

SEA TURTLE RECOVERY ACTION PLAN FOR ST. VINCENT AND THE GRENADINES



WIDECAST

Wider Caribbean Sea Turtle Conservation Network

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PREFACE

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

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

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

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LIST OF ABBREVIATIONS

CCA	Caribbean Conservation Association
CFRAMP	Caricom Fisheries Resource Assessment Management Programme
CITES	Convention on International Trade in Endangered Species
ECNAMP	Eastern Caribbean Natural Areas Management Programme
FAO	Food and Agriculture Organization (of the United Nations)
IRF	Island Resources Foundation
IUCN	World Conservation Union
JEMS	Junction Enhams, McCarthy and Stubbs
MAREMP	Marine Resource and Environmental Management Programme
MARPOL	International Convention for the Prevention of Pollution from Ships
OECS	Organization of Eastern Caribbean States
SPAW Protocol	Protocol concerning Specially Protected Areas and Wildlife (1983 Cartagena Convention)
UNEP	United Nations Environment Programme
WIDECAST	Wider Caribbean Sea Turtle Conservation Network
YES	Youth Environment Service

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ABSTRACT

The multi-island state of St. Vincent and the Grenadines lies between 61°05' and 61°30' W latitude, and 12°30' and 13°25' N longitude. Four species of sea turtles, all internationally classified as endangered or vulnerable species, nest on the beaches of St. Vincent and the Grenadines. The most common is the hawksbill (*Eretmochelys imbricata*), with smaller numbers of green turtles (*Chelonia mydas*) and leatherbacks (*Dermochelys coriacea*) and, much less frequently, loggerheads (*Caretta caretta*). In addition, juvenile and subadult green turtles, hawksbills and occasionally loggerhead turtles can be seen around the islands throughout the year (non-nesting adults are rare). Green turtles are generally more abundant around the Grenadines than around St. Vincent, whilst hawksbills are more common around St. Vincent. This may be because there is more preferred green turtle habitat (i.e., sea grass and algal beds) around the Grenadine islands than around St. Vincent. The leatherback is not a resident species; sightings are restricted to adult females during the nesting season (April-July).

The islands have a history of sea turtle exploitation dating back to the pre-Columbus era. However, it was not until the early colonial period that large numbers of green and hawksbill turtles were harvested, primarily for export of meat and shell to Europe. As the population of St. Vincent and the Grenadines grew following colonisation, sea turtle meat increased in importance as a local source of protein. Today, no fishermen rely solely on sea turtles for income, but there is no denying that there is an active market for any meat (or eggs) that comes available. Until recently, this was also true for sea turtle shell. The consequence of hundreds of years of exploitation is a widely acknowledged decline in the abundance of sea turtles. The decline has implications not only for the livelihoods of fishermen, but also for the developing tourist industry. Tourism in the Grenadines, in particular, is dependent on clean seas and abundant marine life. Sea turtles are an important component of the marine environment, and their rarity is already being noticed by those involved in promoting water-sports tourism. Sea turtles are the central attractions of eco-tourism initiatives elsewhere in the Caribbean. The potential for similar programmes in St. Vincent and the Grenadines can only be realised if populations are protected and allowed to recover.

At present, all species of sea turtle are harvested (in and out of season) either on the beach or in the water, using turtle nets (4-inch mesh gill nets) or spearguns (many of which are unlicensed). Apart from the catch by resident islanders in the Grenadines, many turtles are also taken by fishermen (primarily from Bequia) during "island-hopping" fishing trips which target lobster and conch. Many of the green turtles caught around the Grenadines are either sold locally, or transported to restaurants and hotels on neighbouring islands (often in contravention of CITES). Hawksbill and green turtle shells are often sold to passing yachts. Although no official records are kept, St. Vincent export statistics indicate that shell from over 1,000 adult hawksbills was sent to Japan between 1983-1990. The Japanese market for the shell and the relative ease with which hawksbills can be caught relative to other turtles are major factors contributing to the scarcity of this species nesting on the islands today compared to several decades ago. Since Japan declared a zero quota on the import of hawksbill shell in December 1992, the legal export market has effectively disappeared (although inter-island black markets remain).

