by NGOs, form partnerships with Government. NGOs – such as The Caribbean Coastal Area Management Foundation (C-CAM, formerly the South Coast Conservation Foundation, SCCF), Negril Area Environment Protection Trust (NEPT), and the Portland Environment Protection Association (PEPA) – are active partners with the government in promoting conserva-

tion in Portland Bight, Negril and Portland parish, respectively. The advantages of a co-management approach include, inter alia, greater flexibility in operations and the opportunity to access resources not available to government entities alone. Continued development of trust and good working relationships between the stakeholders are central to successful sea turtle and other conservation initiatives (Tambiah, 1995; Granek and Brown, 2005).

3.5 Other Natural or Man-made Factors

Jamaica's sea turtles are vulnerable to other natural and human-induced disturbances, and in some cases they pose serious threats to new recruitment. These disturbances include:

- Sand compaction and disturbance can kill developing embryos and make beaches less suitable for nesting (Choi and Eckert, 2009). The disturbances result from persistent pedestrian, vehicular, or animal traffic; landscaping and beach maintenance using heavy equipment; and illegal sand mining. In Barbados, these activities cause up to 100% mortality in some nests (Horrocks and Scott, 1991), but the effects on Jamaican turtles have not been evaluated.

- The flooding of turtle nests by fresh and salt water can drown eggs and hatchlings (e.g., Horrocks and Willoughby, 1987). Flooding has been documented at the Morant Cays, where high seas are frequent during the nesting season and at Gut River. If this problem is identified as a persistent threat, nests may occasionally need to be relocated to lower risk incubation zones (see section 4.252).

- Severe storm events, such as hurricanes, can cause damage to coastal ecosystems, including coral reefs, increase soil erosion, expose roots, uproot trees, and scour beaches. Severe hurricanes occur in Jamaica about once every ten years and have severely affected sea turtle habitat. Some of these damaging storms include Hurricane Gilbert in 1988 (Jones, 1989) and the spate of hurricanes between 2004 and 2007. These latter hurricanes negatively affected sea turtle habitat in Portland Bight, Negril, Treasure Beach, and the Palisadoes spit and cays, among other areas (STRN, unpubl. data).

- Dynamiting reefs is a damaging (and illegal) fishing practice (section 4.141); the number of sea turtles killed annually by this practice is not known.

- Sea turtle mortality can result from entrapment in fishing nets discarded at sea and near nesting beaches (see section 4.24).

- Sea turtle mortality can result from collisions with high speed watercraft (e.g., JetSkis^{TM}). While there have been no reports of such incidents to date, use of these craft is increasing even in the less developed parts of the coast. Turtles can be struck and injured or killed by these craft when basking, resting, or surfacing to breathe. If interactions with watercraft emerge as a serious threat to sea turtle survival, efforts should be made to control or to prevent the use of these craft in areas where sea turtles commonly occur (see Choi and Eckert, 2009, for recommendations).

- Global climate change is likely to affect many features of the marine environment, including salinity, temperature, currents, habitat availability, and food resources for sea turtles and other marine creatures (e.g., see Weishampel et al., 2004; Fish et al., 2005, 2008; Pike et al., 2006; Hawkes et al., 2007; IPCC, 2007).

IV. SOLUTIONS TO STRESSES ON SEA TURTLES IN JAMAICA

4.1 Manage and Protect Habitat

Effective protection of foraging and nesting habitat is crucial to the survival of sea turtles in Jamaica. As in many Caribbean territories, the decline of sea turtle stocks in Jamaica has coincided with increased number of fishers and the decline in fisheries stocks in general, including lobster, conch, and many types of fin fish. Between 1963-1981, there was a 93% increase in the number of fishing canoes in Portland Bight while the fish harvest remained constant, suggesting the probable effects of over-fishing (Haughton and Aiken, 1987). Between 1996 and 2001, the estimated number of fishers declined from 20,000 to 14,014, while total marine capture fisheries production declined from 14,497 to 5,745 tonnes (Venema, 2004).

This decline in the fisheries and the corresponding deterioration in the quality of coastal ecosystems (e.g., beach erosion, pollution, degraded mangroves, reefs and seagrass beds: Goodbody, 1989; Hughes, 1994; Goodbody, 2003; Mumby, et al., 2004) have negatively affected fishing and tourism-based local economies. Although these socio-economic impacts have been recognised for many years, noteworthy progress towards habitat protection has been made only since 1992 with the passage in 1991 of the NRCA Act and the establishment, in 1992, of a National Parks Trust Fund financed under "a debt for nature" agreement with the U.S. Government (Smith, 1995).

One significant contribution to habitat protection was the launching of a national system of protected areas in 1995 (GOJ, 1995b). Figure 12 shows the distribution of existing protected areas. Portland Bight and its cays are some of the most important sea turtle habitats, and these have been included in the protected areas system; however, despite its protected status, the area remains extremely vulnerable because the Hellshire coast (an important nesting and foraging area located within the Portland Bight Protected Area) is vulnerable to exploitation, and the distant cays are exposed to poaching pressure from boats passing through the area and from fishers and others who camp on the cays. Fortunately, the management authority (C-CAM) is committed to sea turtle research and conservation, and has a laudable history of involving local communities in resource management issues in the Portland Bight region (e.g., Espeut, 1995; Tambiah, 1995; Espeut 2002). With this in mind, it is a recommendation of this Recovery Action Plan that:

- Portland Bight and other areas of importance for turtles, including the offshore cays, be incorporated into the national system of protected areas. Under the Convention on Biological Diversity, Jamaica was obligated to develop a Protected Area Systems Master Plan by December 2006, and finalisation of such a plan will be an important milestone in rationalising the designation and management of protected areas in the country. Under the current system, protected areas can be designated under a number of statutes managed by several agencies including NEPA, the Forestry Department, the Fisheries Division, and the National Heritage Trust. Existing national parks are designated under the NRCA Act and administered by NEPA or the agency's nominee. The draft Protected Area Systems Master Plan is currently being revised and updated (Carla Gordon, NEPA, in litt. 14 December 2010).

- Government makes an explicit commitment to include 75% of the remaining critical habitat for sea turtles into protected area status before 2015.

- The Pedro and Morant Cays Act of 1907 (as amended in 1971) be rigorously enforced to ensure protection for sea turtles (see section 4.211) and eggs.

Efforts should be made to provide incentives and assistance for private landowners willing to protect beaches important for sea turtle nesting. Because Government cannot provide comprehensive protection to all nesting beaches, the involvement of private landowners is important to the success of conservation initiatives. To this end, a "Turtle Friendly Tourism" award for participating hotels, villas and beach

communities should be considered. Educational material in colorful and easy-to-distribute leaflets should be an important part of the effort to provide guidelines for vegetation management, lighting, beach use and cleaning, and instructions on safeguarding nests. WIDECAST, in partnership with the Caribbean Alliance for Sustainable Tourism (CAST), has developed a 'best practices' manual for beachfront hoteliers (Choi and Eckert, 2009) that discusses many of these aspects and offers recommendations.

Coastal and offshore waters similarly need protection from industrial and agricultural pollution, solid waste disposal, and destructive practices such as anchoring and dredging. Maintaining the integrity of these marine environments, especially the coral reefs and seagrass beds, benefits turtle conservation, the commercial fishing industry, and tourism. The latter two are important for both the national and local economies. For example, tourism accounted for over 13% of the hard currency receipts and employed 23% of the labour force in 1992 (GOJ, 1995c). In 2004, tourism-related businesses accounted directly and indirect for an estimated 32% of the country's employment force (WTTC, 2004).

The following sections identify and discuss recommendations and mechanisms for the long-term preservation of turtle habitats.

4.11 Identify essential habitat

Sandy beaches all around Jamaica were historically used by sea turtles for nesting, and coral reefs, seagrass, and offshore banks are still potential foraging areas. Information about habitat use by sea turtles in Jamaica is available from a variety of sources (see section 2); however, much of it is anecdotal, incomplete, outdated, and/or not easily accessible. The first systematic surveys of sea turtle nesting beaches were carried out by the STRN and (the then) SCCF in collaboration with WIDECAST between 1992 and 1995. Subsequent surveys sought to fill gaps or revisit important areas (e.g., Portland Bight in 2001-2002, Portland in 2002, and Negril in 2003) (STRN, unpubl. data).

In order to facilitate effective conservation and management decisions, it is a recommendation of this Recovery Action Plan that priority be given to regular national surveys, with an emphasis on filling gaps and updating information about locally important foraging and nesting habitats (sections 4.111, 4.112) and to intensively monitor populations at Index Beaches and Index Foraging Grounds (section 4.26). As used in this manual an "index beach" is a site where a standardised data collection protocol is implemented to estimate a variety of demographic parameters, and the results are interpreted to reflect larger national trends. Training and technical material to conduct monitoring programs are available from WIDECAST in partnership with the UNEP Caribbean Environment Programme.

4.111 Survey foraging areas

Available data suggest that remnant stocks of sea turtles occur in Jamaica's coastal areas, especially the south and west coasts where the shelf is broader and there is more seagrass (Figure 3). Reports of relatively large aggregations of turtles in Portland Bight and the observations of fishermen that there are many more turtles at sea than are seen nesting (e.g., see Tambiah, 1995), suggest that this area is important foraging habitat. This observation is not unexpected because the area, consisting of coral reefs, seagrass, and mature wetlands, is ideal feeding habitat for the herbivorous green turtles (see section 2.2), as well as for hawksbills that specialize on reef invertebrates, especially sponges (see section 2.4).

There have been some efforts to assess the distribution and health of these habitats, especially coral reefs (summarized by Wells in 1988; see Lapointe, 1997; Kramer, 2003) and the identification of sea turtle foraging areas in Jamaican waters. Fishermen in Portland, especially spear fishermen and sport fishermen, were canvassed for information about sea turtles (Fisheries Division, 1995) as a follow up to a survey carried out for WATS I (Kerr, 1984), which documented suspected foraging areas in 1982 based on at-sea sightings (Table 3). Data have also come from 1982 and 1992 aerial surveys for manatees, as well as from other sources, including STRN data from dive operators, fishers, fisheries officers, fisheries

co-operative members, the Marine Police, Jamaica Defence Force Coast Guard (JDFCG), and a number of NGOs. Other potential sources of information are scientific research activities undertaken by the University of West Indies' Centre for Marine Sciences (Discovery Bay Marine Lab), NEPA, community volunteers, and yachters. For more than a decade (since 1995), the STRN has provided sighting record forms to dive clubs and dive shop operators and logbooks are regularly checked for notations on sea turtle sightings. It is a strong recommendation of this Recovery Action Plan that such efforts continue, and that involve a suitably broad coalition of stakeholders (e.g., fishers, divers, government officials).

The Ecosystems Management Branch of NEPA is currently attempting to map coastal ecosystems using remote sensing techniques and to compile assessments of specific areas that will be geo-referenced and incorporated into NEPA's GIS databases. Because a comprehensive survey is a major undertaking and funding is a severely limiting factor, it is a recommendation of this Recovery Action Plan that NEPA establish and enhance strong collaborative relations with other entities that have research capabilities and relevant data (e.g., University of the West Indies).

The large area of sea administered by Jamaica, including the EEZ, appears to be important to both foraging and migrating sea turtles. A 1999 project (repeated in 2000) used satellite tracking methods to determine migratory corridors, including post-nesting movements by adult females away from breeding areas and "home" to resident feeding grounds outside the national jurisdiction of Jamaica. While this type of data collection is expensive and requires collaboration with experts, it provides unique and valuable information about both the behaviour of sea turtles and, indirectly, conditions of the marine environment through which they pass. It is, therefore, a recommendation of this Recovery Action Plan that NEPA and partners build on these satellite-tracking efforts, in collaboration with experts.

To date these information collection efforts have yielded a great deal of data which require a management system. A national turtle database has been established and is currently maintained by NEPA in partnership with the STRN. While the volunteer STRN lacks the time and resources to collate, analyse and publish the data, the Clearing-House Mechanism (CHM) has indicated a willingness to accommodate the database. The information needs to be transferred to them, along with the database design. This arrangement for data management will allow NEPA and STRN to have access to information critical for conservation planning and project implementation and to facilitate the development of annual reports. These reports should be made readily accessible to other NGOs and regulatory officers (e.g., Fisheries Division).

In order for the data management system to work efficiently, it is a recommendation of this Recovery Action Plan that:

- Logbook records be revisited on a regular basis; relevant information be updated, collated and analysed; published information be readily available to inform management and policy.
- Field surveys be undertaken to document the distribution and abundance of critical remaining foraging habitats, particularly those not well covered by dive operators and other volunteers, and areas of special importance. Portland Bight is likely to be the most productive area for such surveys, but more work is required all around Jamaica. Areas requiring special attention include the St. Mary and Hanover coastlines, Palisadoes and the Port Royal Cays, the Morant and Pedro Cays, and offshore and inshore banks.
- Collection of information from all available sources be continued, and collaboration and data -sharing emphasized and encouraged.

The volunteer sightings network established by STRN has increased public participation and support for sea turtle conservation and provided other useful information. With this in mind, it is a recommendation of this Recovery Action Plan that the sightings network be strengthened by ensuring the availability of:

- an adequate supply of forms to record sightings,
- promotional posters to encourage people to participate in sea turtle conservation efforts,

- colorful species identification leaflets (available from WIDECAST),
- community and citizen participation recognition, such as acknowledgement cards or awards for the most "turtle-conscious" volunteers, beach patrollers, respondents, and so on; also, "Turtle Friendly Tourism Awards" should be considered,
- a nationally toll-free *Sea Turtle Hotline* (1-888-991-5005) with an answering machine for sea turtle sightings, infractions, and related reports, and
- easy e-reporting to NEPA's Public Education Department (pubedu@nepa.gov.jm).

Finally, it is a recommendation of this Recovery Action Plan that a Project Officer for the STRN (based within NEPA, or elsewhere) be identified to assist the volunteer Coordinator and to take the lead in managing the database of sightings, fostering more public participation in sighting reports, developing maps of reefs for selected areas, and assisting in data collation (see also section 4.56).

4.112 Survey nesting habitat

While Jamaica's coastline and offshore cays historically supported nesting by hawksbill, green, loggerhead and, less frequently, leatherback sea turtles, nesting activity has been significantly reduced. A 1982 survey recorded more than 100 active hawksbill nesting beaches (Kerr, 1984), 75% of which had fewer than 40 nests (i.e., fewer than 8-10 turtles) per year in recent memory. Despite ongoing survey efforts, there has been only one reported loggerhead nesting (in 1993) since 1982.

Since 1996, nesting or nesting attempts by green turtles have been confirmed at only four sites: Gibralta Beach in Oracabessa (2008) and Reggae Beach (near White River) in 2005, St. Mary; Malcolm Beach (2007, and possibly on Pedro Cays (2006).

Similarly, there have been only six encounters with gravid leatherbacks (nesting events and/or killings) in the post-WATS period (i.e. since the 1982 survey).

The lack of sightings suggests that Jamaica may already have lost three of its four breeding species (see also sections 2.1, 2.2, 2.3). While it is possible that low-density and/or remote or inaccessible nesting sites have been overlooked, it is unreasonable to think that major nesting areas remain. Notwithstanding, it is a strong recommendation of this Recovery Action Plan that standardised survey efforts continue to assess the distribution and success of the annual breeding effort by sea turtles in Jamaica.

More than 100 volunteers carried out the first field survey (as opposed to earlier interview surveys) during July to September 1992. Its primary objective was to involve a wide cross-section of persons in a conservation activity while promoting a nationwide commitment to surveying nesting beaches. Beaches in 12 of the country's 14 parishes were surveyed during the "Sea Turtle Summer Nights" programme (see also section 4.41) sponsored by the STRN. The programme, which focused on Portland Bight and continued through 1995, had 70-100 volunteers participating annually. In 1995, the STRN commissioned a comprehensive survey of the south coast beaches from Alligator Pond to Negril Point (Buchanan, 1996).

SCCF, NRCA, and STRN jointly conducted a nesting beach survey between May and November 1995. The survey counted 178 possible nests (SCCF unpubl. data) and estimated the nesting population at between 20-30 hawksbills. A survey on Southeast Cay (Morant group) counted 16 nests between 15 July and 30 August 1995, and there was evidence the Clarendon/ Manchester area of the mainland supported regular nesting. Other areas identified as important nesting beaches include Luana/Font Hill, west of Savanna-la-Mar to Negril, and the Portland/St. Mary coast (STRN, unpubl. data).

The first STRN surveys of the north coast were conducted in 1996 when NRCA biologists and members of the STRN surveyed on foot 150 beaches along the north coast from St. John's Point (Negril) east to Oracabessa (St. Mary's); 70 of these were known to have been historic sea turtle nesting beaches. Throughout the month of October (peak egg-laying period), the beaches and shoreline vegetation were examined for evidence of nesting once every day in the early morning and fishermen and property

owners were canvassed for additional information. Survey personnel documented nesting on only 44 beaches, which represented a decrease of 38% since the previous survey reported by Kerr (1984). The survey revealed strong evidence of 70 nests and the likelihood of an additional 106 nests based on beach disturbance. The survey also uncovered evidence of egg poaching, depredation (by dogs), and the killing of nesting females (NRCA/ STRN, unpubl. data).

Based on the results of the 1992-1996 surveys, as well as informal and more recent information from STRN members, the Portland Bight Cays on the south coast appear to have the most nesting activity on the mainland. Ongoing survey initiatives should include collection of morpho-physiological data which, at present, are almost totally lacking for turtles in Jamaican coastal waters. Specifically, information should be collected on turtle size, nesting frequency, nest to false crawl ratio, behaviour, and nest fate. This additional data collection should be incorporated into a comprehensive tagging programme (e.g., see Tambiah, 1995). If a long-term programme can be developed for the Portland Bight region, these efforts can be extended to the Southeast Cay in the Morant group. Tags and tagging equipment, training, a procedures manual, and database management software are available from WIDECAST.

Data suggest nesting habitat surveys should focus on Portland Bight, the St. Mary and Portland coasts, Runaway Bay, Old Womans Point to Alligator Reef, Great Pedro Bay to Parottee, Malcolm Bay to Luana, Savanna-la-Mar to Green Island, the offshore banks (particularly Morant and Pedro Cays), and areas where parks or protected areas are planned. Additionally, special nest checks during the height of the nesting season should be conducted at all sites where green, leatherback, and/or loggerhead turtles have been reported in the past. At these sites, nocturnal surveillance is not essential because valuable information can be obtained from early morning walks (see section 4.291 for information on how to identify beach crawls).

To facilitate the ongoing monitoring of these important areas, and to properly inform management on a timely basis, it is a recommendation of this Recovery Action Plan that the STRN, in partnership with NEPA and other relevant partners, designate one or more Index Nesting Beaches for comprehensive (annual, long-term) monitoring of nesting and nest fate (see section 4.261).

4.12 Develop and implement area-specific management plans

Sea turtle protection policies should be adopted on a national basis because many coastal areas around the island offer potentially suitable sea turtle habitat. However, within this larger framework, individual area-specific plans may be necessary to reflect unique management challenges at the site level. It is important, for example, that all potential nesting beaches and foraging grounds be surveyed to ensure that critical areas are identified and safeguarded.

Marine parks are a good starting point to develop inclusive conservation-oriented management plans. It is a recommendation of this Recovery Action Plan that a national system of marine protected areas be designed and enacted as soon as possible, that areas known to be important to remaining sea turtle populations be included in such a system, and that area-specific management plans be developed and formalised.

The NRCA Act of 1991 allows the designation of selected areas as Marine Parks, and Montego Bay and Negril were given that designation in 1992 and 1998, respectively. Even though only a few sea turtles still visit these areas, authorities should be assisted in the development and implementation of sea turtle management plans for these sites. Canoe Valley (Clarendon/Manchester) and the Morant and Pedro Cays are both important areas for sea turtle conservation, and both are under consideration for designation as protected areas. NEPA is leading the initiative for their designation. The Beach Control Act of 1955 also has provisions for marine protected areas (Appendix II) – three areas (Montego Bay, Port Royal, Ocho Rios) have been gazetted under this Act, but they appear to have limited importance for sea turtles.

STRN, NRCA (NEPA's predecessor), and C-CAM previously developed an outline plan for the overall management of the Portland Bight area (Espeut, 1995). The first plan was reviewed by NEPA and accepted as the official plan of the Portland Bight Protect Area. The original plan has since expired and two updates have since been prepared (B. Hay, C-CAM, pers. comm., 2010). C-CAM is working with Fisheries Division on management plans for three new fish sanctuaries declared in the Portland Bight Protected Area and will manage those and other prospective designated areas. Additionally, these three management entities are continuing to collect baseline information on the status and distribution of turtles in the area (see section 4.1) and anticipate development of a long-term monitoring programme for nesting beaches. The Portland Bight area should be considered a priority candidate area if a sea turtle tagging programme is established in Jamaica.

The C-CAM has used public education to support management efforts, prepare outreach materials on sea turtles, and sensitise fishers, youth groups and other community groups in the Portland Bight area (Espeut, 1995). A newsletter and regular meetings with stakeholders have also been recommended (Tambiah, 1995). Honorary Game Wardens, C-CAM Ranger Corps and senior staff, NEPA's Enforcement Branch, Fisheries Officers, and JDFCG are important assets in discharging law enforcement aspects of the management plan (Espeut, 1995); however, enforcement of turtle protection laws must be carried out in concert with education and information on the laws and the impact of non-compliance (Tambiah, 1995).

4.121 Involve local coastal zone authorities

The Ecosystems Management Branch of NEPA is the lead agency for watershed and coastal zone planning. Other agencies sharing the responsibility include the Fisheries Division, Marine Police, Jamaica Defence Force Coast Guard, parish councils, and NGOs. C-CAM has expressed interest in taking a lead role in the Portland Bight area; other major NGOs which potentially can be involved in their geographic areas of influence are PEPA in Portland, NEPT in Negril, SEEA in St. Elizabeth, the Bluefields Bay Fishermen's Friendly Society in Westmoreland, and STEPA in St. Thomas. It is a recommendation of this Recovery Action Plan that these authorities and other entities be encouraged to work closely with STRN in developing sea turtle management plans and evaluating implementation actions.

4.122 Develop regulatory guidelines for protected areas

The NRCA Act provides a wide scope for the preparation of regulatory guidelines for the management of habitats important to sea turtles. Guidelines should be developed in consultation with stakeholders and include provisions for assessment, adaptation, and revision.

The focus and specific attributes of the guidelines will vary among areas. However, in general, it is a recommendation of this Recovery Action Plan that in areas critical to remaining sea turtle stocks, regulatory guidelines should be used to establish a framework within which appropriate land use, development (commercial, recreational, residential), resource use (e.g., fishing), and recreation can occur without detriment to turtles. Special attention should be given to the following types of activities:

(a) *Sand mining:* Commercial mining of beach sand should not be permitted under any circumstances (section 4.131). The persistent removal of beach sand disrupts stabilizing vegetation, exacerbates erosion, and can eliminate nesting habitat. Mining pits pose a threat of injury to humans and livestock and accumulate standing water that may become breeding areas for mosquitoes and other undesirable insects. Mining sediments offshore should be carefully evaluated for potential effects on coastal beaches because offshore material is essential for beach maintenance. Preferred extraction sites should be confined to ravines and interior sites.

(b) *Artificial lighting:* Sea turtles, especially hatchlings, are profoundly influenced by artificial light sources. Hatchling sea turtles freshly emerged from the nest depend primarily on a visual response to natural seaward light to guide them to the ocean. In zones of coastal development, sources of artificial

light distract hatchlings and may cause them to turn away from the sea and crawl landward. It is essential that artificial light sources be positioned so that the source of light is not directly visible from the beach and does not directly illuminate areas of the beach. If lighting must be seen from the beach, it should emit wavelengths (560 - 620 nm) which are least attractive to sea turtles (Witherington, 1990; Witherington and Martin, 2000; Perry et al., 2008). The low-pressure sodium (LPS) lamps used in some parking lots are more “turtle friendly” than other lighting types because they emit a yellowish light (589 nm). Low intensity, ground-level lighting is encouraged; nighttime and security lighting should be mounted not more than 5 m above the ground and should not directly illuminate areas seaward of the primary dune or line of permanent vegetation; and no lighting, regardless of wavelength, should be placed between turtle nests and the sea.

Natural or artificial structures should be used to the maximum extent possible to improve dune height in areas of low dune profile. They will help prevent light from directly illuminating the beach/dune system, buffer noise, and conceal human activity from the beach. Native or ornamental vegetation, hedges, or other privacy fences should be encouraged. Barriers between 76-85 cm high are generally sufficient to block visual cues from artificial lights (Ehrenfeld, 1968; Mrosovsky, 1970). Ferris (1986) showed that a simple "fence" of black polyester material stretched between three posts and positioned between the nest and a lighthouse resulted in the hatchlings orienting correctly to the sea. Balcony lighting should be shielded from the beach and safety/security lights should be limited to the minimum number required to achieve their functional roles (section 4.132). Purely decorative lighting, especially spotlights or flood-lights within line-of-sight of the beach, should be prohibited. Useful recommendations specific to Carib-bean coastal properties are available in Knowles et al. (2009) and Lake and Eckert (2009).

(c) *Beach stabilization structures:* Hard engineering options to beach protection, including impermeable breakwaters, jetties, groynes and seawalls located on the beach or in the nearshore zone should be considered only as a last resort. The naturally dynamic characteristics of the coastline should be taken into account prior to coastal construction so that adequate setbacks, rather than expensive and often counter-productive armouring, can be used to pro-vide for the long-term conservation of the beach resource. There are many examples in Jamaica and throughout the Caribbean where beach areas have been degraded as a result of armouring (see section 4.133).

(d) *Design setbacks:* Setbacks should be required for all planned development of land adjoining a sandy beach. Setback design limits should take into consideration beach and backshore characteristics and incorporate features that reflect the damage likely to be caused to the beach and backshore environment during a major storm. Setbacks should have vegetated areas (including lawns) and dunes between hotels, homes and similar structures, and the beach proper. Setbacks not only help to protect coastal properties from storm damage but also reduce over-crowding of the shore zone, lessen the likelihood that local residents will be excluded from the beach, and increase the probability that artificial lighting will not shine directly on the beach (section 4.133).

(e) *Access:* Use of motorised vehicles should be prohibited on beaches at all times and parking lots and roadways (including any paved or unpaved areas where vehicles will operate at night) should be positioned so that headlights do not cast light onto the beach at night. Driving on a sandy beach can exacerbate erosion, lower sea turtle hatch success by compacting nests (section 4.134), and create unsightly ruts that hinder hatchlings seeking to cross the beach. Where vehicles are needed to transport heavy fishing or recreational equipment, multiple access points should be provided and vehicles parked landward of the line of permanent vegetation. Pedestrian access to beaches should be confined to specific locations and strictly regulated in order to minimise disturbance to the beach, such as trampling and destruction of vegetation and sand compaction.

(f) *Waste disposal:* No dumping should be permitted within the nearshore, beach, dune, or wetland (including mangrove) environment of the shore, and all trash currently on the beach should be cleaned up immediately. Trash cans and regular collections should be provided as necessary. Dumping trash on the beach runs counter to the economic interests of both residents and commercial landowners.

Litter can obstruct hatchlings on their journey to the sea, discarded glass and metal can injure turtles, and larger objects on the beach can prevent females from finding a suitable nest site. Visitors should be required to take with them any garbage or other waste brought to or generated at the beach. If a beach cleanup is necessary, it should be conducted using hand tools (section 4.134).

(g) *Vegetation cover and fires:* Efforts should be made to preserve vegetation above the mean high tide mark. Creeping and standing vegetation stabilises the beach, offers protection against erosion caused by wind and wave action, provides important nesting habitat for hawksbill turtles, and offers natural shielding from the artificial lighting of shoreline development (section 4.132). Fires, whether for recreation or charcoal production, should be prohibited on sandy beaches. Fires are a hazard to the surrounding dry forest, create unsightly scars, may scorch sea turtle eggs and hatchlings beneath the surface, and can disorient hatchlings. Grill facilities should be provided in areas where there is already a tradition of 'cook-outs'.

(h) *Marine pollution:* The dumping of solid and chemical wastes into the sea should be prohibited under all circumstances. In addition to degrading the environment for residents and visitors, sea turtles often ingest tar, plastic, rope, and other substances (e.g., Mrosovsky, 1981; Balazs, 1985; Lutz and Alfaro-Schulman, 1991; Derraik, 2002), presumably mistaking these for food. Ingestion of these items, especially plastic bags which often are mistaken as jellyfish, may cause the sea turtles to become weakened and/or die. Polluted effluent, including sewage from land-based sources, should be centrally treated before it is discharged into the sea. (See sections 4.143 to 4.146).

(i) *Anchoring and dredging:* Anchor damage is a major cause of destruction to seagrass beds and coral reefs (Erftemeijer and Lewis, 2006). It is essential that yachts and other boats be required to either anchor in designated sandy bottom areas or tie in at approved moorings in coral reef areas. Alternatively, vessels should be required to remain offshore beyond the zone of living coral and seagrass. Dredging activities should be planned to minimize damage (i.e., sedimentation) to down-current coral and seagrass. Severe disruption of the seabed, especially seagrass and reef communities, can damage foraging areas for sea turtles and negatively affect the natural dynamics of the marine environment including deposition of beach sand (see also section 4.147).

(j) *Physical destruction of coral and seagrass:* Destruction of coral reefs diminishes the sheltering influence they provide the nearshore and shoreline environments, causing economic and environmental losses. Neither coral reefs nor algal ridges should be dynamited or dragged with chains in order to provide boat access. Anchoring should not occur in reef or seagrass areas (see subsection above and section 4.147). Divers should be thoroughly coached on diving etiquette in order to avoid trampling, collecting, and touching living coral. They should be advised that collecting corals is illegal. The practices of using chemicals or dynamite (sections 4.141, 4.142) to stun fish for harvest are prohibited under all circumstances. Many years or decades may be required for these systems to repair themselves after destruction resulting from these types of practices.

(k) *Fishing practices:* The use of beach seines destroys the marine habitat and catches marine fauna indiscriminately, including sea turtles and fish, and their use should be prohibited. Additionally, discarded nets can be a serious hazard to turtles and other wildlife. The public at large and fishermen need to be sensitised to the need to properly dispose of nets. STRN should encourage fishing cooperatives to place and maintain suitable litter bins on fishing beaches.

(l) *Code of ethics for divers/snorkellers, researchers and turtle watchers:* Divers and snorkellers can damage reefs by trampling and collecting items underwater (e.g., souvenirs) and researchers and turtle watchers can disrupt nesting. A code of ethics should be drawn up and circulated to dive operators and adherence to it should be one of the conditions for their licences to operate. Divers/snorkellers should be discouraged from standing on reefs and reminded that collection of coral is illegal. Researchers and turtle watchers should be provided with information about how to avoid disturbing sea turtles. Some effort has already been made by the professional dive community to educate divers,

including visitors to the island, about the importance of "hands-off" diving and to post guidelines at dive shops. A useful series of leaflets about eco-friendly diving when working with or near sea turtles or viewing them can be found at http://www.coral.org. Marine research and recreational institutions and businesses that adhere to the code of ethics can be recognized by "Turtle Friendly Tourism Awards".

(m) *Human habitation on cays:* Expansion of human habitation to unoccupied cays is a constant threat. While all the cays in Jamaica are owned by the Commissioner of Lands, none of them can legally be occupied except selected cays within the Morant and Pedro group which are under the control of the Fisheries Division (Sutton, 1987). Some fishermen illegally occupy on a seasonal or permanent basis several cays important to turtles; these include all the larger cays in the Portland Bight. The Commissioner of Lands has not taken action against this illegal occupation. Additionally, some small islands close to shore are privately owned. Some fishermen consider the presence of occupants and their animals (e.g., dogs) on these cays a threat to turtles and think they should be removed (C. Campbell, pers. comm., 1995). Others, however, argue that fishermen on the cays may actually help protect turtle nests and note that some fishers had actually changed their behaviour to minimise possible impacts on turtles (e.g., not lighting fires at night in places where they would be visible from the beach) (J. Below, SCCF, pers. comm., 1995). Removal of fishermen from these areas is controversial and may need to be addressed on a case-by-case basis. Notwithstanding, illegal activity on the cays is a serious threat to sea turtles and other wildlife and is a management challenge that must be addressed as a matter of priority.

4.123 Provide for enforcement of guidelines

Enforcement of laws and regulations concerning sea turtles has been and continues to be extremely difficult, in part because of the large number of persons involved in the fishing industry and/or live in coastal communities. Moreover, prosecution of illegal activity is unlikely. It is a recommendation of this Recovery Action Plan that more emphasis be placed on public education and awareness of the status of sea turtles and the rationale behind protective legislation. Such a campaign should emphasise the important role Jamaica plays in the life cycle of sea turtles, and the responsibility the community has in safeguarding the turtles and their habitat(s).

A few appropriate and well-publicised prosecutions of persistent or prominent offenders would be effective in increasing public awareness of the regulations designed to protect sea turtles. Target groups for this effort may include: NEPA, Jamaica Promotions Corporation (JAMPRO), National Works Agency and other government and Parish Councils, National Water Commission workers, National Solid Waste Management Authority, security forces, truck operators and septic tank cleaners, protected area managers and wardens, architects, boat operators (recreational and commercial), harbour and port managers, people who live on or near the beaches, villa and hotel owners, tour operators, developers, environmental NGOs, and fisheries co-operatives.

4.124 Develop educational programmes

It is a recommendation of this Recovery Action Plan that residents, visitors, developers, and concessionaires be made aware of regulations designed to safeguard habitat important to sea turtles. Educational materials should be readily available to the visiting public and include clear descriptions of what types of activities are permitted and what types of activities are not permitted in the management areas.

Permanent signboards at nesting beach entrances are one way to educate visitors. A signboard may explain that access permits and/or licensed guides are required, beach fires and littering are prohibited, pets must be leashed, and vehicles must be parked in designated areas. If the nesting beach area is closed to the public at night, this provision should be clearly indicated. A telephone number to report violations should be provided. Other options include distribution of informational pamphlets to nearby hotels and feature stories and general information provided by the media (see also section 4.4).

4.13 Prevent degradation of nesting beaches

It is not possible to protect all sea turtle nesting beaches through a formal system of designated areas. However, a large proportion of nests can be protected by making a concerted national effort to increase public awareness, promote sound management practices, and develop regulatory guidelines for the purpose of safeguarding nesting habitat (see section 4.132). It is, therefore, a recommendation of this Recovery Action Plan that the importance of conserving sea turtle habitats should be acknowledged in all relevant NEPA policy documents (e.g., documents pertaining to beaches, mangroves, coral reefs). Positive (e.g., public recognition, economic incentives) and negative (e.g., arrests, fines) reinforcements should be articulated, and alternatives (e.g., use of crushed stone as a substitute for beach sand) emphasised in policy documents and standard guidelines. Specific recommendations on a variety of related subjects are offered below.

4.131 Sand mining

Several sources, including the Country Environmental Profile for Jamaica (GOJ, 1987) and Creary (2003) cite the serious environmental costs associated with beach sand mining. Beach sand is mined as a source of construction material and for other purposes. This activity not only degrades sea turtle nesting habitat but has the potential to completely eliminate shoreline sand deposits and prevent residents and visitors from enjoying the recreational benefits of coastal beach environments. Sand removal can accelerate beach erosion by degrading or destroying coastal vegetation (by uprooting it or flooding it with seawater). Additionally, pits formed by the mining are potential health and safety hazards for people and livestock and may serve as breeding habitats for mosquitoes and other disease vectors. In extreme cases, saline ponds have formed and large areas of the shoreline are altered, resulting in loss of sand and vegetation. Additionally, sand mining operations leave aesthetically unpleasing scars on the landscape. These alterations to the beach community reduce the ability of the region to support recreation, tourism, commercial development, and wildlife such as sea turtles.

Beach sand mining is widespread in scope, especially where trucks have access to the beach. Some beaches, such as those in Orange Bay, Portland, have been severely altered. However, despite heavy mining pressure in this area, sea turtles continue to attempt to nest there; at least two successful nests (and an unknown number of failed nests) were made there in 1995. Beach conditions there need to be assessed and action taken to protect the beach and nesting turtles. Sand mining from sources removed from the sea also may affect the amount of sand reaching coastal areas. Robinson et al. (2005) noted that the significant sand mining operations along the entire course of the Rio Grande River affected the sand budget in coastal areas which historically were sea turtle nesting beaches.

Efforts have been made to curb beach sand mining. In Montego Bay, on-site Marine Park Rangers routinely confiscate shovels and other mining equipment when violators are caught. The Quarries Control Act (1983) requires a permit to remove sea sand (sand on the sea bed, shoreline or foreshore area). A tallyman and a site manager must also be present, and conviction of a first offence under this Act now carries a maximum penalty of J$30,000 or up to 12 months in prison or both. This increases to J$50,000 on conviction of a second offence. Daily fines of up to J$10,000 per day and up to two years imprisonment may be imposed if the offence continues after conviction (Jamaica Environment Trust, 2008). A single Minerals Development Bill has been proposed to replace both the Mining and Quarries Control Acts (GOJ, 2009).

The law also provides for the seizure of vehicles and equipment. Nevertheless, illegal mining is widespread and there are reports of policemen escorting vehicles involved in illegal mining. Since the scope of this type of activity is so large, controlling it requires the intervention of agencies beyond those available at the local level, such as NEPA.

Offshore sand mining should also be discouraged unless it can be shown that it will not result in net erosion of nearby beaches. It is a recommendation of this Recovery Action Plan that the GOJ impose a

ban on beach sand mining and that laws be amended to provide unconditional protection to beaches from sand mining in perpetuity. The public should be encouraged to report sand mining activities to enforcement agencies and include licence numbers of vehicles in the reports. Development of NEPA's enforcement capacity and an increase in public awareness of the importance of protecting beaches from illegal mining should accompany the revised legislation. The issue of (illegal) beach sand mining can be given wider exposure through public media such as talk shows and feature stories in newspapers.

4.132 Lights

Jamaica has restrictions on beachfront lighting. Since 2001, limits on beachfront lighting have been imposed using the 1956 Beach Control Act. The NRCA [now NEPA] has incorporated mandatory guidelines for the installation and use of lighting as a condition for the issuance of beach use permits. Under the NRCA Act, lighting conditions are added to environmental permits issued for projects along beach areas. These regulations and guidelines pertain to all development projects or activities on beaches known to support sea turtle nesting.

As noted earlier in this document (see Section 4.122), artificial beach lighting interferes with the behavior of nesting female and hatchling sea turtles. Newly emerged hatchlings depend largely on a visual response to natural seaward light to guide them to the ocean (Mrosovsky, 1972, 1978; Tuxbury and Salmon, 2005). Artificial light can disorient hatchlings and nesting females, causing them to crawl landward and making them vulnerable to predation by animals, poaching by humans, or desiccation during daylight hours. Even light sources several kilometers away can disorient turtles, especially hatchlings. Studies in Florida and Tortuguero (Costa Rica) revealed that the bright, full spectrum white lights of mercury vapor lights almost completely eliminated nesting on affected beaches; green turtle and loggerhead nesting decreased by 90% and 95%, respectively, on those beaches illuminated by this type of lighting when compared to darkened beaches (Witherington, 1992). Research also has shown that low-pressure sodium vapor (LPS) luminaries, which emit light in the 560-620 nm range (yellow), do not attract hatchlings to the extent that full spectrum white light does (Witherington, 1990; Witherington and Martin, 2000; Perry et al., 2008).

The absence of lighting will help ensure hatchlings and nesting females safely orient toward the ocean. Where this is not an option, such as along coastlines already heavily developed, Witherington (1990) proposes several "next-best" solutions. These include – (1) Shield and lower light sources: low intensity and ground-level can be both attractive and adequate for most purposes and should be encouraged. Nighttime and security lighting should not be mounted more than 5 m above the ground, and fixtures should be positioned or shielded so that they do not directly illuminate areas seaward of the line of permanent vegetation. The glow from lighting can be shielded from the beach by ornamental flowering hedges or other barriers. No lighting, regardless of wavelength, should be placed between turtle nests and the sea. (2) Use alternative light sources: for example, LPS lighting. (3) Impose time restrictions: for example, limit or extinguish lights from 1900-2300 hrs when hatching is most likely to occur. (4) Utilise motion-sensitive lighting that can be activated only when a moving object, such as a person, approaches the "field of view". This has the advantage of surprising intruders (Eckert and Horrocks, 2002) and can be very effective in low traffic areas. Finally, (5) Impose area restrictions: for example, restrict beachfront lighting to areas where little or no nesting occurs. A handbook (Witherington and Martin, 2000; online at http://www.widecast.org/Resources/Docs/Witherington_and_Martin_2003_Beachfront_Lighting_Manual_ENG.pdf) focuses on assessing and resolving light-pollution problems on sea turtle nesting beaches – WIDECAST has provided this and other relevant resources (e.g., Knowles et al., 2009; Lake and Eckert, 2009) to NEPA and some community groups.

New construction is obligated to abide by national "sea turtle friendly" lighting ordinances and guidelines, and it is a recommendation of this Recovery Action Plan that permit requirements related to "sea turtle friendly" lighting be actively and consistently enforced; further, such lighting should be a mandatory requirement for all beach licences involving construction near active nesting beaches. NEPA should seek to foster strong alliances with hotels and other properties adjacent to nesting beaches, and work to

ensure that lighting is routinely assessed and retrofitted, as needed. Choi and Eckert (2009) offer useful guidance on beachfront lighting, as well as other issues important for the safeguarding of nesting habitat.

To increase awareness of this issue, it is a recommendation of this Recovery Action Plan that NEPA send letters to all hotels and restaurants built near sandy beaches, and request that security or other personnel report incidents of sea turtle nesting/hatching and that lights visible from active sea turtle nesting beaches be redirected, shielded, or extinguished in accordance with established best practices (e.g., see Witherington and Martin, 2000; Knowles et al., 2009; Lake and Eckert, 2009).

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. In some cases it may be possible to station interested residents on the beach during the early evening hours to assist hatchlings to the sea. Even the simple act of shielding the crawling turtles from landward lights with a beach towel may enable them to establish the proper orientation. Hatchlings should not be placed directly in the sea but allowed to crawl unassisted towards the water because the trek to the water is important for their development.

It is also important to educate and sensitise environmental consultants and other professionals working in nesting beach environments about the lighting issue. Further information on construction, materials, and other details concerning "sea turtle friendly" lighting can be obtained from WIDECAST (contact: keckert@widecast.org).

4.133 Beach stabilisation structures

Beaches are naturally dynamic because of the nearshore transport of sand along the coastline and the constant wave action. In order to protect commercial investments, such as beachfront hotels, beach stabilisation structures (e.g., breakwaters, jetties, impermeable groynes, seawalls) are often installed. These structures are expensive and rarely effective in the long-term. Furthermore, because they interfere with the natural transport of sediments up and down the coastline, the coastal protection structures of one beach segment can result in the "starvation" and eventual loss of beach segments down-current.

There are many examples of this phenomenon in Jamaica. Chronic erosion currently experienced in Negril may be the result of coastal protection structures installed in the area. A seawall constructed in Montego Bay to protect several hotels (including the Sunset Beach, Lodge, and Chatham Hotel) was partially responsible for high wave energy conditions that eroded part of an adjoining road and landward wall. Similarly, groyne construction has been implicated in the severe erosion of the beaches associated with Sunset Beach Resort and Wyndham Rose Hall in St. James within the last ten years. Improperly designed structures have also resulted in beach loss in several other areas, such as St. Ann and St. James, and the resultant need for redesign and reconstruction at a high cost (A. Henry, NEPA, pers. comm., 2006). In another example, a breakwater installed at the Foote Prints Hotel resulted in erosion rather than accretion of beach sand there (A. Henry, NEPA, pers. comm., 2006). The problems associated with beach stabilisation structures are most severe on the north coast, and they are likely to escalate in the south coast as development pressures increase there.

In many cases, the long-term scenario of employing beach stabilisation structures has exacerbated erosion and beach loss. It is, therefore, a recommendation of this Recovery Action Plan that hard engineering options to beach protection, sometimes referred to as "beach armouring", be regarded only as a last resort. In particular, alternatives should be explored when armouring is likely to result in the deterioration of sandy beaches where sea turtles nest. Construction of impermeable structures to alter the transport of nearshore sediments and/or to protect coastal development should be carefully evaluated and factor in the long-term negative impacts on the investment they are designed to "protect." If shoreline armouring is the only viable option, the structure should be constructed at a slope of 1:2 to 1:3 to facilitate the natural build up of sand (USACE, 1995; Sorensen, 1997; Basco, 2008.). Protective structures should be made permeable (e.g., constructed on pilings) wherever and whenever possible.

The preferred solution to beach conservation and maintenance is a construction setback requirement. The setback should be adequate to mimimise the risk to coastal buildings as a result of normal erosion or violent storms and to protect nesting sites. It is a recommendation of this Recovery Action Plan that legally defined minimum setback limits be instituted in Jamaica and designed to protect the beach and backshore environment during major storms. Setbacks may include vegetated areas (e.g., naturally occurring vegetation, ornamental plantings, lawns) and dunes and should be of 30-40 m from the line of permanent vegetation for upland coastal development and 80-100 m for lowland (beach) development. Setbacks also help reduce over-crowding of the shore zone, lessen the likelihood that local residents will be excluded from the beach, and decrease the probability of artificial lighting on the beach.

At the present time there are no formal setback regulations in Jamaica, although the Manual for Development (TPD, 1982) provides non-mandatory guidelines. Recommended setback limits for slopes less than 1:20 are 30.5 m from the high water mark, and 15.2 m from the high water mark for slopes 1:4 to 1:20. The Development and Investment Manual (2007) sets out requirements for development activities.

It is a recommendation of this Recovery Action Plan that the guidelines contained in the Manual for Development be amended to maximise the likelihood that sea turtle nesting beaches are safeguarded from degradation and erosion. The amended Manual should be circulated to government agencies (especially Parish Councils), developers, and the general public. NEPA should also be encouraged to make selected recommendations mandatory through specially developed regulations under the NRCA Act. Relevant background information and recommendations are provided in Choi and Eckert (2009).

4.134 Beach cleaning equipment and vehicular use of beaches

All Jamaican beaches are littered to some extent. Sources of the litter are recreational users, waste that is washed to the coast from inland dumping sites, and seagrass and ocean-borne debris (e.g., oil, abandoned fishing gear and nets, cruise ship waste) that washes ashore. Hand rakes are typically used to clean the litter from private beachfront property and some public beaches (e.g., Braco Beach between Rio Bueno to Montego Bay). Oil pollution, usually in the form of tar balls, is a persistent problem on many beaches, especially on the north coast (Jones and Bacon, 1990) and affected areas are raked 2-3 times each day. Such frequent raking removes significant amounts of sand, thereby accelerating beach erosion and potentially threatening incubating sea turtle eggs. Contaminated and littered sand is frequently discarded in the beach vegetation, and its accumulation can obstruct hawksbill nesting and contribute to a toxic nest environment.

To reduce the sand-fouling and littering problem, it is a strong recommendation of this Recovery Action Plan that regulations banning the indiscriminate disposal of waste in ravines and in offshore waters be established and strictly enforced. Additionally, waste disposal facilities (e.g., garbage cans) should be located in areas designed to optimise their use by visitors to the area.

It is a recommendation of this Recovery Action Plan that hand rakes, rather than mechanised cleaning equipment, should be used when cleaning sandy beaches in order to minimise potential damage (caused by the heavier equipment) to incubating eggs. During the cleanup, only the litter and not the substrate should be raked. Beach cleanups should not include the removal of vegetative cover, as supralittoral trees and shrubbery provide hawksbills with nesting habitat (e.g., Ryder et al., 1989). Raking and removal of leaves and grasses above the high tide line can increase the probability of wind erosion and degrade or eliminate important nesting habitat.

Use of vehicles on Jamaican beaches can be problematic to beach stability and the safety of turtles. Driving on the beach compacts the sand; this may reduce the viability of nests, damage beach vegetation, create unsightly tyre ruts, exacerbate beach erosion, and bother and endanger other beach users (e.g., recreationists, fishers). Hatchlings may become trapped in the tyre ruts which run parallel to the sea (Hosier et al., 1981; Cox et al., 1994) making them vulnerable to heat exposure (and desiccation) and/or predation. Vehicles can also run over hatchlings on the beach. While vehicle use on beaches cur-

rently is not considered a major problem, it occurs in selected regions, such as Negril. It is, therefore, a recommendation of this Recovery Action Plan that regulations be developed under the NRCA Act to regulate the driving of private and commercial cars and trucks on beaches before the activity becomes a serious threat to remnant sea turtle populations.

4.135 Beach rebuilding (renourishment) projects

Beaches may be rebuilt or renourished when erosion endangers the integrity of structures (e.g., hotels, resorts, shops) or threatens the economic viability of an area. Beach renourishment involves transporting sand to the beach from inland sites or adjoining beach segments or hydraulically pumping sand onshore from offshore sites. While renourishment may enhance some nesting areas, these projects are expensive and produce some negative impacts on the beach community. Some examples of beach renourishment projects include: Golden Seas, Sandals Ocho Rios, Ciboney, Hedonism, resort areas in Negril, Bogue and Holiday Inn in St. James, and FDR Pebbles in Trelawny. Removal of beach sand from one area to another is illegal without a licence from the Mines and Geology Division of the Ministry of Mining and Energy, but the practice continues. The Sans Souci Lido in St. Mary was caught moving sand in April 1995 (Anon., 1995) and, in 1998 NRCA (now NEPA) stopped the illegal removal of sand from Mammee Bay to Ocho Rios.

To help ensure minimal effects on sea turtle nesting, it is a recommendation of this Recovery Action Plan that beach rebuilding and renourishment activities be required to:

- use replacement sand similar to the original material in physical properties, such as organic content and grain size,
- not use sand taken from active nesting beaches,
- ensure the renourishment activities do not affect offshore sand transport to active nesting beaches, and
- ensure the rebuilding activities do not take place during the primary reproductive (nesting, hatching) season.

If beaches are rebuilt during sea turtle nesting (peak: June-November) and/or hatching (peak: August-January) seasons, heavy equipment and activity can deter nesting, damage nests, and crush eggs. In addition, the new layer of sand (over-burden) may suffocate incubating eggs and prevent hatchlings from successfully digging out of the nest. If leatherbacks are known to nest in the area, personnel should note that nesting begins in March or April, peaks in May or June, and concludes in July.

Continuous loss of sand in one region accompanied by lack of natural down-current sand accretion is an indication of imbalance in the transport system. The underlying causes may be disturbances to the nearshore geography, such as the presence of an up-current solid jetty, pier, or beach sand mining operation that starves down-current beaches by interrupting the constant longshore transport of sand and sediments. Alternatively, the causes may be more subtle, such as the effects of the removal of beach vegetation or nearshore pollution that retards the productivity of calcareous (coralline) algae and other sand sources. The linkages between development and the integrity of sandy beaches are complex and should be considered before construction on or adjacent to sandy beaches is permitted.

It is a recommendation of this Recovery Action Plan that developers, hoteliers, government agencies responsible for planning and permitting, and environmental and engineering consultants be well informed about the potential environmental and economic liabilities and legal responsibilities involved in beach rebuilding projects that hold the potential to adversely affect other properties.

4.136 Other factors

Horses and Livestock on the Beach – Some sandy beaches (e.g., near Alligator Hole River, Clarendon, and the beaches at Port Henderson, St. Catherine, and Runaway Bay, St. Ann) are used for

horse racing and training. Horses can damage incubating nests by crushing eggs and/or emerging hatchlings. They may also leave deep hoof prints in the sand into which hatchlings may fall as they crawl to the sea, and turtles unable to crawl out of these "traps" die from desiccation and/or predation. Horse and livestock traffic may also accelerate erosion by damaging fragile coastal habitats, especially vegetated areas. It is a recommendation of this Recovery Action Plan that a concerted effort be made to ascertain if sea turtles nest on traditional horse racing beaches and, if they do, efforts should be made to restrict the activity to zones below the high tide line or during the non-nesting season.

Exotic Animal Introduction – It is a recommendation of this Recovery Action Plan that every precaution be taken to ensure that mongooses and other exotic species do not spread to areas they do not currently inhabit. It is especially important to protect offshore cays, such as the Morant Cays, which are important nesting areas. Immediate action should be taken to eliminate rats and cats from cays which are known to be important for turtle nesting, including some of the Portland Bight Cays. This would benefit other depleted species, such as seabirds, that have already been reduced by introduced predators (Haynes-Sutton, 1995; Schreiber and Lee, 2000; McGowan et al., 2007).

Development – Increasing interest in the south coast is leading to rapid change, with many previously inaccessible areas coming under pressure from developers. It is a recommendation of this Recovery Action Plan that sandy beaches important to sea turtle nesting be included in the national protected area system and left undeveloped. Important turtle nesting areas currently within the national system of protected areas include the beaches east of Luana Point, St. Elizabeth, beaches between Old Woman's Point, Manchester and Milk River, Clarendon, Manatee Bay, St. Catherine, Palisadoes, and the offshore cays (Pedro and Morant). Manatee Bay is part of the Portland Bight Protected Area and Hellshire Hills Protected Area, but the development of a new town and large-scale tourism at this site has also been proposed; strict development control is essential to ensure continued sea turtle nesting in this area. Other important nesting areas not currently protected are beaches in the Oracabessa area.

Beach Accessories – Sunbeds, sailboats and other recreational equipment left on the beach at night can interfere with nesting turtles and emerging hatchlings. They can block access to nest sites and obstruct the emergence of hatchings crawling to the sea. It is a recommendation of this Recovery Action Plan that hotels situated near nesting beaches not allow recreational equipment to remain on the beach at night.

4.14 Prevent degradation of marine habitat

4.141 Dynamiting reefs

The use of dynamite to kill fish is illegal under the WLPA of 1945 (Appendix II). Nevertheless, this practice is very common in Jamaica, particularly in Kingston Harbour, Portland Bight, and Alligator Pond. Even though illegal possession of dynamite is an offence under the Gunpowder and Explosives Act, a violation still carries a penalty of only J$40. Use of dynamite to harvest fish kills or injures marine fauna indiscriminately and damages habitat, especially if used near coral reefs. It endangers both built structures (e.g., pier pilings, bridge supports) and the fishers handling it. The causeway bridge spanning Kingston Harbour may have been weakened by dynamite used to harvest fish, which accelerated the need for major repairs to be carried out in the early 1990s. Even occasional accidental deaths of fishermen using dynamite have not discouraged its continued use. While there has been some discussion on the national level on controlling dynamite fishing, no resolution has been identified.

It is a recommendation of this Recovery Action Plan that a multi-pronged approach be enacted, including controlling the supply of dynamite; increasing public education targeted at suppliers and users); drafting of more comprehensive legislation to make prosecutions easier; increasing the capacity for monitoring and enforcement efforts; and more carefully inventorying and specifically labeling stockpiles so that dynamite used in an offence can be traced to its owner. Dynamite use will persist as long as dynamite is inexpensive and available, and fish yield a high profit margin.

While there are no documented cases to date of sea turtles dying as a result of the use of explosives, such incidents are unlikely to be noticed or reported. Meanwhile, irreparable damage has been and is being done to coral reef habitats that provide essential food and shelter to the last remaining hawksbill turtles (and many fishable resources) in Jamaica. For detailed recommendations on legal revisions to address dynamite and chemical fishing, see section 4.142.

4.142 Chemical fishing

Some fishermen continue to use chlorine and battery acid to poison fish on reefs and in rivers even though it is illegal under section 10 of the WLPA of 1945 (Appendix II). This practice may cause irreparable damage to coral reef habitats which provide food and shelter to hawksbill turtles in Jamaica and sustain the fishing industry.

To facilitate more effective law enforcement against this practice, it is a recommendation of this Recovery Action Plan that the WLPA be amended to make it an offence to possess equipment intended for use in chemical-assisted fishing. This provision would be similar to the language used in the St. Lucia's Fisheries Act of 1984 and significantly strengthen the current Act. In section 24 (1) of the St. Lucia's Fisheries Act, "any person who . . . (b) carries or has in his possession or control any explosive, poison or other noxious substance in circumstances indicating an intention of using such explosive, poison or other noxious substance for any of the purposes referred to in the preceding paragraph, is guilty of an offence . . . ". Public education about the effects of chemicals on coral reefs and investigation into the illicit sources to control its distribution, are urgently needed.

This approach was supported in a review of fisheries legislation in Jamaica (Lodge, 1995). The reviewer recommended that control of fishing methods be granted to the Fisheries Division and the new Fisheries Act assumes the provisions which refer to illegal fishing currently listed under the WLPA. The proposed provisions include several innovations to help close loopholes that currently make it very difficult to obtain prosecutions for dynamiting (see section 4.141) and chemical-assisted fishing.

The draft Fisheries Bill (2007) includes the following text under "Prohibited Fishing Methods":

Section 35. –

(1) A person commits an offence if he -

(a) permits to be used, uses or attempts to use any explosive, poison or other noxious substance for the purpose of killing, stunning, disabling or catching fish, or in any way rendering fish more easily caught; or

(b) carries or has in his possession or control any explosive, poison or other noxious substance in circumstances indicating an intention of using such substance for any such purpose.

(2) A person who is convicted of an offence under subsection (1) shall be liable on summary conviction before a Resident Magistrate to a fine not exceeding one million dollars and, in default of payment to imprisonment for a term not exceeding twelve months.

(3) Any explosive, poison or other noxious substance found on board any fishing vessel shall be presumed, unless the contrary is proved, to be intended for the purposes referred to in subsection (1).

(4) Every person who lands, sells, receives or possesses any fish taken by any means in contravention of this section, knowing or having reasonable cause to believe them to have been so taken, shall be guilty of an offence and liable on summary conviction before a Resident Magistrate to a fine not exceeding five hundred thousand dollars and in default of payment to imprisonment for a term not exceeding six months.

It is a recommendation of this Recovery Action Plan that the STRN and its partner organizations support the inclusion of these subsections in the new Fisheries Act.

4.143 Industrial discharges

Industrialisation in the absence of strict legislation has had predictable consequences in Jamaica. Improper planning and waste disposal, an increased demand for land, unsustainable population growth around industrial centres in the absence of adequate infrastructure (e.g., sewage treatment plants), and increased shipping traffic have contributed to a deterioration of the coastal environment.

Jamaicans depend on a healthy marine environment as a source of food and economic activity, especially tourism. Nevertheless, many coastal areas, especially those near major industrial centres, are polluted. For example, industries adjacent to Kingston Harbour and the gullies which drain into it empty large volumes of untreated waste into the water (Goodbody, 1989, 2003). The major generators of these wastes include tanneries, oil refineries, power stations, detergent manufacturers, canning and bottling plants, and animal slaughterhouses and processing facilities. Additionally, wastes from the sugar, food, and bauxite processing and loading facilities, leaks from underwater oil pipelines (e.g., JPSCo pipeline at Old Harbour Bay), oil spills, and solid waste refuse dumped on the shoreline have contributed to coastal pollution around the island (GOJ, 1987).

NEPA's predecessor began to demand that industries clean up their wastes and reduce untreated effluent when the NRCA Act of 1991 was gazetted. The NRCA Act provides comprehensive legislation to control pollution (Appendix II). While the 1991 Amendment to the Act raised the penalty for pollution to J$ 50,000 or imprisonment for a term not exceeding two years or both, compliance rather than prosecution was emphasised. In addition, under the WLPA, pollution violations carry a maximum penalty of a $100,000 fine or imprisonment for a term not exceeding two years or both fine and imprisonment.

It is a recommendation of this Recovery Action Plan that action is taken to monitor and regulate pollution of the nearshore marine environment. Specifically:

- existing pollution laws should be reviewed for completeness and enforceability and recommendations made to the Government for needed changes
- industries should be monitored to confirm that discharges are recorded with the appropriate Government agency and the content of the discharge properly identified; and
- fish and other marine life in suspected polluted areas should be tested on a regular basis for the presence of toxins.

4.144 At-sea dumping of garbage

The discharge of sewage, oil, garbage, plastic, toxic materials, discarded fishing gear, Styrofoam and many other materials into the ocean is a serious regional and global problem (O'Hara et al., 1986; CEE, 1987; Laist, 1987; Derraik, 2002). Beaches all around Jamaica are affected by garbage dumped from vessels at sea (e.g., fishing boats, yachts, cruiseliners, and military craft) and from land-based sources washed or dumped into coastal areas. Garbage that enters the sea is a serious problem for sea turtles because ingestion and entanglement can be fatal. Mrosovsky (1981) observed that leatherbacks ingest plastic bags mistaking them for jellyfish, frequently leading to death. Bugoni et al. (2001) recorded plastic bags to be the primary debris items ingested by leatherback sea turtles off the Brazilian coast. Balazs (1985) summarised records from around the world that cited incidents of ingestion of a wide range of oceanic debris.

Plotkin et al. (1993) summarized ingestion of man-made garbage by loggerhead sea turtles in the Gulf of Mexico as follows, "Anthropogenic debris was present in the digestive tract contents of 51.2% of the loggerheads. Debris contributed very little to the total dry weight of the samples, since most ingested debris consisted of light-weight plastics. Pieces of plastic bag constituted the debris most often found in

the digestive tracts. Other debris ingested included hard pieces of plastic, fishing line, pieces of latex balloon, rubber, tar, styrofoam, fish hook, rope, plastic spherules (beads), aluminum foil, cardboard, and cloth. … The debris ingested undoubtedly caused the turtle's death in three instances. The hook of a 6" stainless steel heavy-gauge fishing hook had perforated the esophagus of one loggerhead; a large piece of glass had perforated the stomach lining of a second; and large pieces of plastic trash bags had impacted the digestive tract from mouth to cloaca of a third." Similarly, Frick et al. (2009) reported that "anthropogenic debris (*F* = 25%) was primarily small pieces of hard plastic, but also included corks, white styrofoam pieces, and neon-colored foam similar to that used as recreational fishing floats (bobbers)."

Several NGOs, including the Jamaica Environment Trust (JET), Jamaica National Trust, and the Portland Environment Protection Association, organise annual beach cleanups in Jamaica, but the amount of garbage on beaches and its origins are not monitored island-wide. It is a recommendation of this Recovery Action Plan that more efforts be put forward to monitor the volume and source of solid wastes on Jamaican beaches and to reduce it at the source through outreach education (e.g., targeting boat operators) and the development of guidelines and the enforcement of regulations.

The STRN has also played an active role in removing garbage from beaches by organising early clean-ups of Old Harbour Bay (1993, 1994), and the "Sea Turtle Summer Nights" volunteers to collect rubbish from beaches. It is a recommendation of this Recovery Action Plan that the STRN, in partnership with JET and participating community and civic groups, continue and expand their efforts to integrate local clean-up campaigns modeled after the International Coastal Clean-Up Campaign and to contribute the results to applicable databases: http://www.oceanconservancy.org/site/PageServer?pagename=press_icc

4.145 Oil exploration, production, refining, and transport

Marine traffic, especially oil tankers using local ports or in transit through coastal waters, pose a risk of marine oil pollution resulting from collisions, groundings, sinkings, oil cargo and bunker transfer, bilge cleaning, at-sea spills, and other marine incidents. Such pollution threatens recreational areas, sea turtles, seabirds, and other marine life, coastal installations, and fisheries.

Sea turtles are vulnerable to oil spills and oil-related pollution. Behavioural experiments indicate, for example, that green and loggerhead turtles have limited ability to avoid oil slicks, and physiological experiments show that the respiration, skin, some aspects of blood chemistry and salt gland function of 15-18 month old loggerheads are significantly affected by exposure to crude oil pre-weathered for 48 hours (Vargo et al., 1986). Hawksbills (predominantly juveniles), represented only 2.2% (34 out of 1,551 individuals) of all sea turtle strandings in Florida (USA) between 1980-1984, yet they comprised 28.0% of petroleum-related strandings. Oil and tar fouling of these turtles was both external and internal. Chemical analysis of internal organs showed that crude oil from tanker discharge had been ingested. Vargo et al. (1986) observed oil clinging to the nares (nostrils) and eyes, the upper portion of the esophagus, and in the feces in both experimental and stranded oil-fouled turtles. Other investigators have commented on the effects of oil on turtles, such as sealing their mouths and nostrils (e.g., Fritts and McGehee, 1981; Hall et al., 1983; Frazier and Salas, 1984; Gramentz, 1986, 1988; Hirth, 1987; Lutcavage et al., 1995) and potentially affecting even nesting habitat (Shigenaka, 2003).

The majority of beaches on the north, east and west coasts of Jamaica show signs of tar fouling (Jones and Bacon, 1990); however, the source was not identified. Jamaica lies on major shipping lanes and the east coast is a high risk area for oil spills. There have been oil spills involving tankers delivering oil to bauxite ports on the south coast and from cruise ships. Other spills occur during oil transfers in underwater pipelines in Old Harbour Bay or during ship-to-shore transfers in Kingston Harbour. The amount of oil released in bilge water from passing tankers is not known, but the Harbours Act of 1874 includes reference to the release of oil in harbours. To date, exploration for oil and natural gas in Jamaica's territorial waters by the Petroleum Corporation of Jamaica has failed to show any significant reserves, but exploration continues and vigilance to environmental protection is warranted.

Jamaica ratified the Cartagena Convention (section 4.32) and its Protocol Concerning Cooperation in Combating Oil Spills in the Wider Caribbean Region in 1987. Article 3 of the Protocol states:

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

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

A major oil spill in Jamaican waters would be disastrous not only for turtles but also for the fishing and tourism industries. The Jamaica Defence Force Coast Guard has developed an Oil Spill Contingency Plan and has equipment to deal with oil spills. It is a recommendation of this Recovery Action Plan that Jamaica's contingency plan should be reviewed and the plan and capacity to deal will oil spills should be updated as necessary.