For sea turtle abundance to return around St. Vincent and the Grenadines, two approaches must be taken. First, sea turtles must be given greater protection. Current legislation is not adequate to permit their recovery. For instance, although there is a closed season between 1 March and 31 July, this does not encompass the peak breeding season for the hawksbill. Until a total moratorium on sea turtle harvest can be put in place, it is a strong recommendation of this Action Plan that Fisheries legislation be amended to give full protection to all species whilst nesting (this will necessitate extending the closed season to 1 April-30 November to protect mating pairs and females approaching and leaving nesting beaches), total protection for hawksbills, and maximum (as opposed to minimum) size limits during the open season. The existing full protection for eggs in the 1987 Fisheries Regulations should be retained. Secondly, important nesting and feeding habitat must be identified and adequately protected. Data on numbers of sea turtles nesting in St. Vincent and the Grenadines, as well as the distribution and abundance of foraging turtles, are virtually nonexistent. Information collected in this regard will allow selection of Index Beaches and foraging areas where long-term monitoring programmes can be initiated to quantify numbers of turtles, nests, and nest success. In those cases where critical habitats already fall within marine conservation areas or wildlife reserves, more resources are needed to ensure that regulations governing activities within these areas are enforced.

Tourism has not yet developed to the extent that it has in many other Caribbean countries, and thus many of the adverse environmental effects of tourism have not yet been felt. There is ample opportunity to take natural resources, such as sea turtles and their habitats, into account when designing new developments. By conserving its resource base, St. Vincent and the Grenadines will be in a better position to sustain its development. This Action Plan suggests regulatory guidelines that will enable development of the coastal zone to proceed without impacting negatively on sea turtles. Healthy coral reefs and sea grass beds not only benefit sea turtles, but also enhance important near shore fisheries as well as the growing tourist industry. The Government's foresight in this regard is indicated by legislation enabling critical habitats to be fully protected within marine conservation areas, wildlife reserves, forest reserves and, following passage of the National Parks Act, within national parks also. However, the effectiveness of the concept depends on the Government assigning the resources necessary for proper management (including enforcing regulations), and by refusing to allow development with adverse environmental implications to occur in these protected areas. We propose that independent Environmental Impact Assessments become an obligatory component of the development process to enable the government and non-government communities to review the advantages (often short-term) and disadvantages (often long-term) of developments before permission is given to proceed.

A national Sea Turtle Conservation Programme is proposed to enhance public awareness of and participation in sea turtle conservation, monitor the abundance and distribution of sea turtle populations, and promote sustainable, non-consumptive exploitation of the sea turtle resource.

RESUMEN

El estado multi insular de San Vicente y las Granadinas se encuentra localizado entre los 61°05' y los 61°30' de latitud oeste, y los 12°30' y los 13°25' de longitud norte. En las playas de San Vicente y las Granadinas anidan cuatro especies de tortugas marinas, clasificadas todas internacionalmente como especies vulnerables o en peligro. La mas comun es la Carey (Eretmochelys imbricata), con numeros menores de tortugas Verdes del Atlantico (*Chelonia mydas*) y tortugas Laud o Tora (Dermochelys coriacea) y, con mucha menor frecuencia, tortugas Caguama o Cabezona (*Caretta caretta*). Ademas las juveniles y subadultas de las tortugas Verdes del Atlantico, las Carey y ocasionalmente las Caguama pueden verse alrededor de las islas a todo lo largo del ano (son raras las adultas que no anidan). Las tortugas Verdes son generalmente mas abundantes alrededor de las Granadinas que alrededor de San Vicente, mientras que las Carey son mas abundantes alrededor de San Vicente. Esto pudiera atribuirse al hecho de que existen mas habitats preferidos por la tortuga Verde (es decir, praderas de pastos marinos y de algas) alrededor de las islas Granadinas que alrededor de San Vicente. La Laud no es una especie residente; las que se han visto se limitan a hembras adultas durante la temporada de anidacion (abril-julio).

Las islas tienen una historia de explotación de la tortuga marina que se remonta a la era precolombina. Sin embargo, no fue sino hasta la primera epoca de la colonia que se recolectaron un gran numero de tortugas Verdes y Carey, principalmente para la exportacion a Europa de su carne y su caparazon. Al crecer la poblacion de San Vicente y las Granadinas con la colonizacion, la carne de tortuga crecio en importancia como fuente local de proteina. Hoy en dia, ningun pescador depende solamente de las tortugas para obtener ingresos, pero no se puede negar que existe un mercado activo para cualquier carne (o huevos) que se encuentren disponibles. Hasta hace poco, lo mismo se podia decir de la caparazon de la tortuga. La consecuencia de cientos de anos de explotacion es un descenso ampliamente reconocido en la abundancia de la tortuga marina. Este descenso en el numero de tortugas marinas acarrea implicaciones no solo para la subsistencia de los pescadores sino para la industria turistica en desarrollo. El turismo en las Granadinas, en particular, depende de las aguas limpias y la abundante vida marina. Las tortugas marinas constituyen un componente importante del medio marino, y su rareza ya se ha notado por aquellos involucrados en la promocion del turismo de deportes acuaticos. Las tortugas marinas son la atracción central de las iniciativas de ecoturismo en otros lugares del Caribe. El potencial para programas similares en San Vicente y las Granadinas solo podra hacerse realidad si se protegen las poblaciones y se les permite recuperarse.