4.146 Agricultural run-off and sewage

Land disturbance activities, such as agriculture, and the disposition of sewage in Jamaica often result in high levels of suspended particulate matter (SPM), nitrates, phosphates and chemical residues in coastal marine waters (e.g., Goodbody, 1989) and increased incidence of diseases in coral reefs (Lipp et al., 2002; Kaczmarsky et al., 2005). Soil conservation is not widely practiced in Jamaica, resulting in the loss of large amounts of soil from cultivated land annually. Fertilizers, pesticides, herbicides and other chemicals are heavily used in most agricultural regions in Jamaica and they contribute to pollution in run-off waters that enter the sea. Untreated or partially-treated sewage also flows into coastal water, adding to the pollution load. Septic tanks or pits are currently used in many coastal towns because of the lack of functional sewage systems. Unless properly installed and maintained, effluent from soak-away septic systems can enter the sea by transport through rivers, streams, or shallow aquifers. Septic pit contents are transported by trucks and the loads frequently are emptied into gullies, mangrove swamps or the sea, rather than approved sites.

In small quantities, nitrates and phosphates are needed for metabolic processes in living organisms. However, excess amounts of these nutrients foster phytoplankton blooms which, together with SPM, block incoming light and result in decreased coral growth rates (e.g., D'elia et al., 1981). SPM further stresses marine organisms by physically smothering them and impairs fish respiration. Sediment-covered surfaces restrict larval settlement, and large quantities of SPM settling and decomposing on reefs causes increased bacterial activity. Coral reefs prone to nutrient effects are usually exposed to other anthropogenic stressors that can make a reef more susceptible to nutrient effects or cause symptoms similar to those expected from nitrification (Szmant, 2002).

It is a recommendation of this Recovery Action Plan that studies be undertaken to evaluate the effects of agricultural runoff (i.e., pesticides and herbicides) on nearshore marine communities in Jamaica. A monitoring programme, perhaps as part of a national water quality programme, should be established.

The effluent of chemically-based sewage treatment deposited close to shore may be damaging to coastal communities. As an alternative, some wetlands are used to partially treat sewage. If this less chemical-intensive method is found to be effective in treating sewage, it may be expanded beyond the current trial near Portmore. It is a recommendation of this Recovery Action Plan that NEPA take the lead in developing inter-agency capacity to monitor water and habitat quality in nearshore waters on a routine basis.

In addition, an environmentally sound national strategy for sewage disposal should be identified and implemented as soon as possible.

4.147 Anchoring and dredging

There are only four coastal areas in Jamaica where large ships routinely anchor: Kingston Harbour, outside the barrier reef off Kingston Harbour, east of Port Kaiser in St. Elizabeth parish, and Port Rhoades in St. Ann parish. However, there is no information about the extent of small vessels anchoring in inshore waters and the amount of damage caused to the reefs by this activity and anchor chain dragging from fishing, diving, and other recreational boat operators. Nevertheless, there are specific areas where damage has been significant and mitigation measures have been taken. The damage to the reefs and seabed seem to be substantial in Negril, Portland Bight, Port Royal Cays, and Montego Bay. In order to address this problem, the NCRPS and the MBMP were instrumental in getting mooring buoys installed at sites heavily used by divers. Many more mooring buoys are required around the island on reefs which are used for diving or fishing.

It is a recommendation of this Recovery Action Plan that a national system of moorings be installed to minimize damage to coral reefs and seagrass beds. Inexpensive mooring systems have long been available (e.g., Halas, 1985) and the experience of NCRPS and the MBMP can be modeled. Designated mooring areas should be provided and yachts and mini- cruise ships be required to use them. Ships longer than 200 ft should be required to dock at port facilities or anchor in specially designated offshore areas (away from reefs or seagrass beds).

Dredging of harbours (including Kingston Harbour, Montego Bay, Portland Bight and Discovery Bay) occurs periodically. Dredging projects require Beach Licences under the Beach Control Act for two types of dredging activities: maintenance dredging and capital dredging. A full EIA or specific-direct EIA may be required for maintenance dredging depending on the location and extent of the project, whereas a full EIA is required for all capital dredging projects. It is a recommendation of this Recovery Action Plan that independent environmental impact assessments be carried out for all dredging projects, and that appropriate mitigation measures be put in place *before* dredging is undertaken.

4.148 Other factors

Land reclamation has transformed once-productive mangrove swamps (e.g., in the vicinity of Kingston Harbour) into industrial areas, housing estates, and hotels. Even though the effects of these changes on marine ecosystems have not been documented, anecdotal evidence suggests dramatic declines in ecosystem productivity. Currently there is considerable pressure to “reclaim” some of the remaining wetlands, since they are often viewed as unproductive and potentially inexpensive to acquire. In many cases, mangrove swamps are ecologically linked to sandy beaches in Jamaica, and therefore their integrity is important for sea turtle nesting.

In an effort to address this problem, the National Ramsar Committee recommended that the (then) Integrated Watershed and Coastal Zone Branch integrate and modernize policies into a comprehensive wetland policy that would regulate activities in wetlands and provide protection to these areas.

Wetland modification, clearance or reclamation is a category under the NRCA Permit and Licence system and the Order (in accordance with Section 9 of the NRCA Act) requires a permit issued by NEPA. Therefore, it is the recommendation of this Recovery Action Plan that the Wetlands Policy and the new Order be implemented by the NEPA as soon as possible.

4.2 Manage and Protect All Life Stages

In previous sections, solutions to many threats facing sea turtle nesting and feeding habitats were presented. The following sections focus on managing and protecting the turtles themselves. Existing conserva-

tion legislation is reviewed and improvements are proposed, and related topics, including bycatch, law enforcement, alternative livelihoods for turtle fishermen, and sea turtle population monitoring, trend analysis, and management are also discussed.

4.21 Assess regulatory mechanisms

4.211 Review existing national laws and regulations

Comprehensive protection of sea turtles is provided to the five species included in the 1982 amendment to the Third Schedule of the Wild Life Protection Act of 1945. These species are: Green turtle (*Chelonia mydas*), Hawksbill (*Eretmochelys imbricata*), Loggerhead (*Caretta caretta*), Atlantic [Kemp's] ridley (*Lepidochelys kempii*), and the Leatherback (*Dermochelys coriacea*). Under this regulation it is illegal to harvest or sell sea turtle eggs, or to kill or possess "the whole or any part" of any of these species dead or alive. The Natural Resources Conservation Authority Act, The Wild Life Protection Act (Amendment) Orders (1998) states that persons found guilty of hunting or possessing any protected sea turtle are liable on summary conviction to a maximum fine of J$100,000 or to imprisonment for a term not exceeding 2 years and that the equipment used in the commission of the violation including vehicles and boats, may be seized. There have been several convictions under this Act (section 3.41).

The jurisdictional powers of the WLPA extend three miles from any parish. Additionally, the WLPA appears to apply to the Morant and Pedro Cays because The Morant and Pedro Cays Act (see below) defines these offshore territories as part of Kingston and St. Andrew. Under this Act of 1907 and subsequent amendments, the Fisheries Division can issue licences for turtle fishing. However, since a more recent law generally supersedes an older law, the GOJ should seek to clarify, as a matter of priority, whether the WLPA takes precedence in protecting sea turtles and their eggs on the Morant and Pedro Cays, as it does elsewhere under national jurisdiction.

Lodge (1995) recommended that, “As far as possible, fisheries management should be dealt with by the fisheries administration. Provisions for the protection of endangered species (e.g., turtles) may properly be left to the NRCA Act or Wild Life Protection Act.” It is a recommendation of this Recovery Action Plan that the jurisdictional powers of the WLPA or regulations to protect sea turtles under the NRCA Act should be extended to cover the entire EEZ in an unambiguous attempt to ensure national consistency and continuity with regard to sea turtle protection.

Fisheries Inspectors (or other persons duly authorized in writing by the Minister) are charged with enforcing the Morant and Pedro Cays Act. Persons found guilty of an offence against this Act are liable on summary conviction to a maximum fine of J$400, and in default of payment thereof, to imprisonment for a term not exceeding 12 months. The Fisheries Division, which administers the Morant and Pedro Cays Act, falls within the Ministry of Agriculture and Fisheries, whereas NEPA falls, at present, within the Office of the Prime Minister; consistency in sea turtle protection should be a Ministerial priority for both.

The Endangered Species Act (Protection, Conservation and Regulation of Trade) of 2000 provides another sea turtle protection tool. It implements CITES, to which Jamaica became a Party in 1997 (see section 4.311). Penalties for trafficking in listed species cited in the Endangered Species Act include fines of up to J$2 Million and imprisonment not to exceed two years (if brought before a Resident Magistrate) or ten years (if brought before a Circuit Court). In either case, species specimens are forfeited to the Crown upon conviction.

4.212 Evaluate the effectiveness of law enforcement

In general, laws are not well respected, and among enforcement officers and the judiciary, crimes involving wildlife are not taken seriously. Charges are often discounted in consideration of the economic needs of the defendants. Additional roadblocks to effective law enforcement include the inaccessibility of

many small nesting beaches, the large size of the fishing community, the opportunistic nature of turtle fishing, and the wide expanse of Jamaica's coastal and territorial waters.

Enforcement of the Wild Life Protection Act (1945) is the responsibility of NEPA and authorized persons under the Wild Life Protection Act. The Enforcement Branch under the Legal and Enforcement Division coordinates enforcement activities carried out by NEPA staff, rangers in protected areas, and volunteer Game Wardens. The Island Special Constabulary Force coordinates activities carried out by the police with or without the assistance of NEPA. NEPA's 23 Enforcement Officers monitor infractions of all environmental acts under the supervision of the Branch Manager, the Director of the Division, and ultimately the Chief Executive Officer. In 2003, the Island Special Constabulary Force (ISCF) assimilated the functions of the former Environmental Warden Service.

The Game Warden system was instituted to extend the capacity to enforce the WLPA. It includes Government officers drawn from relevant agencies and concerned private citizens – 85 persons were appointed for the period March 1, 2007 to December 31, 2008. However, the system does not seem to be very effective in reducing the illegal take of sea turtles or promoting sea turtle conservation. Most Game Wardens are not likely to observe infractions of sea turtle protection laws during their daily activities or have the opportunity to monitor nesting beaches. Game Wardens usually are advised to work in conjunction with the Police; generally they are reticent to use the considerable powers given to them.

Law enforcement at sea is the responsibility of the Jamaica Defence Force Coast Guard, Fisheries Division, and Marine Police. The Fisheries Division is an important agency for sea turtle conservation because it maintains an important link with the fishermen and fishing communities which consume most of the turtle eggs and meat. Currently there are only nine Fisheries Officers to service the entire nation.

It is a recommendation of this Recovery Action Plan that, to the extent possible, Fisheries Officers become actively involved with sea turtle awareness programmes within fishing communities (see also section 4.42). Moreover, the monitoring and reporting of violations of the WLPA with reference to sea turtles should be one of the principal responsibilities of Fisheries Officers. The STRN can assist Fisheries Officers by helping to define the programme, and providing incentives, training and materials.

The JDFCG has an excellent record of supporting wildlife conservation, including sea turtles. Despite their limited resources, they provide transportation to near and offshore cays for research and monitoring and have been extremely useful in supporting enforcement activity. It is a recommendation of this Recovery Action Plan that JDFCG personnel be trained to assist with data collection and invited to training opportunities offered by WIDECAST and/or the STRN.

The Coast Guard is planning to upgrade its facility on Pedro Cays, and while its focus there is interdiction of drug transshipments, its expanded presence will provide greater opportunity to enforce sea turtle protection laws. It is a recommendation of this Recovery Action Plan that the Coast Guard be given the resources to expand its base to "ensure compliance with applicable laws and regulations" (JDFCG, 2008).

The Marine Police, a division of the Jamaica Constabulary Force, is confined to inshore waters where they patrol harbours and areas most impacted by drug trafficking. In the future they should be encouraged to increase their role in wildlife law enforcement. Most turtles are harvested in or transported through inshore waters; therefore, the Marine Police can exercise considerable control over illicit activities involving sea turtles. In order to better use this important law enforcement agency, the STRN can facilitate involvement of the Marine Police by ensuring their fullest participation in the STRN and by supplying informational materials.

4.213 Augment existing law enforcement efforts

There has been a steady progression of improved law enforcement efforts designed to protect natural resources, including sea turtles. Nevertheless, enforcement can be further enhanced by providing adequate resources, outreach education, and improved management of enforcement procedures, and by the adoption of additional laws and regulations.

It is a recommendation of this Recovery Action Plan that steps be taken to provide more effective enforcement of conservation and environmental laws by increasing the number of Environmental Wardens at the earliest possible date. The Game Warden system should be reviewed and strengthened; other mechanisms should also be considered, including increased voluntary assistance with law enforcement; increased public awareness and outreach campaigns; and initiatives designed to increase awareness and motivation on the part of Jamaica's law enforcement officers (and the judiciary) to fully enforce existing laws that apply to sea turtle protection. Currently NEPA is training and sensitizing law enforcement and judiciary officials through outreach education on environmental laws administered by NEPA, the Forestry Department and the Fisheries Division.

Since it was established in 1991, the STRN has consistently provided volunteers to assist in the protection and monitoring of sea turtle nesting beaches and foraging grounds. As an extension of its work and experience, it is logical that the STRN become more actively involved in reporting violations to NEPA.

There is also a need to educate fishermen and the community in general of the importance and opportunity to protect and conserve Jamaica's sea turtle populations. Emphasis should be placed on outreach educational programmes on the life history of sea turtles, reasons for declining populations, the importance of protecting remaining stocks, and opportunities for their participation in developing regulations governing protected areas. Fishermen should help design and implement this programme.

It is a recommendation of this Recovery Action Plan that immediate steps be taken to prohibit the offer for sale of turtle products under the WLPA. All incidents of sale or advertising of sea turtle products should be reported promptly to NEPA or the Island Special Constabulary Force. It is also important to educate potential vendors and purchasers (see also section 4.4). Local environmental NGOs and Game Wardens should be enlisted to help (see also section 4.24). Immediate action should be taken by NEPA to regularise approved trade or to confiscate existing tortoiseshell stocks, as appropriate. Earmarking profits from the sale of shell items has been suggested, but at present all inventories are privately held (see section 3.3 – *Tortoiseshell*).

Finally, it is a recommendation of this Recovery Action Plan that the assistance of the JDFCG be sought in monitoring and protecting sea turtle populations throughout Jamaica's territorial seas. Monitoring is a key component of any conservation programme, especially ongoing monitoring of Index Beaches and high priority foraging grounds.

4.214 Make fines commensurate with product value

In a reference to fisheries legislation in general, Lodge (1995) concluded that, “The low level of financial penalties is largely due to the decline in the Jamaican dollar and is not unique to the fisheries legislation. It is suggested that the penalties should not only be increased generally but should also be harmonized across the various areas of maritime jurisdiction. ... An alternative approach may be to introduce a system of penalties according to a scale which may be adjusted from time to time by the Minister by order published in the Gazette. In this way, the level of fines could be maintained at a realistic level. This approach has not been used in Jamaica, although it has been used in several Commonwealth jurisdictions as a mechanism for standardizing penalties across a wide range of legislation.” Current penalties for violating the WLPA are J$100,000 in addition to provisions which allow the confiscation of boats, weapons and traps used in the commission of an offence.

It is a recommendation of this Recovery Action Plan that the GOJ adopt the approach identified by Lodge (1995). Penalties should be reviewed on a regular basis (e.g., 4 years) and modified to reflect the fluctuating value of the Jamaican dollar relative to other currencies. For example, if the currency is devalued (a persistent problem in Jamaica) or the cost of black-market turtle soup or shell jewelry increases, the fines should be increased. Fines under the Morant and Pedro Cays need to be increased from J$400 to J$20,000, or an equivalent value at the time.

4.22 Propose new regulations where needed

It is important that laws and regulations governing sea turtle conservation are unambiguous and clearly identify the roles and parties responsible for monitoring, compliance and enforcement activities. Historically, hindrances to effective law enforcement have been overlapping jurisdiction and lack of will to exercise separation of powers between the four Ministries involved: Office of the Prime Minister; Ministry of Agriculture and Fisheries; Ministry of Industry, Investment and Commerce; and Ministry of Tourism.

It is a strong recommendation of this Recovery Action Plan that regulations concerning sea turtles be developed under the NRCA Act to consolidate legislation and legal jurisdiction, and that primary responsibility for sea turtles be place under NEPA. This recommendation models the suggested changes to fisheries legislation (Lodge, 1995), and was advanced by the NGO community and the GOJ, which undertook a joint review of environmental legislation in 1995 (NRCA, 1995).

4.221 Eggs

Existing laws are adequate to protect eggs from direct collection and sale, but habitat loss and degradation remain a serious threat to sea turtle survival in Jamaica. Many current development practices exacerbate erosion and promote beach loss (section 3.1). Legislation should be developed to require and enforce legal set-backs for all construction activities and relevant controls on coastal land in order to protect eggs from beach erosion and to promote successful egg incubation.

Removal of beach vegetation accelerates erosion and can precipitate the loss of turtle nests. Protection of trees with a circumference exceeding 1 m (measured 1 m from the ground surface) should be considered under Tree Preservation Orders; the Orders can be promulgated under the Town and Country Planning Act of 1958. It is a recommendation of this Recovery Action Plan that additional legislation to protect beach vegetation (e.g., sea grape, *Coccoloba* sp.; crab grass, *Stenotaphium secundatum*) is needed and could be developed under the NRCA Act or the Beach Control Act. Choi and Eckert (2009) offer guidance on planting 'beach gardens' to enhance hawksbill nesting habitat and encouraging hotels to invest in this and other conservation measures.

Incubating sea turtle eggs must also be protected from nest compaction. It is a recommendation of this Recovery Action Plan that protection be achieved by: fencing nest sites; carefully collecting threatened eggs within 12 hours of being laid and reburying them in less heavily used beach zones; prohibiting vehicles on sandy beaches; and/or restricting horse racing to below the high tide line. Further guidance on the protection of eggs can be found in section 4.13 "Prevent degradation of nesting beaches" and in section 4.252 "Management techniques for eggs and hatchlings."

4.222 Immature turtles

Immature turtles are adequately protected by law, but it is a recommendation of this Recovery Action Plan that effective enforcement is urgently needed (see section 4.24).

4.223 Nesting females

Legislation protecting nesting sea turtles is adequate, but regulations to implement it are widely ignored. Adult sea turtles represent decades of selective survival and reach sexual maturity at about 20 to 40

years of age, depending on species. Frazer (1983) calculated that the reproductive value (or the relative worth) of a loggerhead turtle just reaching reproductive age was approximately 500 times that of an egg. Recognizing that this age group is the most difficult life stage of a population to replace, sea turtle conservation science and demographic models suggest that large juveniles and breeding-age adults are the most important age classes to protect in order to promote population recovery and maintenance and therefore should receive stringent protection efforts. Additionally, since less than 1% of hatchlings that reach the sea will survive to adulthood, it is important that hatch success be optimised by, for example, eliminating egg collection on the nation's beaches. Based on the best available science, it is a strong recommendation of this Recovery Action Plan that priority be given to the protection of adult female sea turtles, even when management and enforcement resources are scarce.

4.23 Investigate alternative livelihoods for turtle fishermen

Based on interviews and community workshops conducted during the preparation of this Recovery Action Plan, the exploration of alternative livelihoods does not appear to be a high priority for management. Although many fishermen take turtles opportunistically and fishermen regard them as an important supplemental catch and subsistence food, few if any fishermen depend on turtles and most agree that banning turtle harvests would not involve any significant hardship (Tambiah, 1995). It is a recommendation of this Recovery Action Plan that STRN work in collaboration with the appropriate government agencies, community-based groups, and fisher organisations to further explore creative alternatives (e.g., assistance with supplementary fishing methods). With regard to artisans working with sea turtle shell, the only major producer of turtle shell jewelry has long been using other materials (e.g., cow horn). Therefore, provision of alternatives for artisans would not appear to be a management priority.

4.24 Determine incidental catch and promote the use of TEDs

In the 1983 report to WATS I, fishers provided information on sea turtle bycatch. The report noted incidental capture occurred in beach seines and fishing gear (Kerr 1984). A 2006 preliminary survey of Jamaican fishers by the global bycatch assessment project (Project GloBAL) noted that 27% of the 127 trawl, trap, and gillnet fishers interviewed responded positively to the question of whether sea turtles were captured incidentally in fishing gear (Bjorkland et al., 2008). Fish traps and gillnets ("china nets" and trammel nets) are the gear types primarily identified in sea turtle bycatch, but this probably reflects the preponderance of those types of fishing gear used in Jamaican waters. Shrimp fishers indicated they had no sea turtle bycatch. The survey also suggests that juvenile hawksbills (3-20 kg) are caught in traps while bycatch of larger turtles are generally associated with the gillnet fisheries. One fisher also noted the incidental catch of a leatherback by entanglement in the buoy line of a fish pot off Calabash Bay, southwestern Jamaica. With respect to rates, the fishers' responses varied from infrequent (less than one animal per year) to one animal per month in trammel net fishing.

There are approximately eight boats using trawl nets in Jamaica (A. Galbraith, Fisheries Division, pers. comm.) Studies need to be conducted to establish if and how many turtles are accidentally caught and drowned in these trawls before the use of turtle excluder devices (TEDs) can be considered. A TED is a device fitted to or a modification of a trawl net that allows turtles to escape immediately after capture in the net. Trawl fisheries are implicated in the dramatic declines in olive ridleys in Suriname (Reichart and Fretey, 1993), Kemp's ridleys in Mexico (Ross et al., 1989), and loggerheads in the USA (e.g., Hopkins-Murphy and Murphy, 1988). Prior to the use of TEDs, tens of thousands of sea turtles drowned every year in the nets of shrimp fleets operating off continental coastlines of South and Central America, Gulf of Mexico, and the eastern seaboard of the USA (National Research Council, 1990). It is a recommendation of this Recovery Action Plan that the Fisheries Division investigate the extent to which shrimp trawling is drowning sea turtles in Jamaican waters.

In some parts of the Wider Caribbean, the incidental catch and subsequent drowning of sea turtles in longlines is a growing concern. There is no legal longline industry in Jamaica, although longlines are used by foreign fishermen fishing illegally for swordfish in Jamaican waters and by local fishermen on the

north coast where the resources of the narrow island shelf have been depleted (Lodge, 1995; A. Galbraith, pers. comm., 1996). In the latter situation, vertical longlines are used. Capture of leatherbacks by longlines has been documented in the northeastern Caribbean Sea (Cambers and Lima, 1990; Tobias, 1991), Gulf of Mexico (Hildebrand, 1987), and southeast U. S. (Witzell, 1984). Leatherbacks and loggerheads are captured on longlines in Antigua (Fuller et al., 1992). While there are no reports of sea turtle capture by longlines in Jamaica, it is a recommendation of this Recovery Action Plan that the STRN seek to stimulate research into the scale and nature of incidental capture of sea turtles by all methods in Jamaica, including longlines.

Additionally, this Recovery Action Plan recommends that the STRN work with the Fisheries Division to ensure that the proposed new fisheries legislation provides adequate protection for turtles against incidental capture and include control of fishing methods likely to affect turtles and turtle habitat, and imposition of mitigating measures where necessary (e.g., time and area closures, gear modification, requirements that nets not be left unattended). Finally, it is a recommendation of this Recovery Action Plan that all cases of incidental sea turtle capture, as well as the fate of the animal, be reported to the Fisheries Division and/or to NEPA.

4.25 Supplement reduced populations using management techniques

In addition to protecting the turtles and their habitats, the GOJ must employ appropriate and site-specific management techniques that will enhance the reproductive success of depleted populations. This section discusses some of these techniques with the caveat that manipulative options, such as turtle tagging, predator control, and the relocation of eggs to hatcheries, should be undertaken with caution.

It is a recommendation of this Recovery Action Plan that any management intervention be targeted at a specific threat, and that priority be placed on data collection that serves a specific management objective. Different threats need different responses. As an example, one remedy will not address both the incidental capture of adults offshore (which requires fundamental changes in gear use and perhaps a redistribution of fishing effort) and the loss of eggs onshore. Similarly, different responses are needed depending on how eggs are lost, such as by predators or by beach erosion. The IUCN/SSC Marine Turtle Specialist Group (section 4.54) has published a manual of standard management techniques (Eckert et al., 1999: http://www.iucn-mtsg.org/publications/Tech_Manual/0000%20Table%20of%20Contents.htm).

4.251 Management techniques for turtles

It is a recommendation of this Recovery Action Plan that to minimise the killing of egg-bearing females on their nesting beaches, Jamaica must establish effective habitat surveillance, especially during the night when nesting occurs. Whenever possible, surveillance should be carried out by community-based or other groups or other alternatives rather than law enforcement personnel. Grassroots patrol programmes are cost-effective, actively involve the local community, and help address the problem of turtle take. They can also reduce the loss of nests (eggs) to poachers and predators. It is a recommendation of this Recovery Action Plan that the STRN ensure that a trained Coordinator is identified for each participating nesting beach – and that each Coordinator be responsible for establishing beach patrol schedules, maintaining a database for the beach, and submitting an Annual Report to the permitting agency. Patrollers should be trained staff, or trained volunteers who participate on a rotating basis.

In all cases, surveillance personnel should be adequately equipped and trained. It is a recommendation of this Recovery Action Plan that beach patrollers carry VHF radios, be trained in law enforcement protocols, and be visibly and consistently supported by formal law enforcement authorities. Community-based surveillance efforts should be inaugurated with a sense of community spirit, be well-publicized in the media (also using posters, flyers), and receive clear political support. If surveillance and protection efforts are coupled with tagging of nesting females, training and advice should be sought from WIDECAST and/or other technical sources.

A long-term tagging programme can provide valuable management information about reproductive output, nest site fidelity (including exchange between nesting grounds), and details of post-nesting migration. However, it should be undertaken only where there is an underlying scientific justification. It is expensive, involves trained personnel, and requires a long-term and continuous commitment to the effort; new information cannot be learned from intermittent tagging. Tagging databases are complex, time consuming to maintain, and require computer literacy skills for data archiving and retrieval. Tagging is typically accomplished using a standard metal or plastic flipper tag and/or a small internal tag (Passive Integrated Transponder, or PIT tag) which requires field workers to carry an electronic "reader." WIDECAST maintains a Caribbean Marine Turtle Tagging Centre (MTTC) at the University of the West Indies in Barbados to provide tags, standard record-keeping forms, database management software, and training. A procedures manual is available (Eckert and Beggs, 2006). It is recommendation of this Recovery Action Plan that tagging not be undertaken in Jamaica unless it is in collaboration with this regional resource centre and fully permitted and approved by the national regulatory authority.

Management techniques to improve the survival of egg-bearing females should extend to the coastal and pelagic reaches of sea turtle habitat. Biotelemetry (i.e., tracking sea turtles using VHF or satellite transmitters) has the capacity to yield valuable data on the movements and behavior of turtles at sea including fisheries interactions (Polovina et al., 2004; Eckert, 2006), geography of critical habitat, and migratory corridors. Professional advice and guidance on biotelemetry techniques, data interpretation, and assistance are available through the WIDECAST network.

4.252 Management techniques for eggs and hatchlings

It is a recommendation of this Recovery Action Plan that management efforts aim to achieve a minimum of 50% of all sea turtle nests successfully producing hatchlings each year. Manipulative management techniques, such as collection and reburial of eggs, should be undertaken only if there is evidence of a serious threat. For example, relocation may be necessary when a nest is laid below the high tide line, or constructed in *Sesuvium* (sea purslane) or similar dune vegetation (usually on the cays). In the latter case the plants die after being trampled by the nesting turtle and the trail of dead vegetation identifies the nest location, making the eggs susceptible to poaching; even when turtle tracks in the sand have been concealed, the chance of egg survival is low. Prior to any manipulation, it is a recommendation of this Recovery Action Plan that the advice of the STRN, NEPA biologists, and/or another technical authority be sought during the planning stages, that proposals be submitted to the appropriate government agency, and that proposals be peer-reviewed by experts both inside and outside of Jamaica to ensure the application of best practices.

The following sections provides guidance to managers in deciding whether the collection and reburial of eggs threatened by predators or erosion is advisable and, if so, how to proceed. Ideally, sea turtle eggs should be collected for reburial as they are laid. Excavating nests after 12 hours or more have passed since egg-laying heightens the risk of dislodging the embryo from the inner lining of the eggshell and its resulting death. In emergency situations, such as when eggs are exposed by a storm surge or human activity, an attempt to salvage the mid-term clutch is prudent.

Eggs should always be handled with great care and axial rotation minimised. The eggs should be 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 so that the temperature of incubation is not altered. Hatchlings should always be allowed to emerge from the nest naturally and traverse the beach unaided as soon as they emerge. Hatcheries should be constructed only as a last resort. Eggs should not be incubated in Styrofoam boxes or other artificial media which may bias the natural sex ratio of hatchlings. Hatchlings should never be kept as pets.

In situ relocation – The collection and reburial of eggs should never be undertaken lightly. Even when eggs are carefully collected at deposition, a decline in average hatch success for moved nests is expected (Mortimer et. al., 1994, but see Ralph et al., 2005, who reported no decrease in hatch success

when eggs were moved within 3 hours of deposition). Despite expected declines in hatch success due to even the most careful handling and reburial techniques, this type of manipulation can sometimes substantially improve overall reproductive output by reducing large annual losses to beach erosion.

So-called "in situ" relocation is preferred to an enclosed hatchery (see below). A programme of all-night patrol is necessary for this technique because eggs laid in high risk zones should be gathered as they drop into the nest cavity. Eggs should be placed immediately in a clean bag, bucket or basket. Alternatively, a plastic bag can be positioned in the hole to receive the eggs. The bag or other container must be strong enough to carry 12 kg reliably. If a bag is placed in the hole, the opening should be clasped shut (to exclude falling sand) and the bag swiftly dug out from behind as soon as egg-laying is complete. Efforts should be made to minimise the amount of sand gathered with the eggs. Scoring of the egg shell during handling and transport can reduce hatch success. Be careful. Eggs are fragile.

When all the eggs have been collected and the nest depth recorded, the eggs should be transported to the relocation site without delay. If transport occurs by vehicle, the egg bag or bucket should be secured and cushioned. Reburial should occur within 1-3 hours to minimise movement-induced injury to embryos and the negative effects of changes in the temperature and moisture content of the eggs. To simplify project logistics, minimise transport trauma, and promote the perpetuation of the population at its chosen nesting beach, every effort should be made to relocate the eggs elsewhere on the same nesting beach. The new nest site should be located well above the high tide line, approximate the type of habitat chosen by the female, and not located too near other nests. The eggs should be placed carefully, not dropped, into the new nest. The nest should be covered by replacing the damp subsurface sand removed from the hole and gently but firmly tamping it in place in layers of 8-12 cm. Do not place hot surface sand on the eggs. Finally, dry sand should be sifted over the site to hide evidence of the new nest's location.

Hatchery relocation – In contrast to *in-situ* relocation, enclosed hatcheries can be less effective if the threat is erosion or poaching. Since hatcheries concentrate all the eggs in one place, the risk of loss to erosion or poaching may actually increase. Nocturnal beach surveillance (see section 4.241) and public awareness efforts are more effective in protecting eggs against poaching than hatcheries. To discourage poaching, patrollers should disguise nesting crawls by smoothing them over with a broom, palm frond or rake. Enclosed hatcheries are relatively ineffective against feral or stray animals, such as pigs or dogs, which can dramatically reduce the reproductive success of a sea turtle population. Under these circumstances, the first priority should be to restrain or impound these animals.

Enclosed hatcheries should be considered only as a last resort, and only if a suitable hatchery site is found. Keep in mind that hatcheries are expensive to construct and maintain, they are likely to alter natural hatchling sex ratios, and average hatch success will decline. After all other alternatives have been considered and discarded in favour of an enclosed hatchery, an appropriate site must be identified. The site should be flat, located on the upper beach platform, and mimic the natural nest habitat (e.g., open beach for leatherbacks and green turtles, largely shaded for hawksbills). The site should be well drained; a high water table (e.g., located near an estuary) or a low-lying site susceptible to storm flooding will drown developing embryos. The enclosure should be solid and capable of withstanding strong winds and storms.

Nests should be buried in a grid formation, 1 m from one another, in an enclosed hatchery. A 7 m x 12 m enclosure can accommodate 50 nests and will have adequate room for hatchery personnel to move around. Animal fencing, consisting of 5 cm x 10 cm mesh and at least 1.5 m wide should be secured at regular intervals by 10 cm x 10 cm posts. It should be dug 0.5 m into the sand to prevent dogs from digging under the fence and a perimeter wire (electrified with a battery-powered charger) constructed around the site to discourage dogs from lunging against the enclosure. Fencing to this height makes it convenient for beach patrollers to step over the fence to bury eggs inside the enclosure. If theft by poachers is a threat, fencing must be adequate to exclude trespassers and a guard posted day and night.

An enclosed hatchery must be maintained so that wind-blown sand does not accumulate over incubating nests. Deepening the overburden alters incubation temperature and can make it impossible for the hatchlings to emerge. The site of the hatchery should be changed every year. If this is not done, hatch success will diminish due to destabilisation of the beach from repeated hole-digging and accumulation of bacteria and pathogens from decomposing nest contents (live hatchlings enter the sea, but egg shells, rotten eggs and dead hatchlings remain in the nest).

Hatchlings must be released immediately upon emergence (e.g., Okuyama et al., 2009). Their scurrying about will frenzy predators, and if they are left until morning they will die in the heat of the sun. About two weeks prior to expected emergence (i.e., at about 40 days of incubation), it may be desirable to place a small-mesh wire corral on top of each nest to contain emerging hatchlings so they are not crawling all about. Alternatively, the hatchery might be constructed of large-mesh (12-15 cm) wire so that hatchlings can crawl through the enclosure and on to the beach.

4.253 Sea turtle mariculture

Population recovery objectives are rarely served by keeping hatchlings from undertaking their natural journey into the open sea to begin the long process of maturation. Head-starting and mariculture have been attempted in selected sites around the world as a conservation strategy, but there is limited evidence that these practices have met long-term conservation goals. Typically these management strategies are expensive to operate and require sophisticated facilities with trained husbandry and veterinary staff. It is a recommendation of this Recovery Action Plan that head-starting and mariculture not be considered priority management approaches in Jamaica at the present time due inter alia to a lack of demonstrated benefits and other outstanding environmental issues and economic considerations.

Head-starting of sea turtles involves the collection of turtle eggs and rearing of hatchlings in a controlled environment for 6-12 or more months before their release. The objective is to provide a protective environment for hatchlings during the period of greatest vulnerability to mortality from predation; however, questions remain about their fate post-release. The young turtles may not properly imprint on their natal beaches (and therefore not return to nest as adults on Jamaican beaches); their physiological and muscular development can be compromised by rearing in a tank or other small enclosure; they may introduce disease into the environment into which they are released; and/or they may not participate fully in the complex life cycle that involves an epipelagic stage (i.e., surface-dwelling in the open sea) for most species, lasting from one to several years after leaving the nesting beach.

Lack of success attributed to head-starting programmes attempted in other areas supports the contention that Jamaica's conservation efforts should focus less on manipulative strategies and more on enhanced reproductive output. For example, a head-starting programme in Palau, Micronesia, is indicative of the effectiveness of this conservation effort and the kind of issues faced. During the decade-long programme, 2,364 young turtles (6-12 months old) were released; of these, more than 35% were tagged and only seven were ever seen again (<1% of those tagged and <0.3% of those released). Meanwhile, the population continued to decline precipitously and there was no indication that the time and money had paid off. Officials of Palau's Division of Marine Resources in October 1991 concluded that a new approach was needed to conserve the hawksbill population in Palau because head-starting had not been demonstrated to be a proven management technique to re-stock sea turtle populations. In 1991, the Palau project initiated a new approach to accumulate life history data as a first step toward designing other conservation measures for Palau's hawksbills (Sato and Madriasau, 1991; Risien and Tilt, 2008).

Using the CITES definition, a "ranch" is any operation that relies on wild-caught animals or eggs taken from natural beaches and rears them to an appropriate slaughter size (Dodd, 1982). A sea turtle "farm", on the other hand, is a closed-cycle system, such as the Cayman Turtle Farm, and is generally managed to supply local demand for meat and/or other sea turtle products. As with any harvest-based scheme, a government agency is responsible for accurately determining a sustainable yield so that the initiative does not result in declines in or other threats to wild populations. In setting a harvest quota (recognizing that

wild eggs or turtles are collected or captured to populate the ranch), evidence of depleted or declining trends within the target population should be taken into account. With locally occurring sea turtle species classified as Endangered or Critically Endangered on the IUCN *Red List of Threatened Species* and known to have declined precipitously in Jamaica, it is not clear what benefit could be gained by such a commercial harvest and the related emergence of a legal domestic market.

The "Sea Turtle Conservation Strategy" adopted by the 1979 World Conference on Sea Turtle Conservation concluded that the precautionary principle should be followed until questions about commercial turtle culture (farming and ranching) are adequately addressed. These questions examine the impact of this activity on turtle product price; creation of new markets; capture of turtles from wild populations; and the trade in products derived from wild-caught sea turtles. Until these issues are addressed, the following guidelines should be adopted:

- commercial mariculture must conform with all applicable conservation regulations and laws, including local, national, regional or international;
- care should be exercised to ensure that special legal provisions and exemptions for farmed [or ranched] products are not misused by importers and exporters;
- proponents should refrain from developing or expanding markets for (new) sea turtle products; and
- the establishment of new commercial mariculture operations should be discouraged until it can be demonstrated that such operations will not cause, directly or indirectly, further declines in turtle populations.

Schulz (1975) noted how difficult it would be to assign sustainable harvest quotas (necessary to provide stock for sea turtle ranching) to highly migratory sea turtle stocks. In the absence of data on the long-distance journeys of "Jamaican turtles", it is impossible to know if harvests in Jamaican waters are compromising conservation initiatives in neighbouring countries. "Sustainable" quotas are problematic because many basic demographic features of Jamaican sea turtle populations (e.g., age distribution, total reproductive output, life span, survivability) are not well documented (see Heppell and Crowder, 1996). It is a recommendation of this Recovery Action Plan that GOJ (or private interests) clearly explain how sea turtle mariculture can contribute to conservation or economic strategies in Jamaica. Additionally, GOJ should be cautious of domestic or foreign commercial interests that may seek to make this practice appear more appropriate or relevant for conservation or an economic need in Jamaica than it is likely to be.

4.26 Monitoring sea turtle stocks

The long-term management objective for Jamaica's sea turtle programme is to increase the island's sea turtle populations. It is a recommendation of this Recovery Action Plan that ongoing population monitoring be sufficient to evaluate the success or failure of conservation efforts, remembering that inconsistent data collection can seriously compromise the quality and utility of the data.

Monitoring nesting activity at major beaches provides important information about recruitment levels and the number of nesting females, and, despite shortcomings, is the most common index of overall stock abundance and trend. A more accurate assessment of population status requires determination of ecological management units, and sustainable yield models require information on their life stages (juveniles) and at-sea stocks.

The following subsections describe effective methods for monitoring nests, hatchlings, and various life stages. It is a recommendation of this Recovery Action Plan that Index Beaches be identified and that long-term monitoring programmes be instituted. Additionally, the following action should be given priority and undertaken at an early date:

- establish a sampling regime that facilitates statistically valid inferences within and between Index Beach sites (data from Jumby Bay, Antigua, and Mona Island, Puerto Rico, can be used for comparative purposes);
- encourage research that will provide statistical estimates of stocks and develop a long-term stock assessment programme to identify trends;
- establish and maintain a database of sightings and reports of turtles;
- select a national Coordinator that will manage this database;
- contact WIDECAST's regional tagging programme (based at the University of the West Indies, Barbados) for information, tags, and training;
- analyse data regularly and make the results available to the public;
- elaborate a Data Use Agreement among all parties to ensure transparency in data access, information-sharing, publication, and so on; and
- submit an annual report to NEPA (the permitting agency).

4.261 Monitoring nesting populations

Monitoring of nesting populations provides data on: distribution patterns; timing of breeding effort; species; location of the most important nesting beaches; nest fate (e.g., successful hatch or eggs lost to predators, poaching or erosion) (Eckert, 1999; Kerr *in* Eckert and Abreu-Grobois, 2001; Sims et al., 2008); and estimates of the number of reproductively active females, annual productivity (the number of nests laid), and eggs laid. As a function of the long time period to reproductive maturity, increases in the number of nesting females solely as a result of nest protection efforts probably will not be noticeable for two or more decades. However, a reversal in the rate of decline of egg-bearing females is likely to be immediately apparent if (and when) the killing is effectively stopped.

Because it is neither practical nor necessary to monitor all sandy beaches, it is a recommendation of this Recovery Action Plan that at least six sites (including inshore and offshore cays and at least two mainland beaches) should be selected as Index Beaches. Beach selection criteria should include: beaches with the greatest amount of nesting activity; accessibility; and protection from activity that may compromise the suitability of the habitat to support nesting. Ideally, Index Beaches should be monitored annually for periods that encompass the peak nesting and hatching season: for the hawksbills, Jamaica's most prevalent nesting species, this period is 1 June to 31 December. Based on current data, the following areas may be considered for Index Beach designation: Morant and Pedro Cays, Portland Bight Protected Areas, Alligator Pond to Great Bay, Palisadoes-Port Royal Protected Area, Luana/Font Hill, and Oracabessa. Standard data recording forms should be provided to observers and the results centrally compiled. Database management software is available from WIDECAST.

STRN has provided the impetus and technical oversight for surveys of nesting crawls since 1991, and the results are summarized in Table 2. Conducting aerial surveys of some of the more isolated beaches would provide valuable information and may be implemented if resources become available for this type of activity. Additionally, hotel staff, dive clubs, fishermen and pleasure-boat operators will be invited to participate in the monitoring effort.

Monitoring usually begins with counting turtle crawls on the beach. It is important to remember that the number of crawls is not equal to the number of nests, nor is the number of nests equal to the number of turtles. A "nest" is defined as the successful deposition of eggs. If beach censuses are undertaken in the early morning hours (as opposed to during the night when the turtles can be observed directly), it can be problematic to ascertain if eggs were laid because not all crawls result in a successful egg laying episode. During the crawl, females may encounter obstacles (e.g., erosion bluff, fallen tree, beach lagoon) or become disturbed or frightened away by human activity, dogs, excessive noise or lighting. A gravid female may try to dig a nest cavity, but if she encounters impenetrable roots, buried debris and waste, water, or sand which is too dry to properly excavate, she may return to the sea. Additionally, injured sea turtles may not be able to complete the excavation and abandon the attempt. Therefore, while a crawl

and signs of nesting may be evident on the beach, an observer cannot be certain that eggs were laid unless the nesting was witnessed, the beach patroller was authorized to dig into the site to confirm the presence of eggs, or the eggs were exhumed by poachers or predators.

All-night patrol may not be practical at some sites, and in these cases an estimate of nest density can be determined from crawl tallies conducted during daytime surveys. If Index Beaches are monitored by morning patrols tallying crawls only, it is necessary to determine the ratio between successful and unsuccessful nesting (i.e., the proportion of crawls which result in egg-laying) since this metric can be used to convert a total crawl count to an estimated nest count and also for comparisons of nesting activity between beaches and among years. Databases that use information gathered from morning nest counts, or from night patrols where all nesting females are not seen, are based on "crawl counts" (successful and unsuccessful nesting attempts, combined) and not "nest counts." Crawls which do not result in egg-laying are referred to as "false crawls."

An accurate determination of the nest:false crawl ratio at a particular site requires a sampling of all-night patrols each year. The nest:false crawl ratio depends on the (often changing) physical characteristics of the beach and differs over time, among beaches and between species.

The number of breeding females at a site can be estimated from the nest:false crawl ratio and the average number of clutches laid per female. This latter number, which varies among species, can be gleaned from other populations studied in the region. Green and hawksbill turtles average 4-5 nests per year; leatherbacks, 6-7. Using the hypothetical 4:1 nest to false crawl ratio, one can estimate that 50 sets of hawksbill tracks on a beach may represent only 40 actual nests, which in turn represent only eight egg-laying adults. It is important to remember that the estimate is based on indirect observations – and that a precise count of the number of nesting females on a particular beach, as well as their return intervals within and between seasons, requires all-night patrols and the tagging of nesting females undertaken by trained personnel (see section 4.241).

Sea turtle species can be identified by their crawl pattern in the sand. A symmetrical track is made by the simultaneous movement of the turtle's flippers whereas the asymmetrical pattern, resulting from the turtle moving her front and rear flippers in an alternating rhythm, looks like a zipper. Leatherbacks leave a deep and symmetrical crawl about 2 m in width. Green turtles leave a similar pattern, but only about 1 m in width, and the nest site is often characterised by a deep, solitary pit 1 m or more in depth and breadth. In contrast, hawksbills and logger-heads leave asymmetrical crawl patterns, about 0.7 m and about 1.2 m in width, respectively. The crawl pattern of the hawksbill is often faint compared to that of a loggerhead because of her smaller size; moreover, hawksbills typically, though not exclusively, deposit their eggs within the shelter of a beach forest while loggerheads prefer to nest on the open beach platform.

In addition to the general monitoring recommendations listed in section 4.26 (above), it is a recommendation of this Recovery Action Plan recommends that the ratio of nests to false crawls be calculated for all Index Beaches (see section 4.26), the size and trend of local nesting populations estimated, and determination if the sea turtles are using multiple beach sites for nesting.

4.262 Monitoring hatchlings

Sea turtle management programmes need reliable estimates of mortality during the hatchling stage. Although the suite of the threats has been identified, there has been little documentation of the numbers of hatchlings lost to specific threats at given sites. Threats include: beach erosion or high seas; domestic or feral animals (e.g., dogs, pigs); natural predators (e.g., crabs, birds); introduced predators (e.g., mongooses, rats, pigs) and poachers; entrapment in debris or tyre ruts; entanglement in beach vines; disorientation by artificial lighting; and harassment by onlookers. Dogs are a particular threat to eggs and hatchlings at the Palisadoes.

In order to develop an assessment of hatchling mortality, it is a recommendation of this Recovery Action Plan that a sample of nests be marked for detailed study. In order to protect the nest from potential poachers and vandals, the exact location of the nest site should not be marked. The nest location can be identified indirectly by noting the distance from the nest site to two proximal objects, such as trees other landmarks. In areas of high nest concentration, sequentially numbered stakes marked with reflective tape should be placed at 20 m intervals along the tree line where they will be out of reach of the tides and pedestrian traffic. Coordinates of the stakes obtained by triangulation or a GPS reading should be recorded on the nesting record sheet. This system enables patrollers to readily locate the nests, and to measure and identify changes.

Incubation time varies from about 50 to 75 days, and hatchling emergence at the beach surface usually occurs at dusk and early nighttime hours. The presence of predators, disorientation, or entanglement at the time of emergence should be noted. If monitors are not present at the time of emergence, hatching may be confirmed by the presence of many sets of little tracks leading from the nest site to the sea. After 2-3 days following the primary emergence, the nest can be excavated (by staff trained and permitted to do so) and the number of hatchlings estimated from the remains of broken egg shells and other nest contents. Unhatched (whole) eggs can be counted to determine the proportion of eggs which did not produce hatchlings – and these eggs can 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 at the time of egg-laying to higher ground may be considered (see section 4.242), remembering that the dimensions (depth, width) of the new nest must be replicated to ensure that incubation temperature and hatchling sex ratios are not distorted. It is a recommendation of this Recovery Action Plan that an evaluation of hatch success be undertaken by trained personnel at Index Beaches. Hatchlings should not be retained in captivity.

4.263 Monitoring turtles at sea

Juvenile turtles are not likely to be resident for more than a few months or years. Since non-*Lepidochelys* species do not reach sexual maturity before 25 years of age, juveniles spend many years in “developmental habitats”, moving among foraging areas that may include the jurisdictional waters of many nations. Monitoring juvenile and adult turtles at sea requires special preparation and is considerably more difficult and expensive than counting nests or evaluating hatchling mortality.

To monitor foraging juveniles, systematic surveys of known foraging grounds must be undertaken. If this type of survey is undertaken in conjunction with a tagging programme, it is possible to evaluate both the foraging periodicities of individuals and their movements. However, it is not necessary to tag individual turtles to monitor turtles at sea; density estimates and other valuable information can be gained through repeated observation and reporting. There are a variety of capture-recapture, transect, and other statistical methods available for at-sea monitoring (cf. Eckert et al., 1999; Bjorndal and Bolten, 2000; Eckert and Abreu-Grobois, 2001); these are also available from the STRN Coordinator (first entry, Appendix I). Additionally, tracking sea turtle movements by satellite telemetry can provide useful information on migratory patterns and foraging grounds (e.g., Godley et al., 2003; Hart and Hyrenbach, 2009).

It is a recommendation of this Recovery Action Plan that efforts be made to identify and characterise key foraging grounds, and to determine patterns of sea turtle use. In addition to changing patterns of abundance, regular surveys can provide information about shifts in average turtle size, spatial distribution, and habitat condition. Peer-training in at-sea population monitoring is available from WIDECAST.

4.27 Promote co-management

Co-management brings together stakeholders on equal terms whose agendas may be significantly different from one another. This management technique, which requires time and patience to learn to work together, is not yet commonplace. However, successful co-management partnerships yield benefits to all parties involved: the government (which may have the will, but neither the staff nor the resources to

fulfill its legislative mandate to safeguard the nation's ecological integrity); the communities (which want quality local employment options and more control over issues that directly affect them); and the natural resource base (which is threatened by the "us vs. them" conservation and law enforcement option models. With this in mind, it is a recommendation of this Recovery Action Plan that the relevant government agencies and community-based organizations investigate and employ "co-management" techniques to address sea turtle conservation objectives.

4.28 Investigate non-consumptive uses to generate revenue

The value of non-consumptive use of sea turtles has long been recognised. Referring to Trinidad and Tobago, Pritchard (1984) wrote, "The greatest value of the leatherback [sea turtle] lies in its benefit as a scientific and educational resource. The value of the experience gained by both Trinidadians and by visitors when they have the opportunity of observing the nesting of a 1000 pound turtle is greater than any value that could be derived from direct utilisation of the animal or its eggs for human consumption."

The reality in Jamaica is that mainland beaches which might be accessible for 'turtle watching' no longer support sea turtle nesting to any predictable degree. Sea turtles have been so decimated over the course of this century (see section 3.3) that the option of developing an ecotourism industry around them is not viable for this generation of fishermen or other stakeholders. Effective conservation activities may boost hawksbill populations sufficiently in the future to sustain a small industry based on regulated 'turtle watching' programmes and/or community-based sea turtle museums; however, transporting tourists to the offshore islands to observe hawksbills in their foraging grounds is not recommended by this Recovery Action Plan. Undisturbed periods of foraging or resting are a necessary component to population recovery and, in the authors' views, should not be interrupted at this stage of the management process.

4.3 Encourage and Support International Cooperation

Sea turtles are highly migratory throughout the Caribbean and no single nation can adequately protect sea turtles without the cooperation of other States in the region. To date, Jamaica has demonstrated its willingness to participate in sea turtle conservation efforts within the international community. For example, Jamaica ratified the Cartagena Convention in April 1987 and was instrumental in the drafting and adoption of the Convention's Protocol concerning Specially Protected Areas and Wildlife (SPAW), both of which mandate full protection for sea turtles (see section 4.321).

It is a recommendation of this Recovery Action Plan that Jamaica ratify the two most important regional treaties protecting sea turtles: SPAW and the 2001 Inter-American Convention for the Protection and Conservation of Sea Turtles (see section 4.322). Broad framework conventions, such as the Convention on Biodiversity (CBD) (section 4.312), and important habitat treaties, such as MARPOL (section 4.313), should also be supported at the highest government levels. A full list of relevant treaties to which Jamaica is a party can be found at the NEPA website: http://www.nepa.gov.jm/conventions/index.asp

4.31 Global treaties

4.311 CITES

The 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is one of the most powerful wildlife treaties in the world. With more than 140 members worldwide, CITES has been effective at reducing international commerce in endangered and threatened species, including their parts and products. Appendix I of CITES lists endangered species (including all species of sea turtle), and their trade is tightly controlled. Appendix II identifies 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 while 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 species survival.

Jamaica had a robust trade in the hawksbill shell industry until the country agreed to the provisions under CITES in the latter part of the last century. In a review of the international aspects of this trade, Canin (1991) wrote: "In the period 1970 to 1985, the average exports of bekko from Jamaica to Japan were 756 kg. In 1986, Honduran exports of bekko dropped from approximately 2,000 kg to zero while those from Jamaica increased by a similar amount. In 1987, exports from Belize (which are believed to originate mostly in Honduras) dropped a further 2,000 kg, and Jamaican exports increased by this amount again. Nevertheless, Cruz and Espinal (1987) estimated that 5,000 hawksbills were being killed annually for their shell in Honduran and Nicaraguan waters by Honduran lobster fishermen. As Japan has not recorded any imports of bekko from Honduras since 1985, this shell is likely to be trans-shipped through non-CITES Caribbean countries, such as Jamaica." The import of green turtle shell from Jamaica is also reported by Japanese Customs statistics: 45 kg in 1971, 100 kg in 1972, 453 kg in 1977, 997 kg in 1980, and 140 kg in 1984 for a total of 1,735 kg (Milliken and Tokunaga, 1987).

According to Japanese Customs Statistics, 14,285 kg of 'bekko' (hawksbill shell scutes) were exported to Japan between 1970 and 1986 from Jamaica (Milliken and Tokunaga, 1987) with exports fluctuating considerably during this period (Figure 13). Using a calculated average yield of 1.34 kg of bekko per turtle imported into Japan from the Caribbean region (Milliken and Tokunaga, 1987), this trade represents more than 10,000 hawksbill turtles. However, not all bekko had its origin in Jamaica. Based on historical data, it is improbable that the volumes recorded by Japan represent turtles actually exported from Jamaica. There is evidence that wildlife traders falsified shipping documents to indicate "Jamaica" as the point of origin for sea turtle products illegally exported from CITES countries to Japan in recent years. This observation is supported by import data for 1984 and 1986 which showed a significant discrepancy between the amount reported by Japanese dealers and Japanese customs statistics. The 1984 data from the dealers showed 836 kg more bekko than the customs data; in 1986, data from the dealers showed 1,666 kg less bekko than that reported in the customs statistics. Since 1983, only two exports of bekko were licensed by the NRCD, the agency authorized to issue exemptions to the WLPA. These exemptions were granted because the supply came from pre-1976 stock. The amount was just over 450 kg and the destination was the Federal Republic of Germany, not Japan.

A 2000 TRAFIC survey (Fleming, 2001) of 160 outdoor vendors noted that tortoiseshell was openly sold in many shops although the quantities on display were generally small. An exception to this scenario was one shopkeeper who had 90 items on display – this merchant told the TRAFFIC researcher that he regularly supplied up to US$2,000 of tortoiseshell products to one client for import to the US, disguised as plastic goods. The report concluded that a resolution of the status of the tortoiseshell stockpiled was vital to the nation's monitoring and enforcement of CITES.

Jamaica was one of the last of the Caribbean nations to implement CITES, acceding to the treaty in 1997. In 2000, GOJ enacted the Endangered Species Act (ESA) (for the Protection, Conservation and Regulation of Trade) to implement the provisions of CITES. The ESA simplifies and strengthens import and export restrictions on endangered sea turtle products. While it has been illegal to export turtle shells in rough or unprocessed form for many years (cf. Trade Law 4, 1955), there has never been any specific legal control of the import or export of worked shell (e.g., tortoiseshell jewelry). However, accession to CITES closed that loophole and clarified that trafficking of any sea turtle part or product is illegal.

It is a recommendation of this Recovery Action Plan that GOJ review national legislation and commit to making any upgrades deemed necessary to ensure that legislation fully supports Jamaica's obligations under this treaty, and to eliminate any loopholes under which sea turtle trade may be attempted.

4.312 Convention on Biological Diversity

The Convention on Biological Diversity (CBD) came into force in 1993, and Jamaica deposited its instrument of accession in January 1995.

The objective of this treaty is the conservation and the equitable and sustainable use of biological diversity for present and future generations. It obligates participating nations to develop national strategies, plans or programmes for the conservation and sustainable use of biological diversity; identify and monitor the status of components of biological diversity; develop and manage protected areas and other areas of importance for biodiversity; integrate *in-situ* and *ex-situ* methods of conservation. It also addresses issues pertaining to sustainable use and incentives for biodiversity conservation; research and training; public education and awareness; impact assessment and mitigation; access to genetic resources; technology transfer; information exchange and technical and scientific cooperation; and biotechnology.

A critical component, the Global Environment Fund, established a funding mechanism to encourage the more developed nations to assist developing nations with their biodiversity conservation programmes and projects.

This Recovery Action Plan is assisting the GOJ in fulfilling its obligations under this treaty. Rehabilitation of the national sea turtle resource meets the criteria set forth by the National Strategy and Action Plan on Biological Diversity in Jamaica, developed through the assistance of the Global Environment Facility and the United Nations Development Programme (UNDP), for priority implementation (NEPA, 2003: p.47).

4.313 MARPOL Convention

The 1973 International Convention for the Prevention of Pollution from Ships, known as the MARPOL Convention, is an important treaty for the protection of the marine habitat. Its objective is "to preserve the marine environment by achieving the complete elimination of international pollution by oil and other harmful substances" (UNEP, 1989b). The Convention has five Annexes which provide technical specifications regarding ship construction and equipment installation to prevent major pollution of the marine environment in the event of accidents. These Annexes cover: oil; chemicals in bulk; packaged chemicals; liquid sewage; and garbage. The Convention also establishes norms and technical requirements to minimize operational discharges.

Jamaica became party to this convention on 1 June 1991. The nations of the Caribbean proposed to the International Maritime Organization (IMO) that the region be declared a "Special Area" under Annex V (garbage). This proposal has been accepted and will come into force on 1 May 2011 (UNEP, 2010).

4.314 U. N. Convention on the Law of the Sea

The objective of this convention is to set up a legal regime for the seas and oceans. Its environmental provisions establish rules concerning environmental standards and enforcement of provisions dealing with pollution of the marine environment. It also includes a provision for highly migratory species, and therefore sea turtles could receive some protection under this convention. Jamaica acceded to this convention in 1983 and it entered into force in 1994. Additionally, the headquarters of the International Seabed Authority, established under the Law of the Sea, is located in Kingston, Jamaica.

4.315 Convention for the Conservation of Migratory Species

The Convention on the Conservation of Migratory Species of Wild Animals, commonly referred to as the Convention on Migratory Species (or the Bonn Convention), came into force in 1983. The Convention incorporates two appendices which list migratory species that would benefit from concerted conservation measures. Endangered species, listed in Appendix I, are accorded full protection; all sea turtles, with the exception of the endemic Australian flatback are included on this appendix. Range States of Appendix I species are required to conserve their habitat, counteract factors impeding their migration, and control other factors which might endanger them. Additionally, they are obliged to prohibit the taking of these species, with few exceptions. The definition of "taking" includes hunting, fishing, capturing, harassing and deliberate killing. Appendix II lists migratory species which have a conservation status that requires, or may benefit from, international cooperative agreements which provide for species and habitat conserva-

tion measures, research and monitoring, training and information exchange. Where appropriate, a species may be listed in both appendices, as is the case with Caribbean sea turtles (Hykle, 1992; Caddell, 2005).

It is not clear if Jamaica has plans to accede to this convention at present; nevertheless, it is a recommendation of this Recovery Action Plan that the Government considers the benefits of accession and moves to support this important treaty.

4.316 Others

Jamaica is party to several other conventions which are potentially relevant to the conservation of sea turtles and their habitats. These include the: Convention on the High Seas (control of marine pollution); Convention on Fishing and Conservation of the Living Resources of the High Seas; Convention on the Continental Shelf (exploration and exploitation of the continental shelf); Convention Concerning the Protection of the World Cultural and Natural Heritage (protection of sites of global importance for their cultural or scientific heritage); and the Ramsar Convention on Wetlands, where designation of an area as a Ramsar site provides protection from habitat degradation and opportunities for research and wise use of natural resources within designated areas and subsequently allows for species protection. It is a recommendation of this Recovery Action Plan that Jamaica takes every advantage of these conventions to obtain technical and financial support for their implementation at the national level, and to use the commitment implied in joining these conventions to strengthen conservation priorities and actions throughout the country that may have impacts on sea turtle survival.

4.32 Regional treaties

4.321 Cartagena Convention and SPAW Protocol

One of the most important international agreements for the protection of sea turtles and their habitats is the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (the "Cartagena Convention"). The Convention is coupled with the Action Plan for the Caribbean Environment Programme which, among other things, established in 1981 the Caribbean Trust Fund to support common costs and activities associated with implementation of Action Plan activities. The Cartagena Convention adopted a Protocol Concerning Co-operation in Combating Oil Spills in the Wider Caribbean Region which describes the responsibilities of Contracting Parties to "prevent, reduce and control" pollution from a variety of sources (e.g., pollution from ships, at-sea dumping of waste, land-based sources, seabed activities, and airborne sources). Article 10 of the Convention 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." Jamaica ratified the Convention and the Oil Spill Protocol in April 1987.

The Protocol Concerning Specially Protected Areas and Wildlife (SPAW) to the Cartagena Convention was adopted in 1991. This agreement provides a mechanism which protects species of wild fauna and flora on a regional scale. The Protocol grants explicit protection to species listed in three categories, or annexes. Annex I includes species of flora exempt from all forms of destruction or disturbance. Annex II ensures total protection and recovery to listed species of fauna, with minor exceptions. Specifically, Annex II listing prohibits (a) the taking, possession or killing (including, to the extent possible, the incidental taking, possession or killing) or commercial trade in such species, their eggs, parts or products, and (b) to the extent possible, the disturbance of such species, particularly during periods of breeding, incubation, aestivation 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.

The protocol includes all six species of sea turtle inhabiting the Wider Caribbean (i.e., *Caretta caretta*, *Chelonia mydas*, *Eretmochelys imbricata*, *Dermochelys coriacea*, *Lepidochelys kempii*, and *L. olivacea*) in Annex II (Eckert 1991; UNEP, 1991). The unanimous vote on this issue is a clear statement on the part

of Caribbean governments that the protection of regionally depleted species, including sea turtles, is a priority. Jamaica played an important role in the adoption of the new SPAW Protocol and its Annexes, but the government has not yet ratified the Protocol.

It is a strong recommendation of this Recovery Action Plan that Jamaica ratify the SPAW Protocol with its Annexes at the earliest possible opportunity. This Recovery Action Plan provides the basis for compliance (with respect to sea turtles).

4.322 Inter-American Convention

The "Inter-American Convention for the Protection and Conservation of Sea Turtles", commonly known as the Inter-American Convention (IAC) is the only convention explicitly relating to sea turtles. The IAC's overall objective is "to promote the protection, conservation and recovery of sea turtle populations and the habitats on which they depend, based on the best available scientific evidence, taking into account the environmental, socio-economic and cultural characteristics of the Parties." The Convention mandates that Parties to the Convention "shall take appropriate and necessary measures, in accordance with international law and on the basis of the best available scientific evidence, for the protection and conservation and recovery of sea turtle populations and their habitats." The IAC incorporates "state of the art" features, including the promotion of citizen participation in development and implementation of the Treaty.

It is a recommendation of this Recovery Action Plan that Jamaica ratify this treaty, and that GOJ bring its considerable biodiversity conservation experience to facilitate implementation of this unique hemispheric instrument.

4.323 Western Hemisphere Convention

The Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere, often referred to as the Western Hemisphere Convention, entered into force in 1942. Currently there are 22 Parties, including 13 Wider Caribbean signatories. The Convention's stated objective is to preserve all species and genera of native American fauna and flora from extinction and to preserve areas of wild and human value. Provisions include: the establishment of national parks and reserves (article 2) and strict wilderness areas to remain inviolate (article 4); protection of species listed in the annexes which are declared to be of "special urgency and importance" (article 8); and controls on trade in protected fauna and flora and any part thereof (article 9).

The language of this Convention is broad and far-reaching, encompassing the basic elements necessary to undertake the conservation and sustainable use of natural resources. The overlap in legislative requirements between the Western Hemisphere Convention and the SPAW Protocol (Section 4.321, above) exemplifies how a piece of national legislation can assist in the implementation of multiple treaties. It is a recommendation of this Recovery Action Plan that Jamaica consider accession to this treaty.

4.33 Sub-regional sea turtle management

Sea turtles are among the most migratory of Caribbean fauna, and hundreds of turtles tagged in one area have been captured in another. Additionally, satellite telemetry has brought tremendous advances to our understanding of sea turtle migration, elucidating high use areas and travel corridors. Juvenile sea turtles, in particular, travel widely during the decades prior to sexual maturity. A few examples include: a hawksbill tagged in eastern Nicaragua was recovered on the Pedro Cays after traveling 628 km (Nietschmann, 1981); 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 (Boulon, USVI Div. Fish and Wildlife, pers. comm., 1991); a young hawksbill tagged in Brazil was harvested 3,700 km away by a fisherman in Dakar, Senegal, six months later (Marcovaldi and Filippini, 1991); an adult hawksbill tagged on Long Island (Antigua) while nesting was later captured by a fisherman in Dominica (Fuller et al., 1992);

and migration distances ranged between 84-2,051 km for female hawksbills caught off Mona Island (Puerto Rico) and tracked by satellite telemetry (van Dam et al., 2008)

Leatherback turtles are known to have traveled thousands of kilometers in order to lay their eggs in Jamaica. Some leatherbacks tagged in Chesapeake Bay (USA) and Tortuguero (Costa Rica) have been harvested after swimming into Cuban waters (Carr and Meylan, 1984; Barnard et al., 1989). One leatherback tagged while nesting on St. Croix (USVI) was later stranded in New Jersey, USA (Boulon et al., 1988) and another was captured in Campeche, Mexico (Boulon, 1989). A leatherback tagged while nesting in French Guiana was caught 6,000 km away one year later in Ghana, West Africa (Pritchard, 1973). More recent discoveries from satellite tracking of leatherbacks in the western Atlantic have been reported on by Ferraroli et al. (2004), Hays et al. (2004), James et al. (2005), and Eckert (2006).