En la actualidad todas las especies de tortugas marinas son aprovechadas (dentro y fuera de temporada) ya sea en la playa o en el agua, a menudo utilizando redes ilegales o harpones sin licencia. Fuera de la caza practicada por los residentes islenos en las Granadinas, muchas tortugas son cazadas por pescadores (principalmente de Bequia) durante viajes de pesca a traves de las islas, cuyo objetivo es la obtención de langosta y caracol. Muchas de las tortugas Verde que se cazan en las proximidades de las Granadinas se venden localmente, o se transportan a restaurantes y hoteles en las islas vecinas (a menudo en contravención al Convenio CITES). Los caparazones de las tortugas Carey y Verde del Atlantico se venden a menudo a los yates que pasan. Aunque no se conservan registros oficiales, las estadísticas de exportacion de San Vicente indican que entre 1983

y 1990 se envió a Japón el caparazón de más de 1,000 tortugas (adultos) Carey. El mercado japonés para el caparazón y la relativa facilidad con que se pueden cazar las tortugas Carey con relación a otras tortugas, son los factores principales que contribuyen hoy en día a la escasez de esta especie que anida en las islas si se compara con décadas anteriores. Desde que Japón declaró una cuota cero para la importación de caparazón de tortuga Carey en diciembre de 1992, el mercado de exportación legal ha desaparecido efectivamente (aunque permanece el mercado negro entre las islas).

Para que vuelva a haber abundancia de tortugas en San Vicente y las Granadinas, se deben tomar dos medidas. Primero, se le debe dar mayor protección a las tortugas. La legislación actual no es la adecuada para permitir la recuperación de las tortugas marinas. Por ejemplo, aunque existe veda del 1 de marzo al 31 de julio, esta no comprende la temporada de mayor reproducción para la tortuga Carey. Hasta que pueda entrar en vigor una moratoria del aprovechamiento de la tortuga marina, una de las recomendaciones más firmes de este Plan de Acción es que la Legislación sobre Pesca se enmiende para dar protección plena a todas las especies mientras anidan (será necesario que se extienda la veda del 1 de abril al 30 de noviembre), que las tortugas Carey gozen de protección plena, y que existan límites máximos de tamaño (en vez de mínimos) durante la temporada abierta. Debe conservarse la protección plena que existe para los huevos en el Reglamento de Pesca de 1987. En segundo lugar, deben identificarse y protegerse adecuadamente los principales hábitats de alimentación y anidación. Son prácticamente inexistentes los datos sobre cantidades de tortugas marinas que anidan en San Vicente y las Granadinas, así como la distribución y abundancia de las tortugas que se alimentan de forraje. La información recabada en este sentido permitirá la selección de playas y áreas de forraje donde pueden iniciarse programas de vigilancia a largo plazo con el fin de cuantificar los números de tortugas, nidos y anidaciones exitosas. En aquellos casos en los que hábitats críticos caen dentro de las áreas de conservación marina o de las reservas de vida silvestre, se necesitan más recursos para asegurar que entren en vigor las regulaciones que rigen las actividades dentro de estas áreas.

El turismo no se ha desarrollado todavía al grado en que se halla en muchos otros países del Caribe y, por lo tanto, muchos de los efectos ambientales adversos del turismo aun no se han hecho sentir. Existe amplia oportunidad para tomar en cuenta los recursos naturales, tales como tortugas marinas y sus hábitats, cuando se diseñan nuevos centros turísticos. Mediante la conservación de sus recursos básicos, San Vicente y las Granadinas se encontrará en una mejor posición hacia el desarrollo sostenible. Este Plan de Acción sugiere directrices reguladoras que permitan proceder con el desarrollo de la zona costera sin impactar negativamente sobre las tortugas marinas. Arrecifes coralinos y lechos de praderas marinas sanos no solo benefician a tortugas marinas, sino que también intensifican la pesca importante cercana a las costas, así como la creciente industria turística. La visión del Gobierno en este sentido se indica por medio de la legislación que permite la plena protección de los hábitats críticos dentro de las áreas de conservación marinas, reservas de vida silvestre, reservas forestales, así como dentro de los parques nacionales después de la aprobación de la Ley sobre Parques Naturales. Sin embargo, la efectividad del concepto depende de que el Gobierno destine los recursos necesarios para la gestión apropiada (incluso el cumplimiento de las regulaciones), y que se niegue a permitir el desarrollo que acarree implicaciones ambientales adversas en estas áreas protegidas. Proponemos que Evaluaciones de Impacto Ambi-

ental de caracter independiente se conviertan en un componente obligatorio de los procesos de desarrollo para que permitan a las comunidades gubernamentales y no gubernamentales revisar las ventajas (a menudo a corto plazo) y desventajas (a menudo a largo plazo) de los proyectos antes de que se les conceda permiso para proceder con su desarrollo.