Adult green turtles tagged while nesting in Costa Rica have been recovered from the Greater Antilles (Cuba, Jamaica, and Puerto Rico), the USA, Mexico, throughout Central America, Colombia, and Venezuela (Carr et al., 1978; Meylan, 1982). A green turtle tagged in Venezuela was recovered in the waters offshore Jamaica (G. Solé, FUDENA, pers. comm., 1995), and juveniles 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), and Meylan (1983) reported that "several" green turtles captured by nets off the coast of Nevis (eastern Caribbean) have borne tags originally put on at the nesting beach on Isla Aves, 200 km to the southwest. Duerden (1901 *in* Rebel, 1974) reported that marked turtles from Jamaica traveled to the Misquito coast. Hays et al. (2002) utilized satellite telemetry to document the long distance movement (greater than 2,000 km) of green turtles from Ascension Island to Brazil.

Currently, Jamaica's turtle resources are harvested illegally by Honduran vessels; Nicaraguan and Colombian vessels may also be involved with this activity. Furthermore, there is little information about turtle stocks in the area jointly managed by Jamaica and Colombia: Seranilla Banks; Alice Shoal; and Baja Nuevo. Haiti, one of Jamaica's nearest neighbors, still maintains legal seasonal harvests. Jamaica's efforts to protect its turtle stocks may ultimately be ineffective if these same turtles are later captured by fishermen from adjacent territories. Therefore, it is a recommendation of this Recovery Action Plan that close and sustained cooperation among regional range States be maintained.

There are several ways in which Jamaica can participate in regional and sub-regional sea turtle conservation activities. Ratification of international wildlife treaties and agreements that protect marine and coastal environments are particularly useful; some of the more important treaties have already been discussed (see section 4.32). In addition, the Organization of Eastern Caribbean States (OECS) (of which Jamaica is not a member) has considered subregional conservation measures including an OECS-wide moratorium on the harvest of sea turtles. Wilkins and Barrett (1987) concluded that "turtle stocks in this part of the region [are] on the decline. The OECS countries should be encouraged to implement the harmonised regulations giving effect to the moratorium on sea turtle fishing. Steps should be taken to encourage this to [all] wider Caribbean countries." It is a recommendation of this Recovery Action Plan that Government petition CARICOM to promote such a moratorium among non-OECS countries. Jamaica is well-placed to assume a leadership role in emphasising the importance of regional commitment to recovery of depleted sea turtle stocks.

Sea turtles should be specifically excluded from licenses issued to foreign vessels fishing in Jamaican waters and educational/explanatory materials in their *lingua franca* should be provided to them. Fisheries staff should alert fishermen to the importance of turtle tags and request that they return tags to NEPA so that the scientist who tagged the turtle can be notified. A tag should *never be removed from a live turtle*; if one is caught, the number and address appearing on the tag should be recorded, the information passed on to NEPA, and the turtle released. Colorful posters depicting this information are available from WIDECAST's regional sea turtle tagging centre in Barbados (see www.widecast.org); some posters are already on display at selected locations in Jamaica.

It is a recommendation of this Recovery Action Plan that the STRN promote an assessment of turtle stocks in the "Joint Regime Area" (referenced above) and that the GOJ emphasise, during appropriate inter-governmental forums, the importance of securing an enforced international conservation regime firmly based on the precautionary principle.

4.4 Develop Public Education

Public education is fundamental to the success of sea turtle conservation initiatives; it facilitates changes in behaviour and the acceptance of new "ways of doing business". It is important to ensure that educational programmes are designed to maximise impact by including priority stakeholders such as fishers and coastal communities and organisations involved in law enforcement and development activities. Additionally, material used in these programmes must be carefully designed, updated to remain current, and delivered in appropriate formats (e.g., posters, brochures, videos). The information can be delivered in any number of ways: in school curricula and other activities; slide shows; guided tours of turtle habitats; nesting beach surveys; re-broadcasts of international television programmes; dramatic presentations; workshops; and participatory programmes such as the "Sea Turtle Summer Nights" and sitings reports targeting dive operators and the general public.

"Hands-on education" has been provided to more than 200 volunteers, including dive operators, hoteliers and youth, who have assisted with reporting offshore sightings and collecting nesting data through the "Sea Turtle Summer Nights" programme. Additionally, in 2007 NEPA trained students at the College of Agriculture, Science and Education (Portland) and interested members of the public in sea turtle nesting beach monitoring techniques (A. Donaldson, NEPA, pers. observ., 2010)

Some educational material currently is available, including posters and leaflets developed by NEPA and an assortment of teaching aids and reports generated by WIDECAST. Additionally, the Jamaica Environment Trust, a national environmental NGO has developed a sea turtle conservation programme for classroom teachers, including information and general interest items to stimulate greater support for turtle conservation and more aids appropriate for use in schools. The material should address both the 'need to know' 'and nice to know' information. The former will focus on increasing awareness of and compliance with laws and regulations and may include pamphlets, posters, and newspaper articles about laws and regulations protecting sea turtles; informational and caution signs on nesting beaches and at airports; guidelines and advice to people who have turtle nests on or near their properties; and news items on television and radio about prosecution for sea turtle conservation violations. The nice to know" material will provide general information to help the public better understand the ecology of sea turtles and the importance of conservation activities. Since Jamaica is primarily an oral society, emphasis should be placed on spoken and visual approaches, which will likely be more effective than the written word approach. Narrated slide shows and other helpful educational materials are available on-line at http://www.widecast.org/Educators/Resources.html.

It is a recommendation of this Recovery Action Plan that sea turtle education outreach programmes initiated by local NGOs, which can be adapted for use throughout Jamaica and across multiple stakeholder groups, be extended and increased.

4.41 Residents

The status and fate of sea turtle populations are proxies for our ability to sustainably harvest ocean resources; consequently, there is a compelling need to maintain community-level involvement if conservation efforts are to be successful. This interest can be facilitated by participatory programmes, such as research and monitoring activities and beach clean-ups, and by outreach educational efforts. Since coastal communities are the largest market for sea turtle products, educational programmes targeting them should include a variety of general interest media including brochures, books, DVDs, and television documentaries about turtle conservation activities. It is a recommendation of this Recovery Action Plan

that specifically designed materials should be incorporated into the public school curriculum; visit http://www.jamentrust.org/en/index.php for rationale and resources.

4.42 Fishermen

The continued exploitation through targeted catch or incidental take (bycatch) represents the most serious threat to sea turtles in Jamaica. Therefore, the fishery sector should be a priority for outreach and awareness programmes. More than a decade of various consultations and interviews indicate that the majority of fishers are aware that turtles are protected, so education programmes should focus on increasing compliance. Involvement of fishermen in management decisions, enforcement protocols, and sea turtle surveys, may help improve compliance. Additionally, selectively publicising prosecutions for violation of the law protecting sea turtles may demonstrate the capacity and will of authorities to enforce them. It is a recommendation of the Recovery Action Plan that community organisations consider nominating fishermen to be Honorary Game Wardens.

4.43 Tourism sector

Owners of private lands adjacent to sea turtle nesting beaches can take a variety of actions to safeguard sea turtles on their properties, especially egg-bearing females and their young (e.g., Witherington and Martin, 2000; Eckert and Horrocks, 2002; Choi and Eckert, 2009). It is a recommendation of this Recovery Action Plan that NEPA, in partnership with the Jamaica Hotel and Tourist Association, Chambers of Commerce, and the Private Sector Organisation of Jamaica, encourage their members, hotels, and vendors to prominently display WIDECAST's "Certificate of Pride" indicating to patrons that the establishment does not inventory or sell sea turtle products. These signs, designed by WIDECAST, the [CITES] Treaty Support Fund, and UNEP are currently available from the WIDECAST Country Co-ordinator, Ms. Andrea Donaldson (first entry, Appendix I).

It is important that visitors to Jamaica receive accurate information about the status of sea turtles, conservation efforts, and the laws protecting them. The information should stress that both export and import of turtle products is forbidden by international law (see section 4.311) and should be promulgated in tourist brochures, airline magazines, and leaflets placed at hotels. Additionally, NEPA, the Jamaica Airports Authority, and the Canada/Jamaica Green Fund Project currently sponsor a display on endangered wildlife at Norman Manley International Airport in Kingston, and a similar presentation with a marine theme will be placed on a billboard on the Howard Cooke Boulevard, Montego Bay. The Montego Bay fisherman cooperative has granted permission for the billboard to be placed on the land which they have leased.

4.44 Public sector

Government agencies, including various sections of NEPA, Parish Councils, and quasi-government organisations such as UDC and PCJ, make many decisions which potentially affect sea turtles and their habitats. A core of educational programmes on sea turtle conservation efforts that target relevant public officials should be developed, and existing materials utilised to the fullest. The target audience would logically include policy-makers, enforcement officers, customs officers, wildlife officials, etc. It is a recommendation of this Recovery Action Plan that informative posters, presentations by local experts, and/or technical seminars be incorporated into training workshops that are routinely offered for professional development.

4.5 Increase Information Exchange

4.51 Marine Turtle Newsletter

The *Marine Turtle Newsletter* (MTN) is a scholarly publication that provides timely information regarding the conservation status of sea turtles around the world, new research techniques, and a listing of current

scientific publications about sea turtles. English and Spanish editions of the MTN are available online at http://www.seaturtle.org/mtn/.

4.52 Western Atlantic Turtle Symposium (WATS)

Jamaica has supported this important regional database in the past and is encouraged to continue to support and participate in efforts to convene any symposia of this nature in the future. A National Report of this symposia was drafted by Kerr (1984) under the aegis of the (then) NRCD for the first Western Atlantic Turtle Symposium (WATS I), convened in 1983 in Costa Rica. A follow-up report (Kerr, 1987) was submitted at WATS II which convened in 1987 in Puerto Rico. An important resource book, the Manual of Sea Turtle Research and Conservation Techniques (Pritchard et al., 1983), was a product of WATS I and was later updated and expanded by the IUCN/SSC Marine Turtle Specialist Group (Eckert et al., 1999). All WATS reports are archived online at http://www.widecast.org/What/Regional/WATS.html.

4.53 WIDECAST

The Wider Caribbean Sea Turtle Conservation Network (WIDECAST) consists of local experts (Country Coordinators) in more than 40 nations who, in turn, enlist the support and participation of citizens within and outside the government interested in sea turtle conservation. WIDECAST is supported by the Caribbean Trust Fund of the UNEP Caribbean Environment Programme, as well as by various government and non-government agencies and groups.

Long-term objectives are to foster development of regional capacity to implement scientifically sound sea turtle conservation programmes by:

- implementing WIDECAST initiatives and supported programmes through resident Country Coordinators and other local experts and stakeholders
- utilising local network participants to collect information and draft, with the assistance of regional sea turtle experts, locally appropriate sea turtle management recommendations
- providing or assisting in the development of educational materials (slides, brochures, posters, pamphlets, internet-based resources)
- sponsoring or supporting local and subregional workshops on sea turtle biology, management, and population recovery
- assisting governments and non-government groups, upon request, with the implementation of best practices associated with sea turtle management and conservation

Similarly, short-term objectives are to provide governments of the Wider Caribbean region with:

- information on the status of sea turtles
- specific recommendations for the management and recovery of endangered, threatened, and vulnerable sea turtle stocks
- assistance in the discharge of their obligations specified under the Protocol Concerning Specially Protected Areas and Wildlife (SPAW).

National Sea Turtle Recovery Action Plans (STRAP) are tailored to local circumstances and provide information on:

- local status and distribution of nesting and feeding sea turtles
- major causes of mortality to sea turtles
- effectiveness of existing national and international laws protecting sea turtles
- historical and contemporary role of sea turtles in local culture and economy, and
- recommendations for sea turtle conservation and recovery measures

Beyond supporting local and national efforts of governments and NGOs, WIDECAST works to integrate these efforts into a collective regional response to address the problem of decreases in sea turtle populations. Government and NGO personnel, biologists, fishermen, educators, developers, and other interested persons are encouraged to join in WIDECAST's efforts in Jamaica. The current Country Co-ordinator in Jamaica is Andrea Donaldson (adonaldson@nepa.gov.jm); for her full contact address, see "WIDECAST" in Appendix I.

Jamaica's WIDECAST representative recommends a local network system patterned on the parent WIDECAST to facilitate participation by the diverse environmental NGO community and multiple agencies with responsibilities for sea turtle conservation. To date, efforts to build this network have been very successful but they have also been time-consuming and expensive. Success of the network has increased pressure on the present organizational structure, and it is now time to re-examine it. Questions that need to be addressed include: membership structure; strategies to optimize participation; role of the network co-ordinator; how and at what level decisions are made; and the network's relationship with Government. A new and active STRN co-ordinator is needed, and possibilities for developing and filling this position include seconding a professional from a government agency, requesting assistance from foreign or local volunteers, and seeking support from local or international agencies to fund the position.

The STRN has been instrumental in the development of the present Recovery Action Plan, and it is an example of diverse NGOs and government agencies working together toward a common goal. However, putting the Recovery Action Plan into action will be an even greater challenge. It is a recommendation of this Recovery Action Plan that support is sought for the further development of the STRN and its role in advocating for, actuating, and evaluating STRAP recommendations.

4.54 IUCN/SSC Marine Turtle Specialist Group

The Marine Turtle Specialist Group is responsible for tracking the status of sea turtle populations around the world for the World Conservation Union (IUCN) Species Survival Commission (SSC). The Group has sponsored the development of many useful reference handbooks and other documents (available at http://www.iucn-mtsg.org/) and is an excellent source of information about IUCN, the RedList programme, CITES, and related intergovernmental issues. Dr. Alberto Abreu-Grobois (abreu@ola.icmyl.unam.mx), Instituto de Ciencias del Mar y Limnologia, Unidad Academica Mazatlan in Mexico is the Regional Vice-Chair for Latin America and the Caribbean.

4.55 Workshops on research and management

Prior to implementation of field surveys or other sea turtle conservation projects, it is a recommendation of this Recovery Action Plan that participants be trained in basic sea turtle ecology, applicable protocols (e.g., field techniques, reporting, and animal handling) and species identification. All training should emphasise internationally recognized best practices (e.g., Eckert et al., 1999; Eckert and Beggs, 2006; Phelan and Eckert, 2006; Eckert and Choi, 2009). Trained personnel should be capable of identifying species based on live or dead specimens of hatchlings, juveniles or adults, eggs, and crawl and nesting patterns on the beach. Additional training, where required, may include proper methods for tagging sea turtles, conducting beach patrols and aerial surveys, relocating eggs, satellite telemetry, tissue sampling, etc. All projects involving sea turtles in Jamaica, including initiatives involving the handling of sea turtles, their eggs or young, must be permitted through NEPA. NEPA, in partnership with the STRN, will take the lead in providing training and oversight.

4.56 Exchange of information among local groups

The STRN has been very active in promoting the exchange of information among local groups and seeks the broadest possible involvement in its programmes. Communication among network participants, however, remains a significant challenge as a result of the size and geography of Jamaica, transportation logistics, and administrative challenges inherent in operating a coordinated national effort. It is a recom-

mendation of this Recovery Action Plan that funds be earmarked to hire a paid Project Officer to work for the (volunteer) STRN Coordinator; the Project Officer's duties would include communications, field projects, training, reporting, outreach and recruitment, and so on.

The general public is increasingly turning to the Internet to access and exchange information and printable materials, and this potential for local and regional news groups should be explored. It is a recommendation of this Recovery Action Plan that efforts be made to improve communications among participants in the national network. A sea turtle home page could be added to the Clearing-House Mechanism (CHM) hosted by the Institute of Jamaica (http://www.jamaicachm.org.jm/). The efforts of the STRN should also be featured at http://www.widecast.org/What/Country/Jamaica/jamaica.html, and the STRN should consider developing and managing a listserve as a means of national communication, strategic planning, emergency response, training, and so on.

4.57 Integrated community development

Effective sea turtle conservation in Jamaica requires innovative approaches to community development and a broad engagement of all stakeholders (Table 5). This development must involve local leaders and residents, and the outputs of these efforts must be apparent and accessible to them. Utilising local and expert-based knowledge and resources, demonstration projects which build local support for sea turtle conservation should be pursued.

One option is development of community tourism based on sea turtles. Currently there are few opportunities to view sea turtles directly; an alternative may include an interpretative centre in or near a community which has a history of the turtle industry. The centre may include displays of sea turtle biology, marine ecology, conservation efforts, and the role of sea turtles in Jamaican culture. Community members can stage cultural events with sea turtle themes (story-telling, plays, puppet shows, etc.) and fishermen can earn money by leading controlled visits to selected beaches during the nesting season. Homeowners can offer bed-and-breakfast accommodations and the market for fish and crafts items may develop concurrently. Examples of craft items featuring sea turtles and other aspects of the marine environment include photographs, paintings, and wood carvings. WIDECAST has training available in several community-based eco-crafts, as well as community-based turtle watching, should populations recover in Jamaica to the point where turtles can be predictably seen on guided beach walks.

Development of an interpretive centre requires planning that is sensitive to the environmental, social, cultural and economic conditions and needs of the community. Important areas for consideration include: upgrading waste management; transportation systems and utilities services and infrastructure; training of community leaders; and development of accommodations. The community could also participate in the identification and selection of game wardens responsible for the enforcement of laws and regulations.

It is a recommendation of this Recovery Action Plan that a demonstration project for community-based sea turtle conservation and tourism – including an appropriately sited interpretive centre – be developed.

4.6 Implement a Sea Turtle Conservation Programme

4.61 Rationale

Efforts to recover Jamaica's sea turtle stocks will require a multi-faceted approach. Key areas of need include filling data gaps to identify population trends and assess mortality levels, and to develop effective broad-based conservation strategies. It is a recommendation of this Recovery Action Plan that STRN take the lead in implementing a five-year (2010-2015) conservation programme aimed at expansion of survey and monitoring programmes, identification of the demographic units occurring in Jamaican waters, assessment of the relative importance of various threats to sea turtle survival, and implementation of a comprehensive public education and outreach campaign.

It is a recommendation of this Recovery Action Plan that all species of sea turtle remain listed and fully protected under the Wild Life Protection Act (1945) until recovery can be established, based on the national survey and monitoring programme, and primary sources of mortality to sea turtle populations are genuinely under control. Because the far majority of Jamaica's beaches receive less than 10 nests per year (the equivalent of 2-3 nesting females), we urge a precautionary approach in maintaining the WLPA listing. It is not saying much that, over a period of 15 years (which is less than one-half of one generation for a green sea turtle), a population might triple and still be fewer than 10 breeding females.

How would a recovering or recovered population be recognized? We visualize that a recovered population, be it foraging or nesting, will comprise a standing stock sufficient to safeguard it from a catastrophic event, and exhibit a statistically significant and sustained increase in the number of foraging (or nesting) individuals for a minimum period of 15 years. Moreover, at least 50% of its most important nesting and foraging habitat will be under protected status, and long-term population monitoring programmes will be in place to collect data on abundance and trend. We also consider it important, with regard to de-listing, that the demographic units will have been determined so as to permit an assessment of the regional implications of lifting protections to the stock while abiding under Jamaican jurisdiction.

The following Programme seeks to ensure that this fundamental information is available for management and conservation purposes.

4.62 Goals, objectives and activities

The mission of the Sea Turtle Conservation Programme is: *To ensure the long-term viability of sea turtle populations and their essential habitats under Jamaican jurisdiction, as part of a larger plan that protects the economically and ecologically important species and habitats in Jamaica's coastal and marine areas for the use and benefit of future generations.*

Goal 1. To determine status and trends among nesting and foraging populations

Objective 1: To identify critical nesting and foraging habitats

- assemble and maintain a "register" of Jamaican beaches that support sea turtle nesting activity, including species present, distribution and abundance of the reproductive effort, and nest fate (hatching success, sources of mortality)
- assemble and maintain a "register" of foraging grounds, including species present, habitat utilisation, patterns of residency, and sources of mortality

Objective 2: To estimate demographic parameters of nesting and foraging populations

- establish a national survey and monitoring programme, based on Index Nesting (and Foraging) Grounds
- collect data suitable for estimating population trends and reproductive output, and for measuring recovery
- initiate tagging to estimate survival and recruitment at Index Beaches. Based on information provided in this Action Plan, we recommend: Morant and Pedro Cays, Portland Bight Protected Areas, Alligator Pond to Great Bay, Palisadoes-Port Royal Protected Area, Luana/ Font Hill, and Oracabessa
- initiate tag-recapture studies to estimate population structure, size-specific growth and mortality rates at Index Foraging Grounds. Based on information provided in this Action Plan, we recommend: Negril, Portland Bight, Discovery Bay, Morant Cays, and Port Antonio
- maintain Index Site monitoring (Beach, Foraging Ground) for at least a decade, and ideally indefinitely as the data will only become more useful to management over time
- train members of the STRN (on an annual basis) to conduct regular surveys at Index Sites
- emphasise a 'train the trainers' programme by identifying STRN community-level leaders to participate in regional training workshops, such as those offered from WIDECAST or as exchange opportunities with WIDECAST-affiliated projects

- hire an STRN Project Officer to coordinate training, scheduling, record-keeping and reporting, communications, and recruitment
- establish a central depository for sea turtle sightings data with the Clearing-House Mechanism at the Institute of Jamaica
- utilise the WIDECAST database management software, including regionally standardised data forms and user's manual, to maintain Index Site data; this will ensure that any information collected will be compatible with that collected by range States

Objective 3: To identify distinct demographic units in Jamaica

- collect a statistically viable sample of genetic material from reproductive females and/or nest contents from each of four areas: north coast, south coast, Portland Bight cays, Pedro and Morant Cays
- collect a statistically viable sample of genetic material from foraging juveniles in representative habitats
- conduct telemetry studies on inter-nesting habitat use, post nesting movements and migratory corridors
- collaborate with WIDECAST experts and other regional expertise in the design and implementation of studies involving genetic analysis and biotelemetry

Objective 4: To determine sources of mortality to sea turtle populations

- assess threats, including natural predators, at nesting beaches
- assess threats, including diseases and natural factors, at foraging grounds
- Investigate the origin(s) of pollution at key nesting and foraging sites
- determine the extent of the illegal sea turtle harvest
- survey fishermen and coastal communities to estimate the numbers and sizes of discarded carapaces as a measure of the illegal harvest
- estimate the extent of incidental capture through interviews, sea turtle stranding records, research (e.g., duplicating longline or trawl effort under controlled circumstances), logbook records, and/or onboard Observers
- determine the fisheries most responsible for incidental capture; develop and advertise mitigating options (e.g., gear alternatives, time and area closures)
- organize a national stranding network to record sea turtle strandings, and assess sources of mortality (see www.widecast.org/trauma)
- determine the extent to which sea turtle products, raw and worked, are available – utilise STRN members to survey vendors for sea turtle products, origin, price, and target consumer
- arrange to have all sea turtle items removed from any commercial sale (all such sales are illegal under Jamaican law, and tourists departing the country with such items are in violation of CITES both in Jamaica and with regard to their country of origin and return)

Goal 2: To enhance the legal protection for sea turtles and their habitats

Objective 1: To strengthen the regulatory framework for management

- identify and seek to address any deficiencies or loopholes in the regulatory framework that hinder effective management and protection of habitat, including nesting beaches
- submit to NEPA a proposal to amend the WLPA to specifically prohibit "taking, attempt to take, sale, attempt to purchase or sell, or possession of any sea turtle, egg, part or product"
- clarify any residual jurisdictional conflicts between NEPA and the Fisheries Division regarding sea turtle management and control, especially in the Pedro and Morant Cays
- submit to NEPA recommendations regarding important sea turtle habitats for inclusion in Jamaica's National System Plan for Protected Areas

Objective 2: To strengthen capacity to enforce sea turtle management laws

- identify ways in which to improve the mechanisms and capacity for enforcing laws relating to sea turtles

- identify means of outreach to inform citizens of laws protecting sea turtles
- identify means of outreach to inform citizens of regulations pertaining to protected areas, and especially those that embrace habitats critical to the survival of sea turtles
- design training courses for public agencies involved in sea turtle protection, such as NEPA, planning authorities, representatives of the Tourism Sector, fishers, and NGOs
- design a training course and engagement programme for fishermen, restaurant owners, craftsmen, the Tourist Board (and its affiliates), Police/Game Wardens/Park Ranges, and others involved in sea turtle monitoring
- negotiate formal agreements with private owners of hawksbill shell stockpiles in order to dispose of any such stockpiles
- lobby for increased international cooperation and involvement by Jamaica in areas relating to sea turtle conservation

Goal 3: To increase public awareness of the endangered status of sea turtles

Objective 1: To implement a cross-sectoral education and outreach programme

- create sector-specific outreach materials (posters, brochures, information packets, public signage) for national display and distribution
- seek sponsorship for the development and distribution of outreach materials
- involve educators and other partners in the development of a Primary School campaign
- establish an STRN Internet site to feature educational materials, teacher opportunities, and data suitable for classroom study (such as telemetry results)
- create an educational programme on Jamaican sea turtles and their journeys; e.g., feature satellite tracking, information technology, supporting written material

Objective 2: To promote compliance with national legislation

- NEPA should prepare area-specific management plans for a minimum of six (6) sites critical to the survival of sea turtles. This should be done in conjunction with parish-based NGOs and other official agencies
- Implement a campaign against the illegal marketing of sea turtle products, with an initial focus on Old Harbour, Savannah-La-Mar, and Negril
- in addition to promoting reports to local authorities (e.g., NEPA), maintain a national *Sea Turtle Hotline* to encourage and facilitate reporting of sightings, as well as offences
- create outreach mechanisms, including media events and public signage (e.g., at protected areas and nesting beaches), that inform the public concerning laws protecting sea turtles
- promote citizenry involvement through an improved sea turtle sighting network and volunteer opportunities
- involve fishers and Fisheries extension officers in the development of an information campaign for fishers, with an aim to solving the illegal take of turtles while preserving the livelyhoods of fishers
- create displays for both international airports to highlight the endangered status of sea turtles and the ban on trafficking in sea turtle products

Objective 3: To promote participation in implementing this Recovery Action Plan

- promote and distribute the “Sea Turtle Recovery Action Plan for Jamaica”
- host a National Consultation on implementing the priority recommendations of the Plan
- develop a condensed “Agenda for Action” for distribution that highlights the Action Plan’s major recommendations
- establish an STRN Internet site to highlight STRAP recommendations that encourage public participation
- lobby for Jamaica’s continued support and involvement in international agreements and treaties pertinent to sea turtle conservation.

- encourage, support and guide six environmental NGOs to each begin a community-based sea turtle project with a particular focus on non-consumptive uses of sea turtles and economic alternatives to sea turtle fishing

4.63 Products and outputs

The activities described above will result, at a minimum, in the following products and outputs after a period of five years:

- Successful National Consultation on STRAP implementation, with agency focal points identified for each implementation activity
- Complete inventory of active sea turtle nesting beaches
- National network of long-term monitoring projects at selected Index sites
- Tag-recapture studies initiated at Index foraging sites
- Genetic 'fingerprinting' of domestic nesting stocks
- Genetic origin of foraging stocks (which would be expected to comprise the genetic signatures of many different Caribbean nesting beaches, including those in Jamaica)
- At least 20 'trainers' and supervisors identified within the STRN professionally trained in sea turtle research and monitoring techniques
- Comprehensive report: "Availability of Sea Turtle Products in Jamaica"
- Measures in place that fully eliminate the sale of worked shell products in Jamaica
- Measures in place to routinely assess the status of private turtle shell stockpiles
- Complete inventory of threats to sea turtle survival on land and at sea
- Preliminary report: "Incidental Capture and Mortality to Sea Turtles in Jamaica"
- Development of booklet: "Turtle-friendly Beach Development and Management"
- Development of booklet: "Recommended Regulations and Guidelines for Sea Turtle Conservation in Protected Areas"
- A minimum of 75% of important nesting and foraging habitat included within the National System Plan for Protected Areas
- A minimum of 3 workshops convened on the development of area-specific sea turtle management plans
- A minimum of 3 specific projects, arising from the area-specific management plans, will be identified for funding and implementation
- 5,000 colorful posters /brochures distributed to target audiences
- 2 airport displays established
- STRN Internet site established and maintained
- Educational packet - "Jamaican Sea Turtles and their Journeys" - will be produced and distributed to 10,000 school children
- Efforts at outreach and enforcement will result in a minimum of 50% reduction in illegal take and sales of sea turtles in target areas

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APPENDIX I

Directory of Relevant Organizations

Sea Turtle Recovery Network
c/o National Environ. & Planning Agency
10 Caledonia Road
Kingston 10
Tel: (876) 754-7540-7
Fax: (876) 754-7595
e-mail: adonaldson@nepa.gov.jm
http://www.nepa.gov.jm
Contact: Ms. Andrea Donaldson,
Acting Manager, Ecosystems Management Branch

National Environ. & Planning Agency
10 Caledonia Road
Kingston 10
Tel: (876) 754-7540-7
Fax: (876) 754-7595
http://www.nepa.gov.jm
Contact: Ms. Andrea Donaldson,
Acting Manager, Ecosystems Management Branch

Fisheries Division
Marcus Garvey Drive
Kingston 13
Tel: (876) 923-3811
Contact: Ms. Avery Galbraith

Jamaica Conservation and
Development Trust
29 Dumbarton Avenue
Kingston 10
Tel: (876) 920-8278-9, 960-2848-9
Fax: (876) 960-2850
e-mail: Jamaicaconservation@gmail.com
Contact: Mrs. Donna Fray, Administration Manager

Jamaica Environment Trust
11 Waterloo Road
Kingston 10
Tel: (876) 906-3693
Fax: (876) 926-0212
Contact: Diana McCaulay,
Chief Executive Officer

United Nations Environment Programme
Regional Coordinating Unit,
Caribbean Environment Programme
14 Port Royal Street
Tel: (876) 922-9267
e-mail: avk@cep.unep.org
http://www.cep.unep.org/
Contact: Mrs. Alessandra Vanzella-Khouri
SPAW Programme Officer

Environmental Foundation of Jamaica
18 Norwood Avenue
Kingston 5
Tel: (876) 960-6744, 960-7125, 960-3224
Fax: (876) 920-8999
e-mail: efj.ja@cwjamaica.com
website: http://www.efj.org.jm
Contact: Mrs. Karen McDonald-Gayle

Portland Environ. Protection Association
6 Allan Avenue
Port Antonio, Portland
Tel: (876) 993-9632
e-mail: pepa@cwjamaica.com
Contact: Mr. Machel Donegan,
Executive Director

St. Thomas Environ. Protection Association
c/o Rural Agricultural Develop. Authority
Belfast, Morant Bay, St. Thomas
Tel: (876) 982-2234
Contact: Mr. Terrance Cover

St. Elizabeth Environment Association
Black River, St. Elizabeth
Caribbean Coastal Area Management Foundation
7 Lloyd Close, Kingston 8
Tel: (876) 986-3344
http://www.portlandbight.com.jm
Contact: Mr. Peter Espeut,
Executive Director

Marine Police Division,
Jamaica Constabulary Force
Newport East, Kingston
Tel: (876) 923-9728
Contact: Inspector Errol Forbes

Jamaica Defence Force Coast Guard
HMJS Cagway, Port Royal
www.jdfmil.org/organisation/coast_guard
Contact: Cdr. Kenneth Douglas,
Commanding Officer, JDFCG

Wildlife and Environment Conservation Action Now
c/o Hope Zoo, Hope Gardens
Kingston 6
Contact: Mr. Shae Stewart, Coordinator

Urban Development Corporation
12 Ocean Boulevard, Kingston
Tel: (876) 922-8310; 922-5122
Fax: (876) 922-9326
e-mail: info@udcia.com
www.udcia.com

Jamaica Public Service Co. Limited
6 Knutsford Boulevard
P. O. Box 54, Kingston 5
Tel: 926-3190, Telex: 2180
CABLE: JAMSERV
Tel/Fax: (876) 926-6710
http://www.jpsco.com/

Ministry of Tourism
64 Knutsford Blvd, Kingston 5
Tel: (876) 920-4924; 920-4926-30
Fax: (876) 920-4944
www.mot.gov.jm

Centre for Marine Sciences
Department of Life Sciences
University of the West Indies
Mona, Kingston 7
Tel: (876) 935-8835-36
Fax: (876) 977-1033
e-mail: cms@uwimona.edu.jm
http://www.uwimona.edu.jm/centres/cms
Contact: Professor Dale Webber

Hope Zoo - Ministry of Agriculture and Fisheries
Hope Gardens, Kingston 6
Tele: (876) 927-1085 / Fax: (876) 970-3504
e-mail: hopegardens.zoo@gmail.com
Attn: Mr. Orlando Robinson, Curator

Negril Environment Protection Trust
Negril Community Centre
P. O. Box 2599
Negril, Westmoreland
Tel: (876) 957-3736
Fax: (876) 957-4626
e-mail: nept.negril@yahoo.com
Contact: Maxine Hamilton, Exec. Director

Negril Coral Reef Preservation Society
Norman Manley Boulevard
P. O. Box 2710
Negril, Westmoreland
Tel/Fax: (876) 957-4626
e-mail: ncrps@yahoo.com
Contact: Candice Dias, Exec. Director

Petroleum Corporation of Jamaica
36 Trafalgar Rd, Box 579
Kingston 10
Tel: (876) 929-5380/9
Fax: (876) 929-2409
e-mail: ica@pcj.com
www.pcj.com

Town and Country Planning Department
See National Environment & Planning Agency

Friends of the Sea
Tel: (876) 974-4428
e-mail: friendsofthesea@yahoo.com
Contact: Ms. Kathy Byles

National Environmental Societies Trust
95 Dumbarton Ave.
Kingston 10
Tel: (876) 960-3316
Fax: (876) 960-3909
e-mail: nest@infochan.com
Contact: Mr. Peter Forde, Chairman

Jamaica Sub-aqua Club
University of the West Indies
Mona, Kingston 7
Contact: Ms. Tamia Harker

UWI Discovery Bay Marine Laboratory
Discovery Bay, St. Ann
Tel: (876) 973-2241/973-2946
Fax: (876) 973-3091
Contact: Dr. Dayne Buddo
Lecturer and Academic Coordinator
email: dayne.buddo@uwimona.edu.jm
Contact: Mr. Camilo Trench
Chief Scientific Officer
e-mail: camilo.trench@uwimoa.edu.jm

Ministry of Foreign Affairs and Foreign Trade
2 Dominica Drive
Kingston 5
Tel: (876) 926-4220

Jamaica Hotel and Tourism Association
2 Ardenne Road
Kingston 10
e-mail: infor@jhta.org
www.jhta.org

Canadian International Develop. Agency (CIDA)
Canada Jamaica Green Fund
1st Floor, Building #3
17 Ruthven Road
Kingston 10
Tel: (876) 929-3597
e-mail: gfund@cwjamaica.com
Contact: Mrs. Effie McDonald

UWI/EFJ Port Royal Marine Laboratory
Biodiversity Centre
Contact: Mr. Hugh Small
Chief Scientific Officer
Tel: (876) 967-8344
e-mail: hugh.small@uwimona.edu.jm

WIDECAST
c/o National Environ. & Planning Agency
10 Caledonia Road
Kingston 10
Tel: (876) 754-7540-7
Fax: (876) 754-7595
e-mail: adonaldson@nepa.gov.jm
Contact: Ms. Andrea Donaldson,
Acting Manager, Ecosystems Management Branch
and WIDECAST Country Coordinator

APPENDIX II

Laws affecting sea turtles and conservation of their habitats

The main laws of relevance to sea turtle conservation are summarised and the most important sections are quoted; see also Table 4.

A. SPECIES PROTECTION

A1. Wild Life Protection Act (1945)
Administered by: NRCA

Protected animals
Section 6:
(1) No person shall hunt any protected animal or protected bird. It is an offence to have in one's possession the whole or any part of a protected animal living or dead.

List of protected animals (Schedule III)
Five species of sea turtle were included in a 6 July 1982 amendment to the Third Schedule (1945) – the Green turtle (*Chelonia mydas*), Hawksbill (*Eretmochelys imbricata*), Loggerhead (*Caretta caretta*), Atlantic [Kemp's] ridley (*Lepidochelys kempii*), and Leatherback (*Dermochelys coriacea*).

Turtle eggs
Section 8 states:
Every person who (a) takes or attempts to take; or (b) sell or has in his possession for the purpose of sale, any turtle eggs shall be guilty of an offence against this Act.

Penalties
By recent amendment (6 August 1991) to the Wild Life Protection Act (1945), persons found guilty of hunting or possessing any protected sea turtle are liable on summary conviction to a maximum fine of $100,000 or to imprisonment for a term not exceeding 12 months.

Section 23 states:
(1) Any animal, bird or fish or any part thereof in respect of which there is a conviction for an offence against this Act shall be forfeited to the Crown. (2) Any boat, gun, catapult or other weapon or any trap used in the commission of any offence against this Act in respect of which there is a conviction may, in the discretion of the court be forfeited to the Crown.

Enforcement
Section 16 states:
Any Game Warden, Fishery Inspector or Constable may in any public place or on any Crown lands or in any Game Sanctuary or Fish Sanctuary, search any person whom he may have reasonable cause to suspect of having contravened any of the provisions of this Act or of any regulations made thereunder, and may stop and search any vehicle, boat or other conveyance in or upon which he has good cause to suspect that there is any animal, bird or fish or the nest or eggs of any bird in respect of which any offence against this Act or any regulations made thereunder has been committed or in or upon which he has reasonable cause to suspect that there is any gun, catapult or other weapon or any trap used in the commission of any such offence.

Exemptions
Section 22 states:
Notwithstanding anything to the contrary contained in this Act, the Minister may, by writing under his hand for purposes of conservation or for scientific, historic or educational purposes, exempt either absolutely or for such time and subject to such conditions as he may think fit, any person or institution from all or any of the provisions of this Act.

Jurisdiction
Section 21 states:
Any offence against this Act committed at sea within three miles of any parish shall be deemed to have been committed in any place adjoining such sea and may be tried and punished accordingly.

Other relevant provisions
The act defines 'fish' as 'any creature which lives wholly or mainly in water' (i.e. a turtle is a 'fish') and provides for protection of immature fish (section 9) (immature fish to be defined by regulation under section 14); prohibits various means of catching fish (sections 10 and 11; sale of illegally caught fish section 12) and management of fisheries (section 14 and 15).

A2. Natural Resources Conservation Act (1991)

Prescribed fauna and flora
Section 38 states:
The Minister may make regulations for the purpose of giving effect to this Act... (m) the protection of particular species of prescribed fauna and flora. [N.B. as of 1995, no such regulations had been made.

A3. Jamaica National Heritage Trust Act (1985)

Protected national heritage
Section 2 states:
'protected national heritage' means ..(b) any species of animal or plant life ...designated by the Trust to be a protected national heritage'. Sections 12-17 provide for protection.

Penalties
Section 17 states:
'destroy(ing)...protected national heritage...a fine not exceeding $40,000 or 2 yrs imprisonment..'
[N.B. no wildlife species have ever been protected under this Act.]

A4. The Endangered Species (Protection, Conservation and Regulation of Trade) Act, 2000

The Act provides for the protection, conservation and management of endangered species of wild fauna and flora and for the regulation of trade in such species. The Act enables Jamaica to implement its obligations under the CITES, as such sea turtles is listed in the First Schedule of the Act and corresponds to Appendix I of the Convention.

Section 19, requires persons to apply for a permit/certificate to trade in any species listed under the Schedules of the Act.

Section 40 states that if a person trades without a permit or certificate they are liable to:
a) on summary conviction before a Resident Magistrate, to a fine not exceeding two million dollars or imprisonment for a term not exceeding two years or to both such fine and imprisonment
bi) on conviction on indictment in a Circuit Court to a fine or to imprisonment for a term not exceeding ten years or to both such fine and imprisonment

The are also fines if the postal service is used (Section 41) where (a) on summary conviction before a Resident Magistrate
(i) in the case of a first offence, to a fine not exceeding one million dollars or to imprisonment for a term not exceeding one year or both such fine and imprisonment; and
(ii) in the case of a second or subsequent offence to a fine not exceeding two million dollars or to imprisonment for a term not exceeding two years or to both such fine and imprisonment.
(b) on conviction on indictment in a Circuit Court to a fine or to imprisonment for a term not exceeding ten years.

B. EXPLOITATION OF TURTLES

B1. Morant and Pedro Cays Act (1907)

Catching turtles and collection of eggs
By a 1971 amendment to the Act, no person can, without written licence from the Minister, catch turtle on these cays or inside the outer limits of the territorial sea thereof, or take any eggs from the said cays, or either of them.

Enforcement
Fisheries Inspectors (or other persons duly authorised in writing by the Minister) are charged with enforcing the Act.

Penalties
Offenders are liable on summary conviction to a maximum fine of $400, and in default of payment thereof, to imprisonment for a term not exceeding 12 months.

B2. Fishing Industry Act (1975)

Fishing generally
Definitions:
The term "fish" includes "shell fish, crustaceans and marine or fresh water animal life" (thus theoretically including sea turtles). However the body of the act never actually mentions sea turtles and provides no explicit protection to them.

Sections 3 and 5 state:
provide for licencing of all fishermen and vessels operating in Jamaican waters, protection of the fishery by establishment of closed seasons, creation of fish sanctuaries, and penalties for the landing and sale of illegally caught fish. The Schedule lists specified methods of fishing, including (a) traps or pots; (b) nets; (c) spear guns; (d) lines from a boat.

B3. Trade Law 4 (1955)
Administered by the Trade Administrator

Shell exports
Requires licences for export of raw turtle shell. [N.B. the Trade Administrator has agreed to consult with NRCA before granting licences, but there is no legal requirement for him to do so, except insofar as possession of turtle shell is illegal under the Wild Life Protection Act (see above).]

B4. Natural Resources Conservation Act (1991)

Methods of capture
Section 38(1) The Minister may make regulations
(l) the limitation or prohibition of
(i) the production, importation, exportation, trade or use of any type of equipment, means or device designed to kill, catch, or destroy, indiscriminately, prescribed animals or prescribed plants;
(ii) any action or method which may bring about the extinction of or major adverse effects on, prescribed fauna or flora species.

[N.B. no prescribed animals have been specified and no regulations developed under this subsection.]

B5. Fishing Industry Act (1975)

Regulation of the fishing industry
Section 25 states:

The Minister may from time to time make regulations generally for giving effect to the purposes and provisions of this Act and in particularly (but without prejudice to the generality of the foregoing) may make regulations -
(b) prescribing the form of any licence or certificate of registration to be issued under this Act;
(f) prescribing or prohibiting the use of various types of fishing equipment;
(g) prescribing or prohibiting methods of fishing within certain areas or at certain periods;
(j) making provision in respect of the keeping of statistics in connection with the fishing industry;
(j) prescribing measures for conservation of fish;...

The Fishing Industry Regulations 1976 provide a regulatory framework for the industry but do not include any regulations, which control fishing activities or equipment relevant to turtles.

C. HABITAT PROTECTION

C1. Natural Resources Conservation Act (1991)

Protected areas
Section 4(1) states:
The functions of the Authority shall be-

a) take such steps as are necessary for the effective management of the physical environment of Jamaica so as to ensure the conservation, protection and proper use of its natural resources
b) to promote public awareness of the ecological systems of Jamaica and their importance to the social and economic life of the island
c) to manage such national parks, marine parks, protected areas and public recreational facilities as may be prescribed
d) advise the Minister on matters of general policy relating to the management, development, conservation and care of the environment; and
e) to perform such other functions pertaining to the natural resources of Jamaica as may be assigned to it by the Minister or by or under this Act or any other enactment

Section 5(1) states:
The Minister may on the recommendation of the Authority after consultation with the National Heritage Trust, by order published in the *Gazette* designate-

a) any area of land as a national park to be maintained for the benefit of the public;
b) any area of land or water as a protected area in which may be preserved any object (whether animate or inanimate) or unusual combination of elements of the natural environment that is of aesthetic, educational, historical or scientific interest; or
c) any area of land lying under the tidal water and adjacent to such land or any area of water as a marine park.

Section 32 (1) states:
Where the Authority reports to the Minister--

a) the existence of any local condition in any part of the Island tending to endanger the environment, and there are no powers under any law other than this section whereby such condition may be removed or guarded against; or
b) that a natural resource in any part of the Island appears to be threatened with destruction or degradation and that measures apart from, or in addition to those specifically provided for in this Act should be taken promptly,

The Minister may by order published in the *Gazette*, direct the enforcement of any measures that he thinks expedient for removing or otherwise guarding against such condition and the probable consequences thereof, or for preventing or mitigating as far as possible such destruction or degradation.

Penalties
Section 32(4) states:
… for obstructing a person taking measures ... $10,000 or one year.
Section 32(5) states:
...a fine not exceeding $50,000 or to imprisonment not exceeding 2 years or to both... or .... $3,000 for each day...

Section 33(1) states:
....the Minister may, on the recommendation of the Authority, and if he is satisfied that it is in the public interest to do so ....declare any area to be an environmental protection area and direct the Authority to submit to him for approval an environmental protection plan for that area;...
(2) The undertaking of any activity in an environmental protection area shall be subject to such provisions as may be prescribed by regulations, subject to negative resolution, in relation to the protection of the environment and the natural resources in that area.

Section 38(1) states:
The Minister may make regulations for
(a) Standards and codes of practice with respect to the protection and rehabilitation of the environment and the conservation of natural resources;
(b) the description or category of enterprise, construction or development in respect of which an environmental impact assessment is required by the authority;
(c) the quality, condition or concentration of substances that may be released into the environment;..
(f) the discharge of waste generally, and the fees payable in relation thereto;
(g) the design, construction, operation, maintenance and monitoring of facilities for the control of pollution and the disposal of waste;
(h) the management of national parks, marine parks, protected areas and public recreational beaches or other public recreational facilities...;...
(j) the preservation of good order and good conduct among members of the public; using national parks, marine parks, protected areas..;

General provisions
Section 39 states:
This Act binds the Crown.

Penalties
Section 38(3) states:
Maximum penalty $50,000 or 2 years imprisonment.

C2. <u>The Beach Control Act (1956)</u>

Section 3(1):
- vests control of foreshore and seabed in the Crown except where fishers had rights before 1956
Sections 8-9:
- controls construction of docks, wharves, jetties and groynes

Section 11:
- requires licences for the use of foreshore or floor of the sea

Section 18:
- lists activities which may be regulated under the law.

Section 7 (1):
provides for declaration of (a) any part of the foreshore and the floor of the sea, together with the water lying on such part of the floor of the sea to be a protected area for the purposes of this Act; and (b) specify prohibited activities including fishing, use of boats, rubbish disposal, water skiing, dredging or disturbance, destruction or removal of coral etc. and treasure hunting

Three areas have been declared under section 7: Ocho Rios (1966) and Port Royal (1967), Montego Bay (1974).

Penalties
… $50 plus $20 for every day the offence continues after conviction.

C3. Fishing Industry Act

Fish Sanctuaries
Section 18(1) states:
The Minister may, from time to time, by order declare any area specified in such order to be a fish sanctuary.

Under the Fishing Industry (Fish Sanctuaries) Order 1979 Bogue Island in Montego Bay was been gazetted.

Penalties
Section 18 (2) states:
Any person who fishes or attempts to fish in any area declared by the Minister to be a fish sanctuary shall be guilty of an offence and liable on summary conviction before a Resident Magistrate to a fine not exceeding five hundred dollars and, in default of payment thereof, to imprisonment for a term not exceeding six months.

D. POLLUTION

D1. The Wild Life Protection Act (1945)

Section 10 states:
Every person who-
(a) uses, or causes to be used, dynamite or other explosive substance with intent thereby to take, kill or injure fish in any water; or
(b) places or causes to be placed any poison, lime or noxious material in any water with intent thereby to take, kill or injure fish that may then or may thereafter be put therein; ...
is guilty of an offence against this Act.

Section 11 states:
...every person who causes or knowingly permits to be out, whether directly or indirectly, into any harbour, river, stream canal, lagoon or estuary, containing fish, any trade effluent or industrial waste from any factory shall be found guilty of an offence against this section...

Section 12 states:
Every person who knowingly buys, sells or has in his possession fish taken, killed or injured in contravention of the provisions of this Act or of any regulations made thereunder shall be guilty of an offence against this Act.

Penalties
A 1991 Amendment to the Act raised the penalty to $50,000 or to imprisonment for a term not exceeding two years or to both such fine and imprisonment.

D2. Natural Resources Conservation Act (1991)

Section 1:
(functions of the Authority) see above.

Section 12 (1):
Subject to the provisions of this section, no person shall-
(a) discharge on or cause or permit the entry into any waters, on the ground, of any sewage or trade effluent or any poisonous, noxious or polluting material; ..
except under an in accordance with a licence for the purpose granted by the Authority under this Act.
(2) provides for exceptions
(3) penalty - ....$50,000 or 2 years imprisonment

Section 14:
- provides for exemption for the National Water Commission under stated circumstances

Section 15:
- provides for enforcement with respect to farms

Section 16:
- provides for other actions for enforcing regulations concerning pollution.

Section 17:
- provides for control of sewage plants and other waste treatment facilities
- penalties: $20,000

D3. Petroleum Act, 1979

Regulates exploration for petroleum and allows the Minister to make regulations to control pollution in areas where petroleum operations occur (e.g. to protect fishing).

D4. Harbours Act, 1875

Controls dredging in harbours and prohibits discharges (e.g. of rubbish, earth, stones, ballast, mud, oil, etc.) into harbours.

D5. Pesticides Act, 1987

Regulates importation, manufacture, sale, use and disposal of pesticides.

D6. Port Authority Act, 1972

Regulates the operation of ports.

D7. The Litter Act, 1985

Prohibits various types of littering (including in public places and private places without consent).

E. DEVELOPMENT CONTROL

E1. Natural Resources Conservation Act

Sections 10 and 11:
requires environmental impact assessments for selected developments in proscribed areas

E2. Town and Country Planning Act, 1958
Provides for approval of large developments generally and specifies that all developments within one mile of the coast must be approved by the Beach Control Authority (now incorporated into the NRCA). It also provides for gazetting of "Development Orders" which are over-all land use plans for specified areas (usually a parish or resort).

E3. Local Improvements Act, 1914

Requires developers to get planning permission for sub-divisions.

E4. Roads Protection Act, 1937

Inter-alia prohibits the removal of sand, gravel, etc. within two (2) chains of the foreshore.

E5. Prescription Act, 1882

Safeguards the public's right to continued use of the beach, where such use has been uninterrupted for 20 years.

E6. Parish Councils Act, 1901

Controls construction of sewers in towns.

E7. Local Improvements (Community Amenities) Act, 1977

Allows the Minister to declare special improvement areas (e.g. to rectify problems with sewage disposal or water supply). Once such an area is declared the area is not subject to the provisions of the Local Improvements Act or the Town and Country Planning Act.

E8. Urban Development Corporation Act, 1968

Enables the UDC to acquire and dispose of land within and sometimes outside areas designated as UDC lands, to manage completed projects. The UDC is not subject to the local Planning Authority in UDC designated lands (e.g., Hellshire Hills).

E9. Minerals (Vesting) Act, 1947

Vests all mineral in, on or under and land or water (including territorial waters, rivers or sea) in the Crown.

E10. Quarries Control Act, 1983

Established quarry zones and provides for licensing of all quarries (including beach sand). Licences can be revoked if environmental impacts are not controlled.

E11. Crown Property (Vesting) Act, 1960

Gives the Commissioner of Lands sole power to acquire, hold and dispose of lands owned by the government (e.g. inshore and offshore cays).

F. OTHER

F1. The Gun Powder and Explosives Act (1967)

Dynamite is listed in First Schedule Part II of the Act and under Section 23 of the Act [Penalties], anyone guilty of an offence against the Act for which no penalties has been provided is liable to a penalty not exceeding forty dollars ($40) and in default of payment imprisonment with or without hard labour for a term not exceeding six months.

Regulates use of dynamite (Penalty $40 per offence) for possession.

F2. Maritime Areas Act

The Act declares Jamaica as an archipelagic State, and thus provides for sovereignty of the territorial sea and air space, as well as the bed and subsoil and the resources, living and non-living, contained therein. "For the purpose of the exercise of the jurisdiction of the courts of Jamaica, the territory of Jamaica shall include the internal waters and the archipelagic waters. Under section 14 of the Act, an offence committed on or in the territorial waters whether a Jamaican citizen and similar to an offence on land, is punishable under this Act." In addition, the Act states that a Game Warden appointed under the Wild Life Protection Act is a Marine Officer with authority to enforce the Act.

Table 1. Summary of sea turtle nesting records in Jamaica, as compiled from interviews with fishermen in September-November 1982. Source: Jamaica National Report to the 1983 Western Atlantic Turtle Symposium (Kerr, 1984). L = Loggerhead (*Caretta caretta*); G = Green turtle (*Chelonia mydas*); H = Hawksbill (*Eretmochelys imbricata*). No nesting records for *Dermochelys* were reported during the survey, although a few historical records exist for this species (see Figure 7). No total annual population estimates are available for any species. Beaches are listed in geographic order, beginning on the mainland with the Kingston Harbour area and moving counter-clockwise around the island. Beach length is measured in meters (m). An asterisk (*) indicates a beach that could not be verified (perhaps due to a name change) and its location geo-referenced for inclusion in Figures 5-8.

Beach	Length	Species	Comments
1. Louzy Bay	--	H	max. 7 nests/night; 30 nests/yr
2. Manatee Bay	80.5	L	--
		H	max. 5 nests/night; 88 nests/yr
3. Coquar Bay	--	L	--
		H	max. 10 nests/night; 40 nests/yr
4. Three-Sandy Bay*	40	H	max. 15 nests/night; 60 nests/yr
5. Long Pond Beach	--	H	max. 30 nests/night; 90 nests/yr
6. Peake Bay	--	H	max. 3 nests/night; 70 nests/yr
7. Pigeon Island	30	H	max. 6 nests/night; 25 nests/yr
8. Miller Bay	--	L	--
		H	max. 6 nests/night; 35 nests/yr
9. Beau Champ	70	H	max. 7 nests/night; 80 nests/yr
10. Gut's River	1207.5	H	max. 7 nests/night; 75 nests/yr
11. Old Woman's Pt	40	H	max. 4 nests/night; 70 nests/yr
12. Calabash Bay	402.5	H	max. 10 nests/night; 80 nests/yr
13. Malcolm Pt	15	G	--
		H	max. 8 nests/night; 500 nests/yr
14. Luana Beach	402.5	H	max. 5 nests/night; 50 nests/yr
15. Sand Hill	40	G	--
		H	max. 8 nests/night; 30 nests/yr
16. Auchindown	60	H	max. 12 nests/night; 30 nests/yr
17. Parker's Bay	--	H	max. 12 nests/night; 30 nests/yr
18. Long Bay	8055	H	max. 4 nests/night; 50 nests/yr
19. Jack's Hole*	--	H	max. 2 nests/night; 200 nests/yr
20. Brighton Beach	--	G	--
		H	max. 2 nests/night; 20 nests/yr
21. Crab Pond Pt	--	H	max. 6 nests/night; 50 nests/yr
22. Tan-Tan Bay*	--	H	max. 5 nests/night; 50 nests/yr
23. Sabbito Beach	--	H	max. 6 nests/night; 50 nests/yr
24. Hope (Old) Wharf	60	L	--
		H	max. 4 nests/night; 60 nests/yr
25. Robin's Pt	--	H	max. 4 nests/night; 60 nests/yr
26. St. John's Pt	805	H	max. 4 nests/night; 40 nests/yr
27. Little Bay	1207.5	L	--
		H	max. 2 nests/night; 20 nests/yr
28. Mary's Beach*	60	H	max. 4 nests/night
29. White Sands	--	H	max. 3 nests/night
30. Pampy's Beach*	--	H	max. 4 nests/night

Table 1, continued

Beach	Length	Species	Comments	
31. Long Bay	--	H	max. 4 nests/night; 50 nests/yr	
32. Lances	20	H	max. 2 nests/night; 40 nests/yr	
33. Green Island	--	H	max. 5 nests/night; 24 nests/yr	
34. Johnston's Beach	--	L	--	
		H	max. 1 nest/night; 30 nests/yr	
35. Barbican	20	H	max. 4 nests/night; 50 nests/yr	
36. Meagre Bay*	--	H	max. 2 nests/night	
37. Salthouse Beach*	--	H	max. 6 nests/night; 50 nests/yr	
38. Tryall Beach	--	H	max. 3 nests/night; 25 nests/yr	
39. Black Bay*	--	H	max. 2 nests/night; 12 nests/yr	--
40. Hopewell Beach	--	L	--	
		H	max. 2 nests/night; 12 nests/yr	
41. Habbindon Beach*	--	H	max. 2 nests/night	
42. Old House Pt*	--	L	--	
		H	max. 5 nests/night; 25 nests/yr	
43. Success Beach	--	H	max. 3 nests/night; 25 nests/yr	
44. Red House Beach*	--	H	max. 3 nests/night; 25 nests/yr	
45. Rose Hall Beach	--	H	max. 4 nests/night; 40 nests/yr	
46. Mini Hall Beach*	--	L	--	
		H	max. 1 nest/night; 30 nests/yr	
47. Billy Clarke*	--	L	--	
		H	max. 3 nests/night; 25 nests/yr	
48. Shark Bay*	--	L	--	
		H	max. 3 nest/night; 16 nests/yr	
49. Pat Chung Beach*	20	H	max. 4 nests/night; 28 nests/yr	
50. Devil's Kitchen*	--	H	max. 3 nests/night; 25 nests/yr	
51. Half Moon Bay	--	H	max. 10 nests/night; 25 nests/yr	
52. Spring Bay	--	H	max. 3 nests/night; 40 nests/yr	
53. White Bay	--	H	max. 3 nests/night; 25 nests/yr	
54. Stewart Bay	--	H	max. 3 nests/night; 25 nests/yr	
55. Mangrove Pt	--	L	--	
		H	max. 1 nest/night; 30 nests/yr	
56. Thatch Tree*	--	H	max. 1 nest/night	
57. Braco Beach	1207.5	H	max. 5 nests/night; 20 nests/yr	
58. Silver Sands	805	H	max. 1 nest/night	
59. Queen's Way	--	H	max. 2 nests/night; 20 nests/yr	
60. Pear Tree Bottom	--	H	max. 1 nest/night	
61. Rocky Wood Pt*	402.5	H	max. 1 nest/night; 9 nests/yr	
62. Salem Beach	--	H	max. 1 nest/night	
63. Llandovery	--	L	--	
		H	max. 2 nest/night; 12 nests/yr	
64. Windsor Beach	805	L	--	
		H	max. 2 nest/night; 12 nests/yr	
65. Mamee Bay	60	H	max. 2 nest/night; 12 nests/yr	
66. Drax Hall Beach	10	H	max. 2 nests/night; 20 nests/yr	
67. Shaw Park	60	H	27 nests/yr	
68. Megartorbon*	40	H	27 nests/yr	
69. Rio Nuevo Beach	50	H	27 nests/yr	
70. Golden Head	--	H	27 nests/yr	

Table 1, continued

Beach	Length	Species	Comments
71. Tower Isle	--	H	27 nests/yr
72. Ladder Bay*	--	H	max. 3 nests/night; 40 nests/yr
73. Roaring River	--	H	max. 2 nests/night; 20 nests/yr
74. Salt Bay Cove*	--	H	max. 4 nests/night; 50 nests/yr
75. Shearness Bay	30	H	max. 3 nests/night; 12 nests/yr
76. Wagwater Veil	--	H	max. 3 nests/night; 12 nests/yr
77. Annette Bay	64.4	H	max. 3 nests/night; 12 nests/yr
78. Buff Bay	80	H	max. 3 nests/night; 40 nests/yr
79. Orange Bay	805	G	--
		H	max. 3 nests/night; 40 nests/yr
80. Hope Bay Beach	--	L	--
		H	max. 6 nests/night; 50 nests/yr
81. Barras Hole*	--	H	max. 4 nests/night; 40 nests/yr
82. Horsewood Beach*	--	H	max. 4 nests/night; 40 nests/yr
83. Windsor (Castle?)	805	H	max. 3 nests/night; 40 nests/yr
84. Doctor Wood*	--	H	max. 3 nests/night; 40 nests/yr
85. Spring Garden	--	L	--
		G	--
		H	max. 6 nests/night; 50 nests/yr
86. Passley Gardens	--	H	max. 5 nests/night; 45 nests/yr
87. Hermitage	--	L	--
		G	--
		H	max. 6 nests/night; 50 nests/yr
88. Drapers Beach	40	L	--
		H	max. 2 nests/night; 25 nests/yr
89. Fairy Hill	10	L	--
		H	max. 3 nests/night; 20 nests/yr
90. San-San	64.4	L	--
		H	max. 3 nests/night; 20 nests/yr
91. Frenchman's Cove	40	L	--
		H	max. 2 nests/night; 25 nests/yr
92. Turtle Cove	20	L	--
		H	max. 2 nests/night; 25 nests/yr
93. Long Bay	8050	L	--
		H	max. 7 nests/night; 20 nests/yr
94. Turtle Bay	--	L	--
		H	max. 2 nests/night; 7 nests/yr
95. Dalvey	805	H	max. 2 nests/night; 10 nests/yr
96. Holland Bay	120	H	max. 5 nests/night; 35 nests/yr
97. Rocky Pt	402	G	--
		H	max. 2 nests/night; 30 nests/yr
98. Morant Bay*	--	L	--
		H	max. 5 nests/night; 35 nests/yr
99. Duhaney Pen*	--	L	--
		H	max. 2 nests/night; 40 nests/yr
100. White Horses	805	H	max. 3 nests/night; 20 nests/yr
101. Yallahs	32.25	H	max. 2 nests/night; 20 nests/yr
102. Cow Bay	--	H	max. 2 nests/night; 20 nests/yr

Table 1, continued

Beach	Length	Species	Comments
103. Grant's Pen	--	H	max. 2 nests/night; 50 nests/yr
104. Nine Mile Beach*	--	H	max. 2 nests/night; 50 nests/yr
OFFSHORE ISLETS AND CAYS			
105. Gun Cay	5	L	--
		H	max. 3 nests/night; 18 nests/yr
106. Eastern Cay	5.5	L	--
		H	max. 3 nests/night; 18 nests/yr
107. Lime Cay	300	H	max. 3 nests/night; 18 nests/yr
108. South Cay	--	L	--
		H	max. 3 nests/night; 18 nests/yr
109. Salt Island Cay	4.5	H	max. 5 nests/night; 25 nests/yr
110. Little Portland	13.7	L	--
		H	max. 10 nests/night; 125 nests/yr
111. Big Portland	30	L	--
		H	max. 10 nests/night; 125 nests/yr
		?	aerial survey 23 Sept 1982 unidentified crawls
112. Cays off Portland	--	?	aerial survey 5 Oct 1982, 3 unidentified crawls
113. Bare Bush Cay	--	L	--
		H	max. 10 nests/ night; 105 nests/yr
114. Pelican Cay	--	H	max. 30 nests/night; 90 nests/yr
115. Needles Cay	--	H	max. 5 nests/night; 25 nests/yr
116. Bush Cay	--	H	max. 1 nest/night; 7 nests/yr
117. Rocky Cay	--	H	max. 7 nests/night; 150 nests/yr
118. SW Pedro Cay	--	H	aerial survey 30 Sept 1982, 4 crawls
		?	aerial survey 30 Sept 1982, 4 unidentified crawls
119. SE Morant Cay	--	?	aerial survey 7 Sept 1982, 4 unidentified crawls
		?	aerial survey 30 Sept 1982, 4 unidentified crawls
120. SW Morant Cay	--	H	aerial survey 7 Sept 1982, 4 crawls
		H	aerial survey 30 Sept 1982, 3 crawls
		?	aerial survey 7 Sept 1982, 4 unidentified crawls
		?	aerial survey 30 Sept 1982, 3 unidentified crawls
121. “3 small cays” (Hellshire)	--	?	aerial survey 23 Sept 1982, 1 unidentified crawl
122. Pigeon Cay	--	?	aerial survey 23 Sept 1982, 2 unidentified crawls
123. “7 small cays”	--	?	aerial survey 23 Sept 1982, 3 unidentified crawls on one cay

Table 2. Summary of sea turtle nesting records in Jamaica, 1991-1995, based on field surveys conducted by the Sea Turtle Recovery Network in Jamaica. L = Loggerhead (*Caretta caretta*); G = Green turtle (*Chelonia mydas*); H = Hawksbill (*Eretmochelys imbricata*); and D = Leatherback (*Dermochelys coriacea*). No total annual population estimates are available for any species. Beaches are listed in geographic order, beginning with the Kingston Harbour area and moving counter-clockwise around the island. An asterisk (*) indicates a beach that could not be verified (perhaps due to a name change) and its location geo-referenced for inclusion in Figures 5-8. The most significant change from the 1982 interview data reported in Table 1 is the virtual extinction of nesting by green and loggerhead turtles.

Beach	Species	Comments
1. Louzy Bay	?	current status unknown
2. Manatee Bay	H	max. 10 nests/yr; nesting activity current to 1995
3. Coquar Bay	?	max. 10 nests/yr; nesting activity current to 1995
4. Three-Sandy Bay*	?	current status unknown
5. Long Pond Beach	?	current status unknown
6. Peake Bay	?	no evidence of nesting activity (1995)
7. Pigeon Island	H	max. 10 nests/yr; nesting activity current to 1995
8. Miller Bay	?	unconfirmed reports (1994)
9. Beau Champ	?	unconfirmed reports (1994)
10. Gut's River	H	max. 10 nests/yr; nesting activity current to 1995
11. Old Woman's Pt	H	max. 10 nest/yr; nesting activity current to 1995
12. Calabash Bay	H	max. 10 nests/yr; nesting activity current to 1995
13. Malcolm Pt	?	unconfirmed reports (1994)
14. Luana Beach	H	max. 10 nests/yr; nesting activity current to 1995
15. Sand Hill	?	no updated information
16. Auchindown	H	max. 10 nests/yr; nesting activity current to 1995
17. Parker's Bay	?	max. 10 nests/yr; nesting activity current to 1995
18. Long Bay	?	current status unknown
19. Jack's Hole*	?	current status unknown
20. Brighton Beach	?	current status unknown
21. Crab Pond Pt	H	max. 10 nests/yr; nesting activity current to 1995
22. Tan-Tan Bay*	?	no nesting observed; South Coast survey 1995
23. Sabbito Beach	?	no nesting observed; South Coast survey 1995
24. Old Wharf	H	max. 10 nests/ yr; nesting activity current to 1995
25. Robin's Pt	H	max. 10 nests/ yr; nesting activity current to 1995
26. St. John's Pt	H	max. 10 nests/yr; nesting activity current to 1995
27. Little Bay	H	max. 10 nests/yr; nesting activity current to 1995
28. Mary's Beach*	?	current status unknown
29. White Sands	?	current status unknown
30. Pampy's Beach*	?	current status unknown
31. Long Bay	H	max. 10 nests/yr; nesting activity current to 1995
32. Lances Bay	H	max. 10 nest/yr; nesting activity current to 1993
33. Green Island	?	current status unknown
34. Johnston's Beach	?	current status unknown
35. Barbican (W of Tryall)	?	current status unknown
36. Meagre Bay*	H	max. 10 nests/yr; nesting activity current to 1993
37. Salthouse Beach*	?	current status unknown
38. Tryall Beach	H	max. 10 nest/yr; nesting activity current to 1993
39. Black Bay	?	current status unknown
40. Hopewell Beach	?	current status unknown

Table 2, continued

Beach	Species	Comments
41. Habbindon Beach	?	current status unknown
42. Old House Pt	?	current status unknown
43. Success Beach	H	max. 10 nests/yr; nesting activity current to 1993
44. Red House Beach*	?	current status unknown
45. Rose Hall Beach	?	current status unknown
46. Mini Hall Beach*	?	current status unknown
47. Billy Clarke*	?	current status unknown
48. Shark Bay*	?	current status unknown
49. Pat Chung Beach*	?	current status unknown
50. Devil's Kitchen*	?	current status unknown
51. Half Moon Bay	?	current status unknown
52. Spring Bay	?	current status unknown
53. White Bay	?	current status unknown
54. Stewart Bay	?	current status unknown
55. Mangrove Pt	?	current status unknown
56. Thatch Tree *	?	current status unknown
57. Braco Beach	H	max. 10 nests/yr; nesting activity current to 1995
58. Silver Sands	H	max. 10 nest/yr; nesting activity current to 1995
59. Queen's Way Beach	?	current status unknown
60. Pear Tree Bottom	H	max. 10 nests/yr; nesting activity current to 1995
61. Rocky Wood Pt*	?	current status unknown
62. Salem Beach	?	current status unknown
63. Llandovery	?	current status unknown
64. Windsor Beach	?	current status unknown
65. Mammee Bay	H	max. 10 nests/yr; nesting activity current to 1994
66. Drax Hall Beach	H	max. 10 nests/yr; nesting activity current to 1994
67. Shaw Park	H	max. 10 nests/yr; nesting activity current to 1994
68. Megartorbon Beach*	?	current status unknown
69. Rio Nuevo Beach	?	current status unknown
70. Golden Head Beach	H	max. 10 nests/yr; nesting activity current to 1994
71. Tower Isle	?	current status unknown
72. Ladder Bay*	H	max. 10 nests/yr; nesting activity current to 1994
73. Roaring River	?	current status unknown
74. Salt Bay Cove	?	current status unknown
75. Shearness Bay	?	current status unknown
76. Wagwater Veil	?	current status unknown
77. Annette Bay	?	current status unknown
78. Buff Bay	?	current status unknown
79. Orange Bay	H	max. 10 nests/yr; nesting activity current to 1995
80. Hope Bay Beach	H	max. 10 nests/yr; nesting activity current to 1994
81. Barras Hole*	?	current status unknown
82. Horsewood Beach*	?	current status unknown
83. Windsor Beach	?	current status unknown
84. Doctor Wood*	H	max. 10 nests/yr; nesting activity current to 1994
85. Spring Garden Beach	?	current status unknown
86. Passley Gardens	?	current status unknown
87. Hermitage	?	current status unknown
88. Drapers Beach	?	current status unknown
89. Fairy Hill	H	max. 10 nests/yr; nesting activity current to 1994

Table 2, continued

Beach	Species	Comments
90. San-San	?	current status unknown
91. Frenchman's Cove	H	max. 10 nests/yr; nesting activity current to 1994
92. Turtle Cove	?	current status unknown
93. Long Bay	H	max. 10 nests/yr; nesting activity current to 1994
94. Turtle Bay	?	current status unknown
95. Dalvey	?	current status unknown
96. Holland Bay	?	current status unknown
97. Rocky Pt	?	current status unknown
98. Morant Bay*	?	current status unknown
99. Duhaney Pen*	?	current status unknown
100. White Horses	?	current status unknown
101. Yallahs	H	max. 10 nests/yr; nesting activity current to 1993
102. Cow Bay	H	max. 10 nests/yr; nesting activity current to 1994
103. Grant's Pen Beach	?	current status unknown
104. Nine Mile Beach*	?	current status unknown
OFFSHORE ISLETS AND CAYS		
105. Gun Cay	?	current status unknown
106. Eastern Cay	?	current status unknown
107. Lime Cay	H	max. 10 nests/yr; nesting activity current to 1994
108. South Cay	?	current status unknown
109. Salt Island Cay	?	current status unknown
110. Little Portland Cay	H	max. 10 nests/yr; nesting activity current to 1995
111. Big Portland Cay	H	max. 10 nests/yr; nesting activity current to 1995
112. cays off Portland	?	current status unknown
113. Bare Bush Cay	H	max. 10 nests/yr; nesting activity current to 1995
114. Pelican Cay	H	max. 10 nests/yr; nesting activity current to 1995
115. Needles Cay	H	max. 10 nests/yr; nesting activity current to 1995
116. Bush Cay	G	hatchling reported 1993
117. Rocky Cay	H	max. 10 nests/yr; nesting activity current to 1995
118. SW Pedro Cay	?	current status unknown
119. SE Morant Cay	H	max. 10 nests/yr; nesting activity current to 1995
120. SW Morant Cay	?	current status unknown
121. “3 small cays” (Hellshire)	?	current status unknown
122. Pigeon Cay	?	current status unknown
123. “7 small cays”	?	current status unknown
NEW AREAS NOT IDENTIFIED IN PRE-1991 SURVEYS		
124. Billys Bay	H	>30 nests/yr; nesting activity as current as 1995
(St. Elizabeth)	D	reported nesting in 1995
125. Great Bay (St. Elizabeth)	H	<20 nests/yr; nesting activity as current as 1995
126. Merrimans Point (St. Elizabeth)	H	>30 nests/yr; nesting activity as current as 1995
127. Thatchfield (St. Elizabeth)	H	>30 nests/yr; nesting activity as current as 1995
130. Galleon Harbour (St. Elizabeth)	H	50-100 nests/yr; nest activity as current as 1995

Table 2, continued

Beach	Species	Comments
131. Alligator Pond-cay (Manchester)	H	>10 nests/yr; nesting activity as current as 1995
132. Alligator Pond (east of Port Kaiser)	H	<10 nests/yr; nesting activity as current as 1995
133. White Horses (west of Little Pedro Bay)	H	>10 nests/yr; nesting activity as current as 1995
134. Bluefields (Westmoreland)	H	<10 nests/yr; nesting activity as current as 1994
135. Parottee	H	>20 nests/yr
(St. Elizabeth)	D	2 reported nesting attempts in 1993?
136. Black River	H	<10 nests/yr; nesting activity as current as 1995
137. Paradise (Westmoreland)	H	<10 nests/yr; nesting activity as current as 1994
138. Bloody Bay (Negril)	H	<10 nests/yr; nesting activity as current as 1993
139. Booby Cay (Negril)	H	<10 nests/yr (?); nest activity as current as 1992
140. Sandy Bay (cay off Green Island)	H	<10 nests/yr (?); <10 nest from 1993 survey
141. Prospect (St. Ann)	H	<10 nests/yr; nesting activity as current as 1995
142. Runaway Bay	H	<10 nests/yr; nesting activity as current as 1995
143. Prospect (St. Thomas)	H	<10 nests/yr; nesting activity as current as 1993
144. Palisadoes/Port Royal	H	<10 nests/yr; nesting activity as current as 1995
145. Little Pelican Cay	H	<10 nests/yr; nesting activity as current as 1995
146. Sand Bank Cay (between Portland & Half Moon Cays)	H	>10 nests/yr; nesting activity as current as 1995
147. Sand Cay (between Portland & Half Moon Cays)	H	>10 nests/yr; nesting activity as current as 1995

Table 3. Foraging/observation sites as reported by Kerr (1984), based on interviews with fishermen in September-November 1982 (see also Figure 9). L = Loggerhead (*Caretta caretta*); G = Green turtle (*Chelonia* mydas); and H = Hawksbill (*Eretmochelys imbricata*). While the following information represents a beginning, comprehensive efforts to identify important foraging areas are needed. Note: "Incidental catch" was not defined in the source document.

Location	Species	Source/Comments
1. Bushy Cay to Eastern Cay (16 km radius)	H, G	Incidental catch, observation
2. 1.6 km S of Kingston Harbour off the deep edge for ca. 8 km	H, L, G	Incidental catch, observation
3. 0.8 km S of Long Acre Pt	H, G	Incidental catch, observation
4. Offshore Pigeon Island	H, L	Fishery observation
5. King Fish Bank, 20 km off Rocky Beach (Clarendon)	H, G	Fishery observation
6. 40 km offshore Carlisle Bay - Jackson Bay	H, G	Fishery observation
7. Ballas (1 km offshore from Farquhars beach)	H, L, G	Incidental catch, observation
8. From Old Woman's Pt out to Alligator Reef	H, L, G	Incidental catch, observation
9. Offshore Frenchman's Beach to about 6 km south	H	Incidental catch, observation
10. Offshore between Calabash Bay and Old Woman's Pt	H, L, G	Incidental catch, observation
11. Reef offshore Great Pedro Bluffs	H, L, G	Incidental catch, observation
12. Offshore Pedro Bank (St. Elizabeth)	H	Fishery observation
13. 1 km offshore Parottee fishing beach, Parottee (St. Elizabeth)	H, L	Incidental catch, observation
14. Offshore Luana Pt	H, L, G	Fishery observation
15. Offshore Malcolm's Pt (St. Elizabeth)	H, G	Fishery observation
16. 2 km south of Black River (St. Elizabeth)	H, G	Incidental catch, observation
17. 0.5 km from Crab Pond Bay (Auchindown)	H, L	Incidental catch, observation
18. Old Johnson's Rock (Westmoreland)	?	Incidental catch, observation
19. 5 km offshore Auchindown (Westmoreland)	H, G	Fishery observation
20. 0.4 km off Robin's Pt (Westmoreland)	H	Incidental catch, observation
21. 16 km offshore Cock's fishing beach, Savanna-la-mar (Westmoreland)	H, G	Fishery observation
22. 1.5 km off Hope Wharf, Savanna-la-mar, (Westmoreland)	H, G	Fishery observation
23. Turtle Stag Reef, Savanna-la-mar (Westmoreland)	H, L, G	Observation

Table 3, continued

Location	Species	Source/Comments
24. Middle Ground S/SE to St. John's Pt (Westmoreland)	H, L, G	Observation
25. 1.6 km off Homer's Cove	H, G	Incidental catch, observation
26. 1.6 km off Mary's Bay beach	H, G	Fishery observation
27. Off South Negril Pt	H, G	Fishery observation
28. 1 km offshore Booby Cay, along to Bloody Bay	H, L, G	Incidental catch, observation
29. 1 km ofshore Green Island beach	H, L, G	Observation
30. 1 km from Cotton Tree Bay	H, L, G	Incidental catch, observation
31. Offshore the Negro Bay area	H, L, G	Fishery observation
32. Near Bamboo Bay (St. James)	H, G	Observation
33. 1 km off Hopewell Farm Beaches (St. James)	H, G	Incidental catch, observation
34. 1 km offshore from Ironshore to Rose Hall (St. James)	H, G	Incidental catch, observation
35. Along the coast from Bush Cay to Spring Bay (Trelawny)	H, L	Incidental catch, observation
36. Turtle Ground (near Bush Cay, Trelawny)	H, L, G	Observation
37. From 0.8 km offshore Success Beach (St. James)	H, L, G	Incidental catch
38. 3 km offshore Flankers Beach (St. James)	H, L, G	Incidental catch
39. 5 km offshore Scarlett Hall Beach	H, L, G	Incidental catch
40. 0.4 km offshore Lilliput (Trelawny)	H, L, G	Incidental catch
41. About 0.8 km offshore Coopers Pen (Falmouth Trelawny)	H, G	Fishery observation
42. About 0.2 km beyond Darby's Reef (Trelawny)	H, L	Fishery observation
43. Offshore from Long Sand's to Turtle Pass (Trelawny)	H, L	Fishery observation
44. Just offshore the Queen's Way Beaches (Discovery Bay, St. Ann)	H	Fishery observation
45. Unity Wharf and 0.4 km off Runaway Bay Beach (St. Ann)	H, L, G	Fishery observation
46. Just offshore Salem Beach to Llandovery	H, L	Incidental catch, observation
47. 1 km offshore Priory	H, G	Fishery observation
48. Boscobel Beach 0.4 km offshore by reef (St. Mary)	H, L, G	Incidental catch, observation
49. Offshore 0.4 km Pagee Fishing Beach	H, L, G	Incidental catch, observation
50. Sherness Channel 0.4 km offshore Robin's Bay (St. Mary)	H, L, G	Fishery observation
51. 1 km offshore Annotto Bay Beach (St. Mary)	H, L, G	Fishery observation
52. 5 km offshore Dr. Wood Pt (Portland)	H, L, G	Incidental catch, observation
53. 0.8 km offshore Orange Bay (Portland)	H, L, G	Incidental catch, observation

Table 3, continued

Location	Species	Source/Comments
54. Black Bess Pt 0.8 km offshore Orange Bay (St. Mary)	H, L, G	Incidental catch, observation
55. 3 km east of Spring Garden Pt Hope Bay (Portland)	H, L	Fishery observation
56. 3 km beyond Ship Rock - St. Margaret's Bay (Portland)	H, L, G	Fishery observation
57. Just offshore Boundbrook Beach on the reefs	H, L, G	Fishery observation
58. Jumby Stone (offshore Long Bay, Portland)	H, L, G	Fishery observation
59. 1.6 km offshore Draper's Beach (Portland)	H, L, G	Fishery observation
60. Potato Piece Bay 1.6 km offshore (Boston, Portland)	H, L, G	Fishery observation
61. Offshore from Lond Bay to Kensington (Portland)	H, L, G	Fishery observation
62. Within 0.3 km at Manchioneal Harbour (Portland)	H	Incidental catch, observation
63. Just offshore Innis Bay - Hector's River (Portland)	H, L, G	Incidental catch, observation
64. 1.6 km offshore Holland Bay (Turtle Set, Portland)	H, L, G	Fishery observation
65. 0.5 km offshore Rocky Pt (St. Thomas)	H, L, G	Fishery observation
66. 4 km offshore Port Morant - St. George's Bank (St. Thomas)	H, G	Fishery observation
67. Macca Pt offshore Duhaney Pen (St. Thomas)	H	Fishery observation
68. 0.1 km offshore Lyssons (on reef) (St. Thomas)	H, L	Fishery observation
69. 0.8 km offshore Lyssons (St. Thomas)	H	Fishery observation
70. 0.5 km offshore Yallahs to White Horses Bank (St. Thomas)	H, G	Fishery observation
71. Offshore "Nine Miles" Bully	H, L, G	Fishery observation

Table 4. Summary of Laws and Regulations Relevant to Sea Turtle Conservation

Legislation	Relevance to Sea Turtles
Natural Resources Conservation Authority Act, 1991	Develop, implement and monitor plans and programmes relating to the management of the environment and the conservation and protection of natural resources
Wild Life Protection Act, 1945	Designation of protected status. Removes protected species from possession, use and trade.
Harbours Act, 1874	Regulates activities within harbours through the Marine Board by regulating the movement of boats and vessels in harbours, channels or approach thereto; the placement of buoys and removal of sunken structures from harbours; penalties provided for the depositing of refuse and waste matter from vessels and removal of sand, stone, ballast etc., from harbours, reefs or shoals.
Jamaica National Heritage Trust Act, 1985	Establishes a statutory body to protect Jamaica's national heritage, including any place, animal or plant species or object/building.
Morant & Pedro Cays Act, 1907	Affirms the status of the Morant and Pedro Cays and prohibits fishing inside certain limits, slaying or catching of birds on the Cays or the catching of turtles within the territorial limits of the cays.
Petroleum Act, 1979	Vets all petroleum in the State and makes provisions for the creation of Regulations which prevent pollution or orders remedial action where this takes place, as well as the protection of fishing, navigation etc.
Port Authority Act, 1972	Establishes the Port Authority whose functions include regulation of ports and port facilities.
Town and Country Planning Act, 1958	Allows for the preparation of tree preservation and development orders and approves developments.
Urban Development Corporation Act, 1968	Establishes the UDC as a statutory body, which has amongst its functions the duty to carry out construction, maintain public parks, car parks etc. in any manner to ensure preservation of architectural or historical objects or sites.
The Litter Act, 1985	Prohibits various types of littering (including in public and private places without consent).
Beach Control Act, 1956	Establishes the control of the foreshore and floor of the sea in the Crown. Regulates the use of the foreshore and floor of the sea. Controls the construction of jetties, groynes, wharves and docks.
Fishing Industry Act, 1975	Provides for the licencing of all fishermen and vessels operating in Jamaican jurisdiction.

Table 4, continued

Legislation	Relevance to Sea Turtles
Trade Law 4, 1955	Requires licences for the export of raw turtle shell.
Gun Powder and Explosives Act, 1967	Regulates the use of dynamite.
Gun Court Act, 1974	Establishes a special court and procedures for offences involving fire-arms.
Pesticides Act, 1987	Regulates importation, manufacture, sale, use and disposal of pesti-cides.
Crown Property (Vesting) Act, 1960	Gives the Commissioner of Lands sole power to acquire, hold and dispose of lands owned by the government (e.g. inshore and offshore cays).
Minerals (Vesting) Act, 1947	Vests all mineral, in, on or under and land or water (including territori-al waters, rivers or sea) in the Crown.
Roads Protection Act, 1937	*Inter-alia* prohibits the removal of sand, gravel, etc. within two (2) chains of the foreshore.
Prescription Act, 1882	Safeguards the public's right to continued use of the beach, where such use has been uninterrupted for 20 years.
Local Improvements (Community Amenities) Act, 1977	Allows the Minister to declare special improvement areas (e.g. to rectify problems with sewage disposal or water supply). Once such an area is declared the area is not subject to the provisions of the Local Improvements Act or the Town and Country Planning Act.
Local Improvements Act, 1914	Requires developers to get planning permission for subdivisions.

Table 5. Stakeholders with interests in turtle conservation (adapted from Tambiah, 1995).

STAKE-HOLDERS	INTEREST
Fish catchers	Direct or opportunistic take of turtles.
Vendors	Buy turtle products from fish catchers and shell processors, and distribute them to consumers.
Processors	Use turtles to make products, such as turtle shell jewelry and 'turtle pride.'
Consumers	Mostly subsistence in the families of fishers, also a few restaurants.
Government Agencies	**Fisheries Division** - controls fishing in Jamaica. Has Fisheries Officers on Fishing Beaches, working directly with fishers as instructors and inspectors. **Natural Resources Conservation Authority** - enforces wildlife laws through Conservation Wardens, Honorary Game Wardens, and Wildlife Officers. Also control all types of beach developments and require environmental impact assessments. **Jamaica Defence Force Coastguard** - protects Jamaican waters, including cays; enforces marine legislation; provides assistance to marine conservation projects. **Jamaica Constabulary Force** - including the **Marine Police** - responsible for law enforcement. **Magistrates** - responsible for prosecutions.
Non-goverment organizations	**Sea Turtle Recovery Network of Jamaica** - coalition of government agencies, NGOs, volunteers, working together to develop and implement the Sea Turtle Recovery Action Plan. **Other parish and national NGOs** - which have or expect to develop responsbility for management of areas of importance for sea turtles; e.g., SCCF, PEPA, NEPT, TEPA. **Youth Clubs** - some of which are involved with sea turtle projects.
Volunteers	Citizens who assist the recovery network because of their interest in sea turtles.
Indirect Interest Groups	Developers and managers of beachfront properties Polluters 'Jet-ski' and speed boat operators Gun clubs Polluters **Government agencies responsible for development control and pollution** (e.g., ECD, Town and Country Planning Department, Parish Councils)

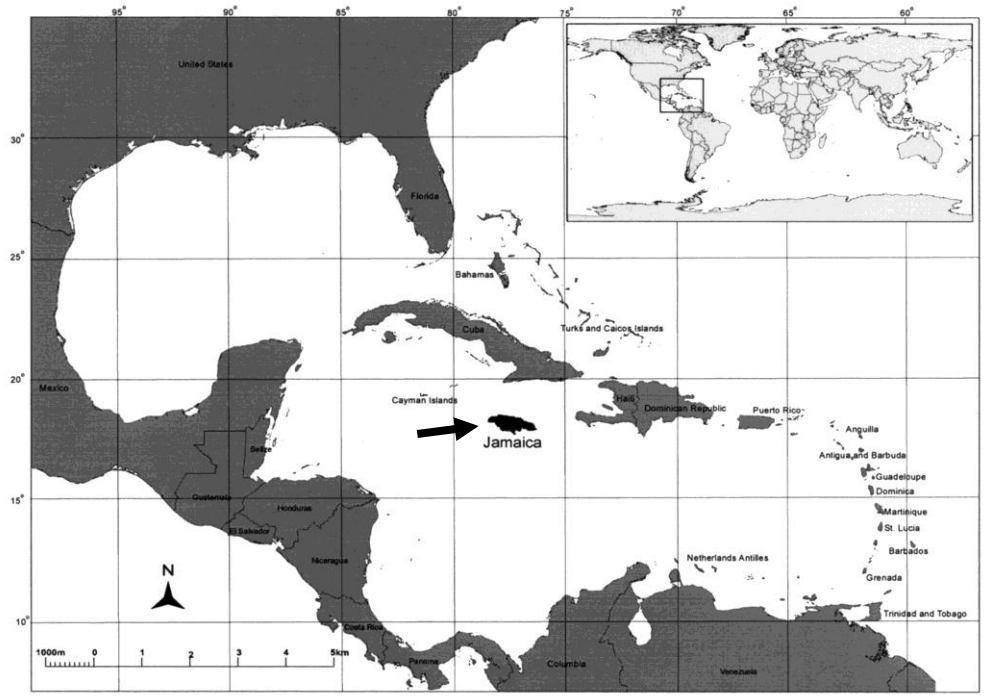

Figure 1. Jamaica, located approximately 145 km south of Cuba and 161 km west of Haiti, is the third largest island in the Caribbean Sea. The Wider Caribbean Region includes the marine environment of the Gulf of Mexico, the Caribbean Sea and the areas of the Atlantic adjacent thereto, south of 30°N latitude and within 200 nautical miles of the Atlantic coasts referred to in Article 25 of the Cartagena Convention.

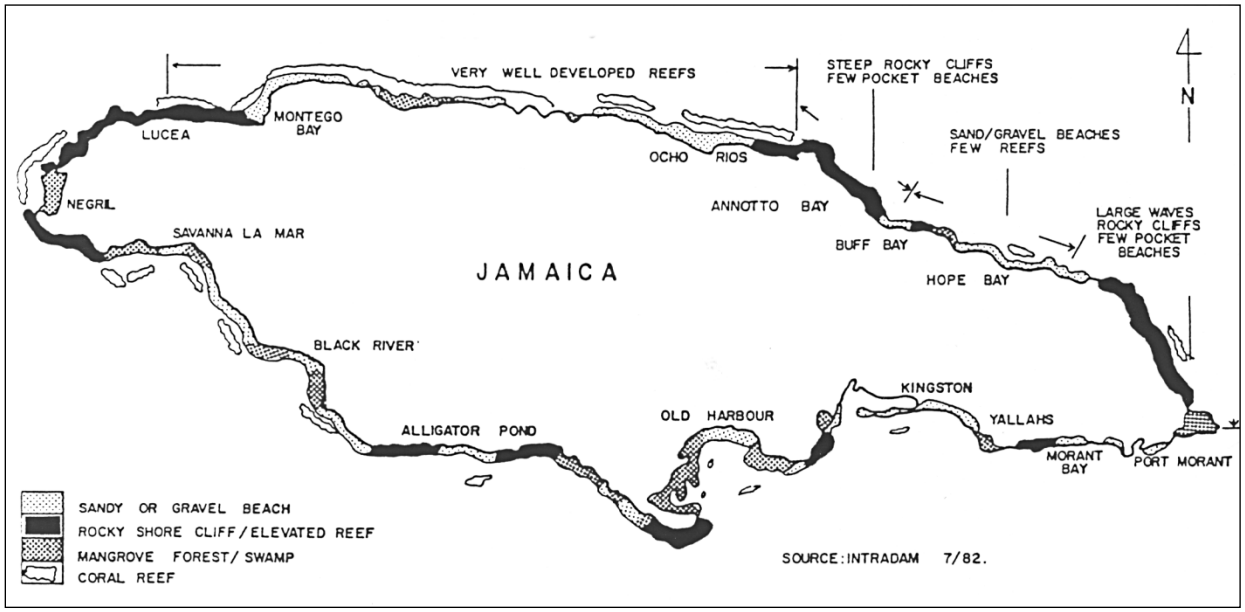

Figure 2. Jamaica's varied coastline is 885 km in length, including at least 321 km of sandy beaches potentially suitable for sea turtle nesting. Source: adapted from GOJ (1987).

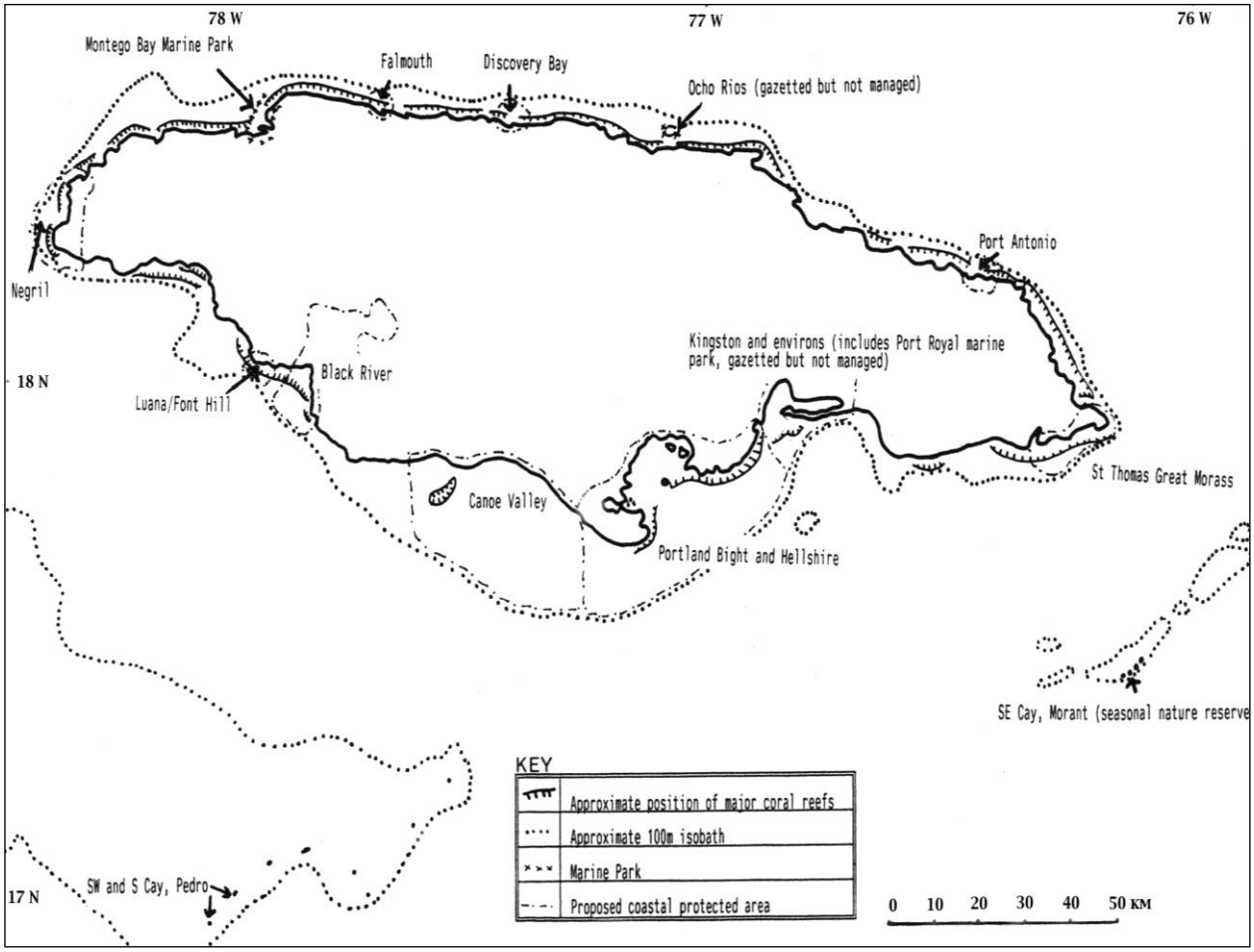

Figure 3. Jamaica's offshore banks and cays, showing shoreline configuration, coral reefs and seagrass. Source: adapted from GOJ (1997).

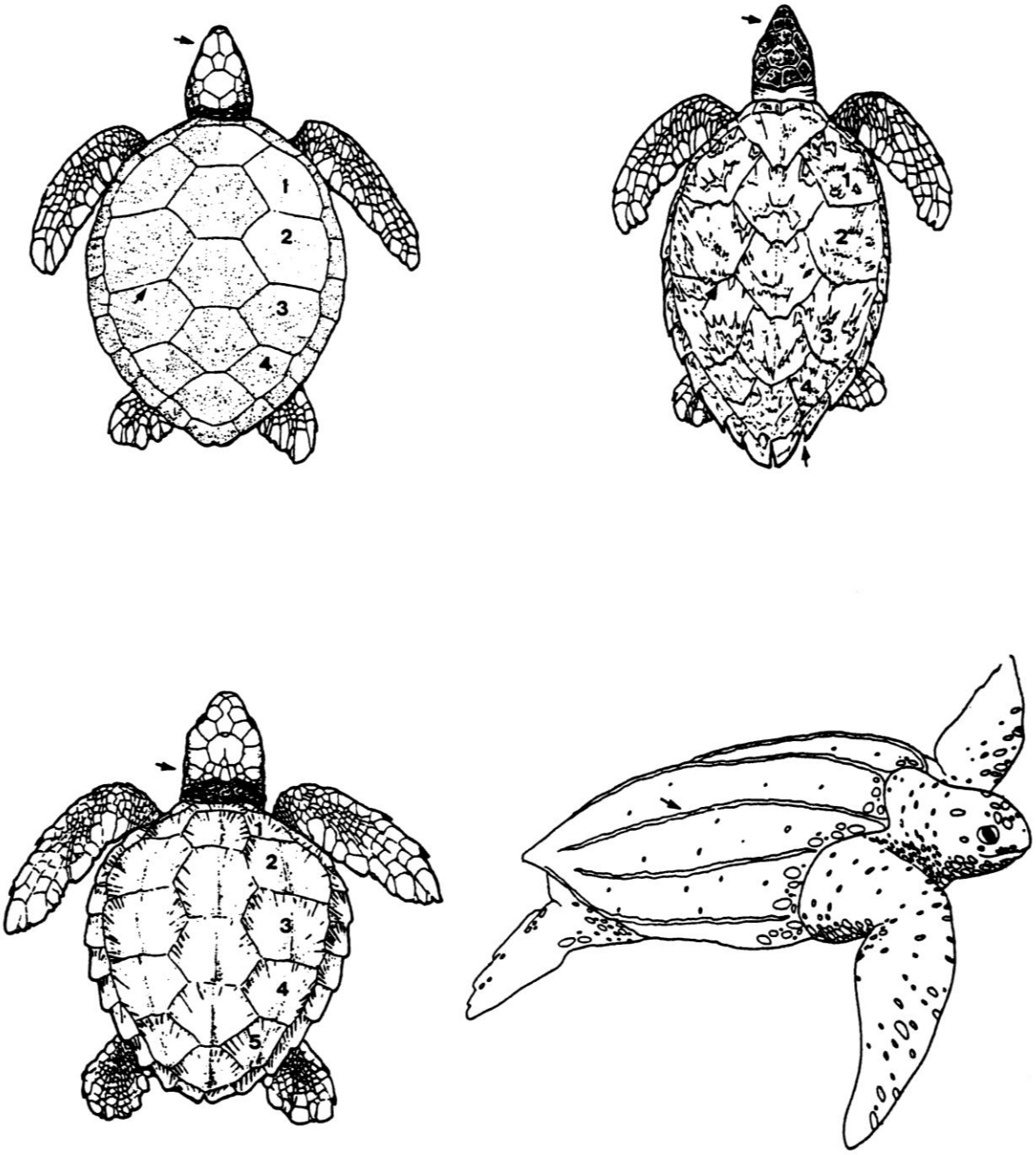

Figure 4. Four species of sea turtle are reported as occurring historically in Jamaica. Clockwise from the upper left, these are the green turtle (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), loggerhead (*Caretta caretta*), and leatherback (*Dermochelys coriacea*). With the exception of the hawksbill, which still nests predictably on the mainland and offshore cays, all species are extremely rare today. Green turtle nesting, for example, has been documented at only three sites in the last twenty years.

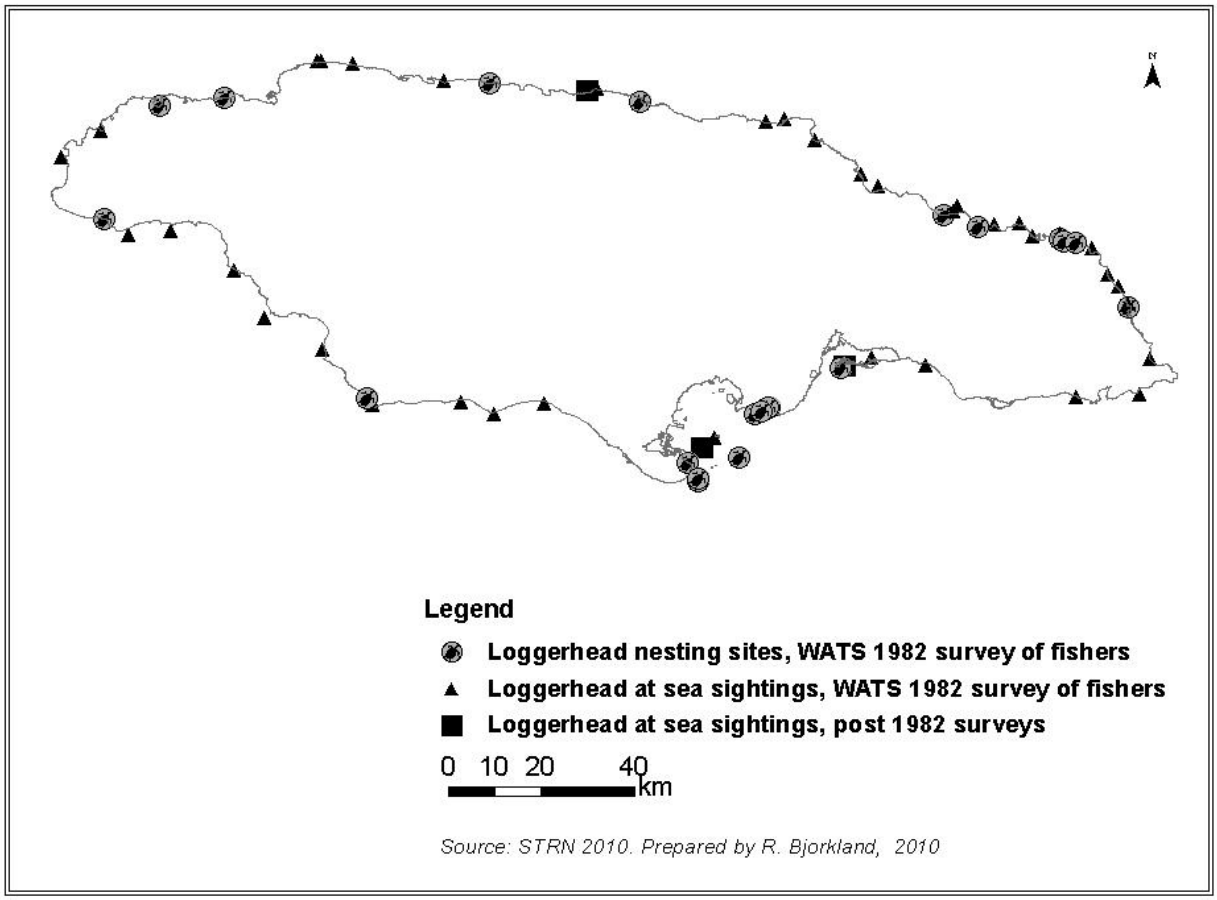

Figure 5. Documented and reported nesting beaches and at-sea sightings for loggerhead sea turtles (*Caretta caretta)* in Jamaica, based on Lewis (1940, 1947), Kerr (1984), and STRN and NEPA (unpublished data). Four at-sea sightings exist for loggerheads in Jamaica after 1982, namely, Runaway Bay, the Port Royal Cays, and the Portland Bight (STRN and NEPA, unpublished data). There is no confirmed nesting post-1982, suggesting that reproducing populations may be extinct in Jamaica.

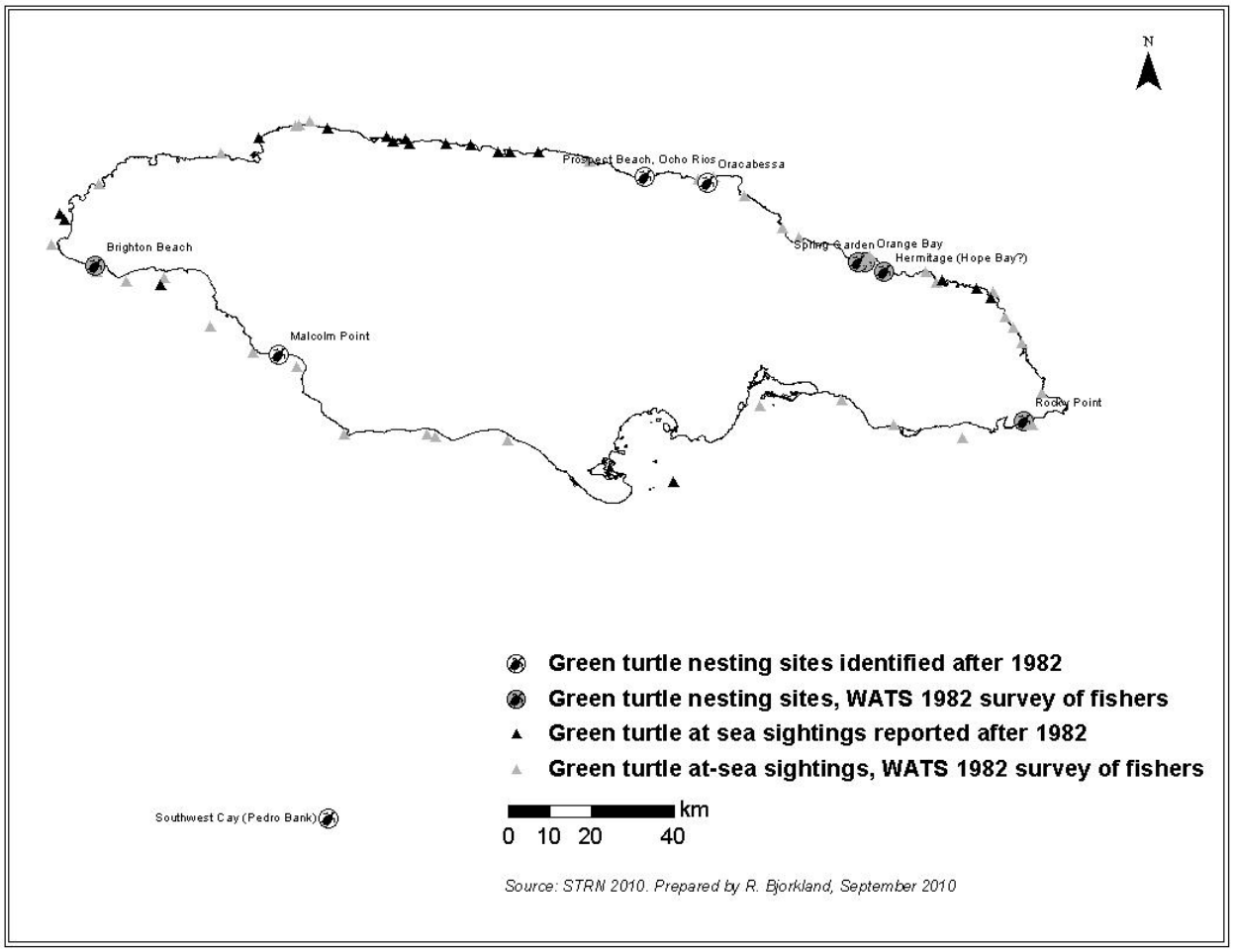

Figure 6. Documented and reported green sea turtle (*Chelonia mydas*) nesting beaches and at-sea sightings based on Kerr (1984) and unpublished data held by STRN and NEPA. Since 1982, green turtle nesting has been confirmed on the Pedro Cays, Malcolm's Bay (St. Elizabeth), Reggae beach and Oracabessa in St. Mary.

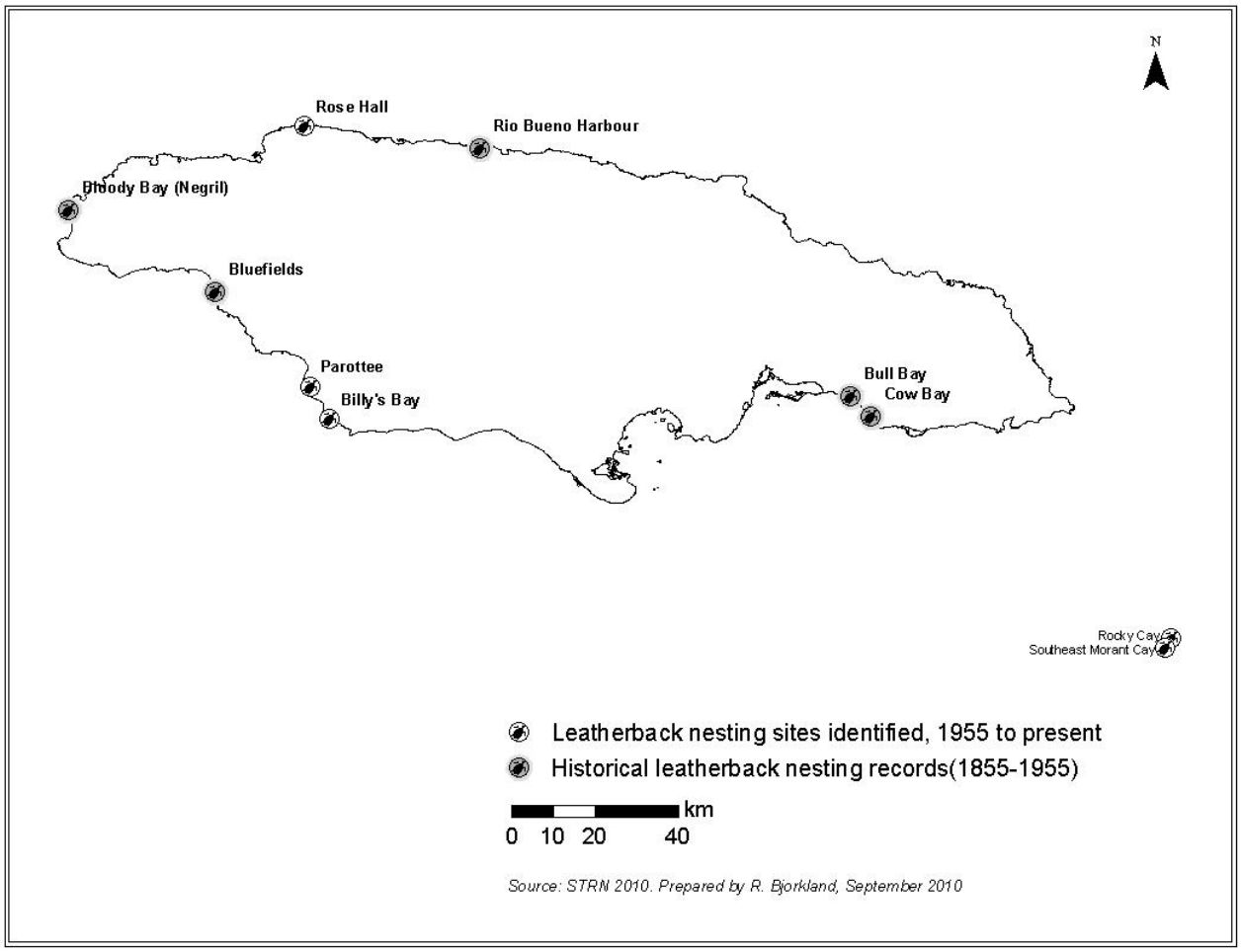

Figure 7. Documented and reported nesting beaches for leatherback sea turtles (*Dermochelys coriacea*). Historical accounts are based on Gosse (1851), Lewis (1940), Mcbride (1946) and Caldwell (1955). Current reports are based on unpublished data from STRN and NEPA.

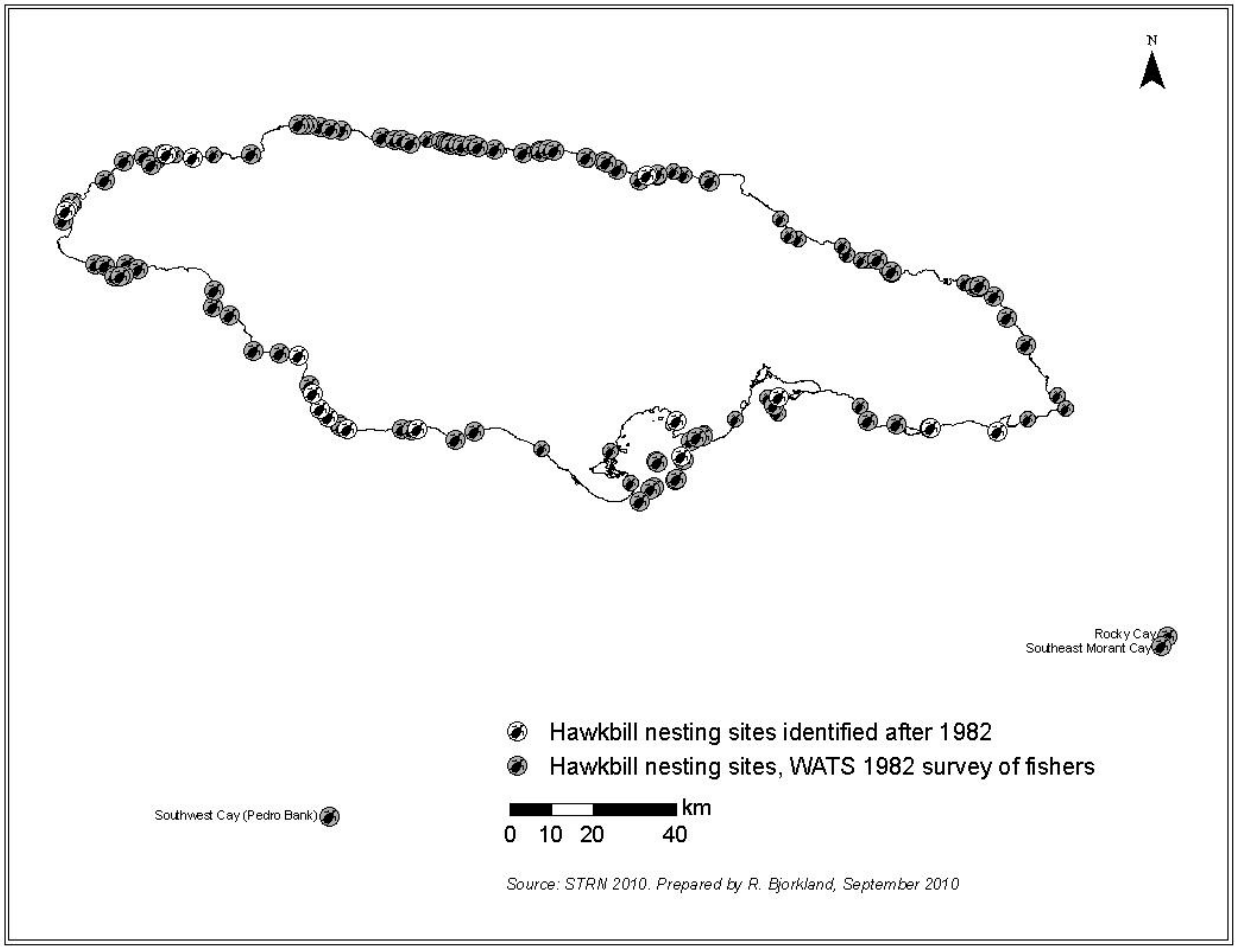

Figure 8. Hawksbill sea turtle (*Eretmochelys imbricata*) nesting beaches identified from a 1982 survey of fishers reported to WATS (Kerr, 1984) and post-WATS surveys from 1991 until the present. The hawksbill remains the only consistent nesting species in Jamaican waters (STRN and NEPA, unpublished data).

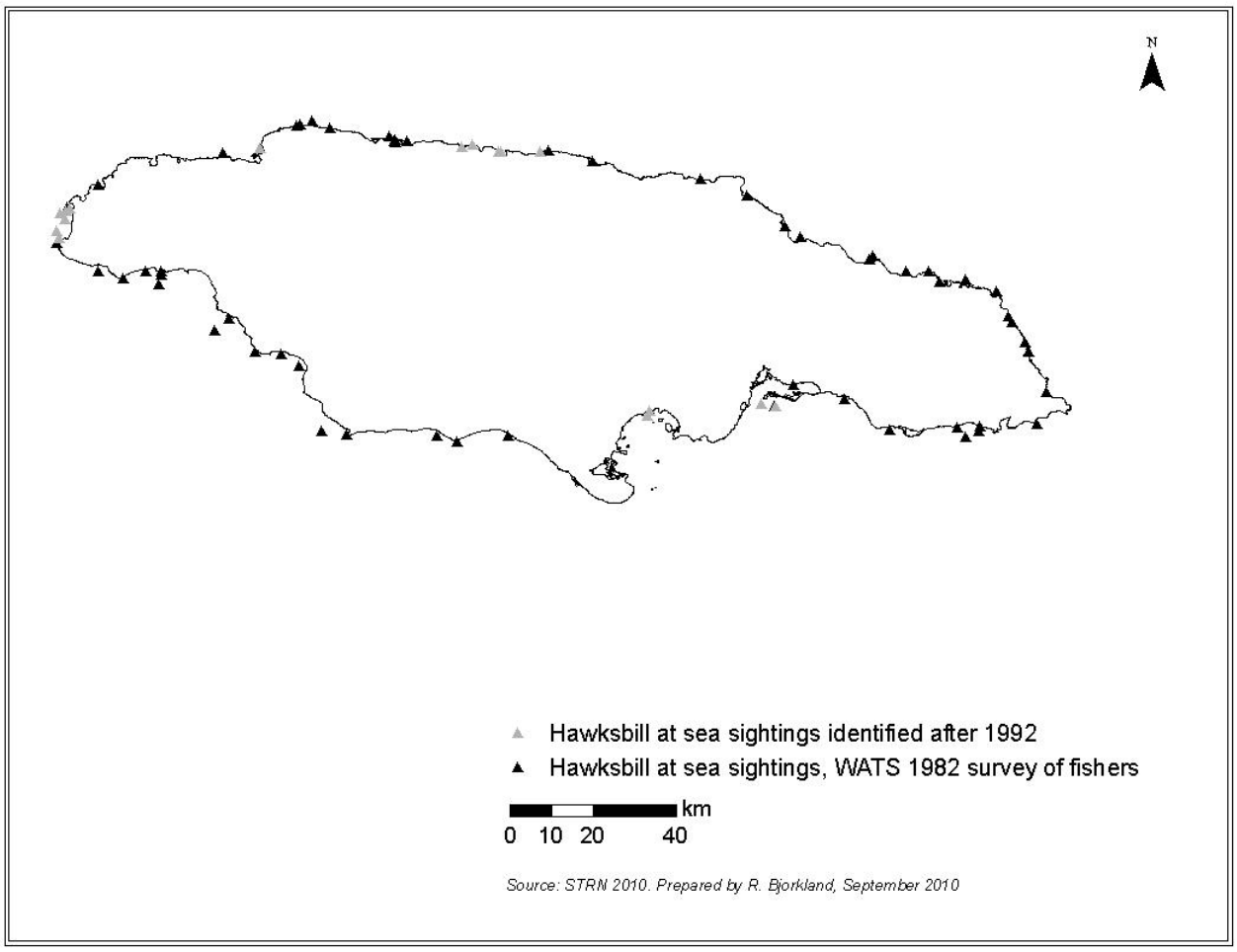

Figure 9. Hawksbill sea turtle (*Eretmochelys imbricata*) at-sea sightings identified from a 1982 survey of fishers reported to WATS (Kerr, 1984) and post-WATS data collection from 1991 until the present (STRN and NEPA, unpublished data).

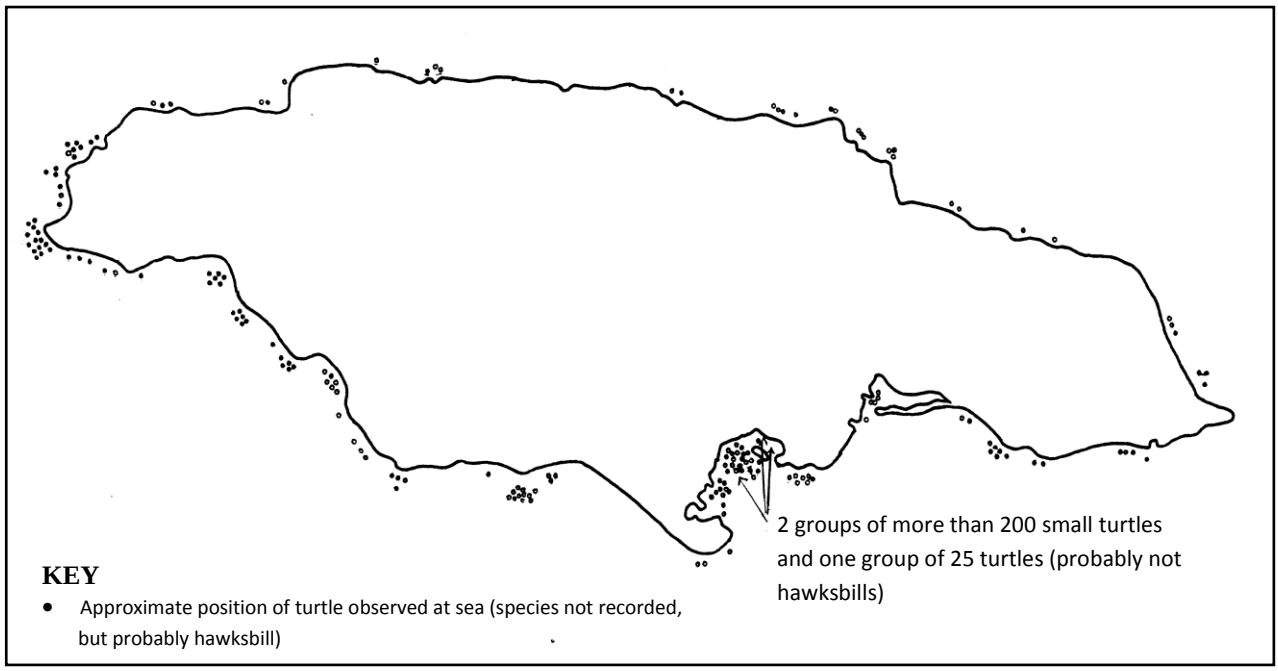

Figure 10. Sea turtle locations based on aerial surveys, 1982-1983. Source: Natural Resources Conservation Department (NRCD, unpublished data).

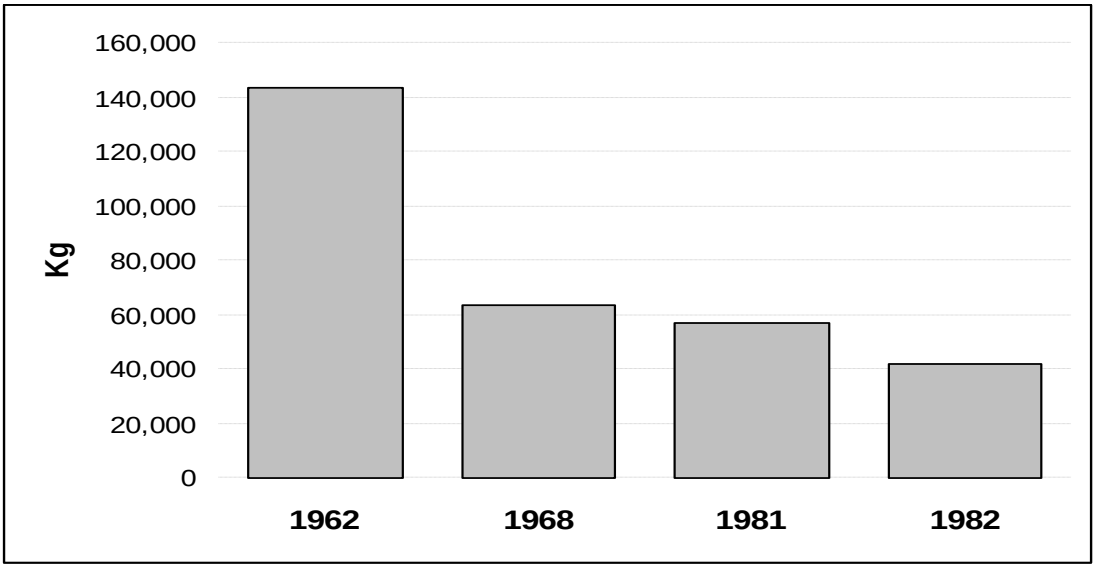

Figure 11. Decline in the sea turtle fishery, 1962-1982, based on fisheries surveys. Modified from Kerr (1984).

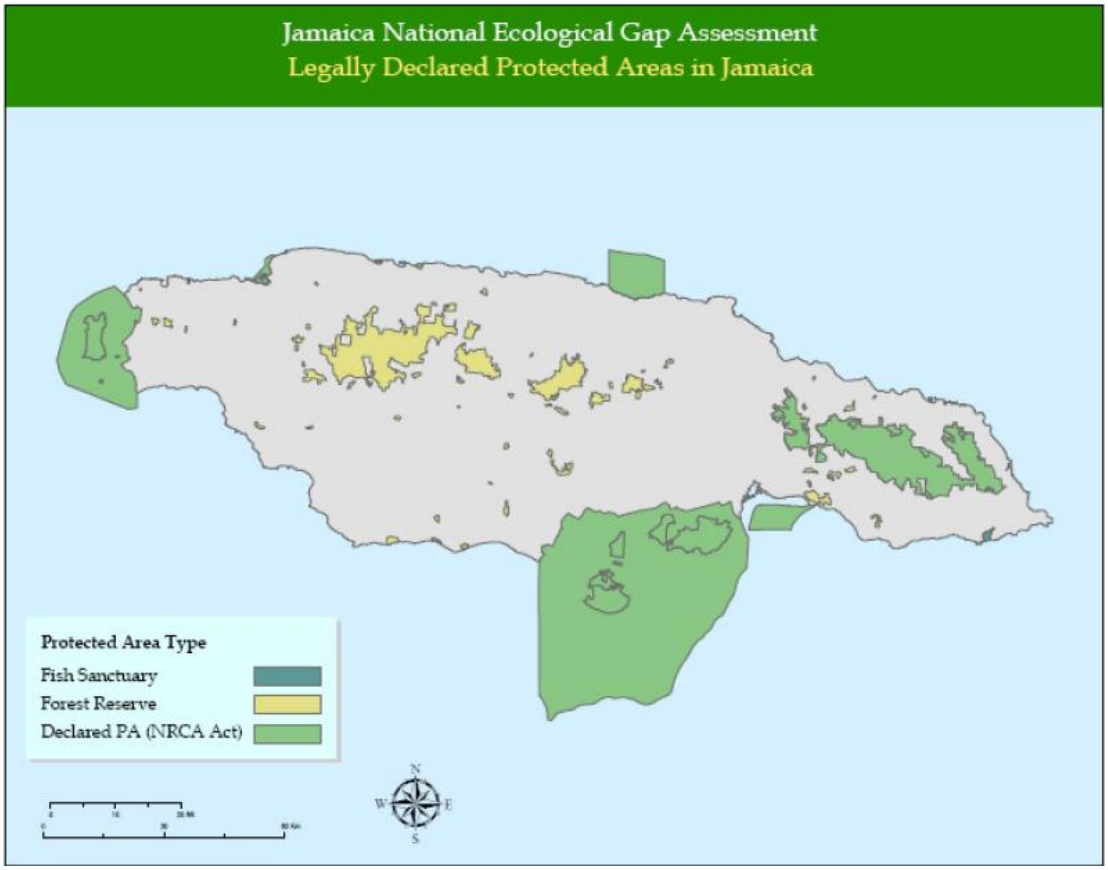

Figure 12. The distribution of existing protected areas, including fish sanctuaries, forest reserves and declared protected areas. Source: NEPA (2009).

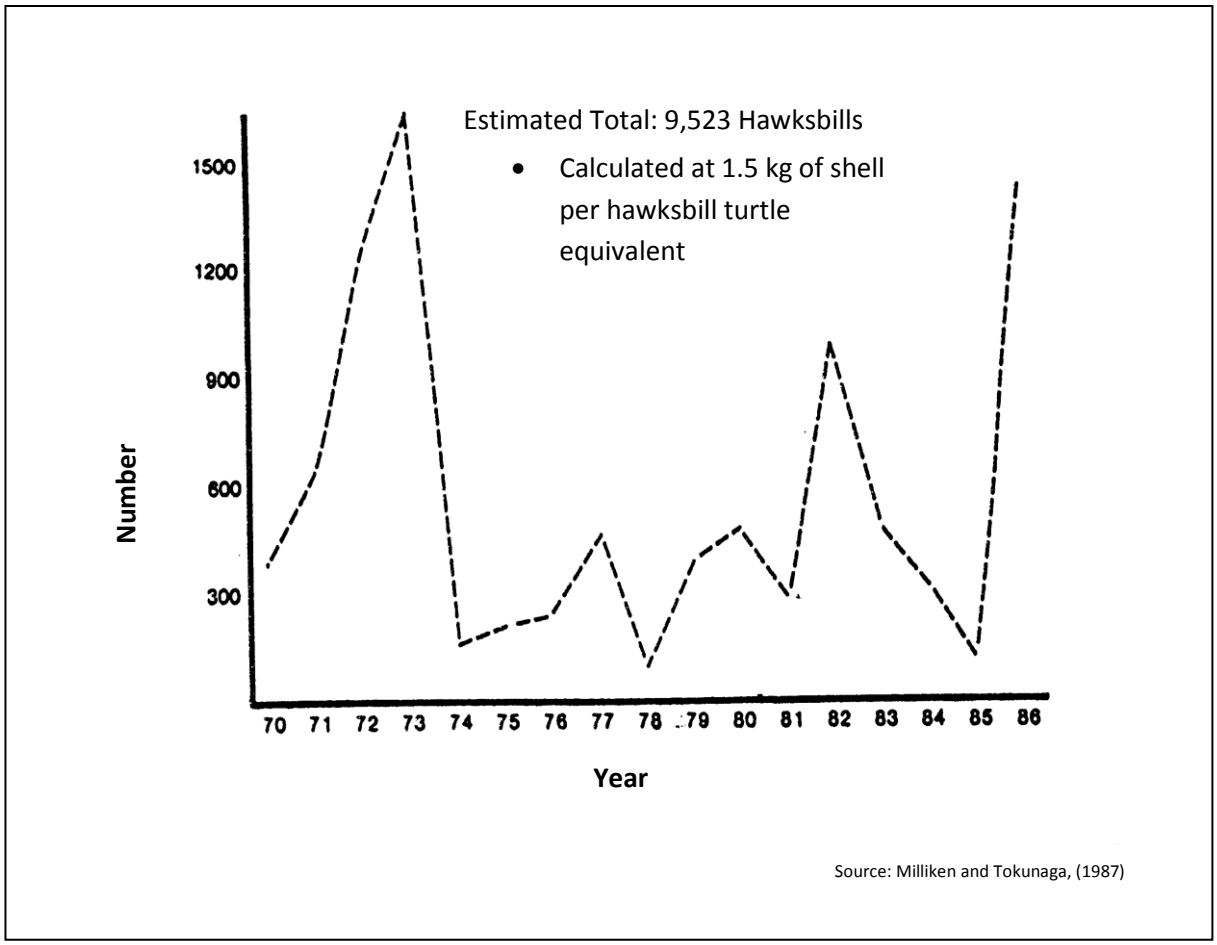

Figure 13. Shell exports from Jamaica to Japan, 1970-1986. Source: Milliken and Tokunaga (1987).

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