Se propone un Programa Nacional para la Conservacion de la Tortuga Marina que intensifique la concientizacion publica y su participacion del publico en la conservacion de la tortuga marina, vigile la abundancia y distribucion de las poblaciones de tortugas marinas, y fomente la explotacion sostenible y no destructiva, ni de consumo de la tortuga marina como recurso.

RESUME

L'Etat de Saint-Vincent et les Grenadines, qui se compose de plusieurs îles, est situé entre les longitudes 61°05 et 61°30 ouest et les latitudes 12°30 et 13°25 nord. Quatre espèces de tortues marines, toutes classées comme menacées ou vulnérables, font leur nid sur les plages de Saint-Vincent et des Grenadines. La plus commune est la tortue à écaille (*Eretmochelys imbricata*), et en nombre moindre des tortues vertes (*Chelonia mydas*), des tortues luth (*Dermochelys coriacea*) et, beaucoup plus fréquemment, la tortue caouanne (*Caretta caretta*). De plus, les tortues vertes jeunes et jeunes adultes, les tortues à écaille et, de temps en temps, les tortues caouannes sont observées autour des îles toute l'année. Il est rare de trouver des adultes qui ne nidifient pas. Les tortues vertes sont en général plus abondantes autour des Grenadines tandis que les tortues à écaille se trouvent à Saint-Vincent. Ceci peut être attribué au fait que la tortue verte a des demeures bien plus préférées (comme par exemple, les herbiers, les bancs d'algues) aux environs des îles Grenadines plutôt qu'aux environs de St. Vincent. La tortue luth n'est pas une espèce résidente; sa présence se limite aux adultes femelles au cours de la saison de nidation allant d'avril à juillet.

Les îles ont une histoire d'exploitation de la tortue de mer qui remonte à l'époque pré-colombienne. Néanmoins, ce n'est qu'avant la période coloniale que de grands nombres de tortues vertes et de tortues à écaille ont été récoltées, surtout pour l'exportation de leur chair et de leur carapace en Europe. Au fur et à mesure que la population de Saint-Vincent et des Grenadines augmentait à la suite de la colonisation, la chair de la tortue de mer est devenue de plus en plus importante comme source de protéine. Aujourd'hui, les pêcheurs ne comptent pas uniquement sur le revenu découlant de la tortue marine, mais il n'y a aucun doute que le marché pour tous les types de chair (ou d'œufs) disponibles est toujours très actif. Jusqu'à très récemment, ceci était également vrai pour la carapace de la tortue marine. Les centaines d'années d'exploitation ont eu comme résultat la diminution du nombre de tortues marines ce qui a des implications non seulement pour les moyens d'existence des pêcheurs, mais aussi pour le développement du tourisme. Le tourisme, surtout aux Grenadines, dépend de mers propres et d'une vie marine abondante. Les tortues marines font partie intégrante du milieu marin et leur rareté est déjà très sentie par ceux qui sont chargés de la promotion du tourisme basé sur les sports marins. Les tortues de mer constituent l'attrait principal des initiatives d'écotourisme ailleurs dans les Caraïbes. Le potentiel des programmes similaires à Saint-Vincent et les Grenadines ne peut être réalisé que si les populations sont protégées et leur quantité reconstituée.

Actuellement, toutes les espèces de tortue sont récoltées (que les saisons soient ouvertes et fermées) sur la plage ou mer à l'aide de filets ou de fusils sous-marins illégaux. En plus des captures effectuées par les habitants des Grenadines, beaucoup de tortues sont prises également par des pêcheurs (le plus souvent de Bequia) au cours de leurs expéditions de pêche dans différentes îles à la recherche de homards et de lambis. Beaucoup des tortues vertes capturées dans les Grenadines sont vendues sur le marché local ou à des restaurants ou hôtels dans les îles avoisinantes (souvent en contravention avec la CITES). La carapace de la tortue à écaille et de la tortue verte est souvent vendue à des yachts qui passent. Bien qu'il n'ait pas de chiffres officiels sur les prises, les statistiques relatives à l'exportation provenant de Saint-Vincent indiquent que les carapaces de 1 000 tortues à écaille adultes ont été envoyées au Japon entre 1983 et 1990. Le marché japonais et

la facilite de la capture de la tortue a ecaille sont des facteurs importants qui contribuent a la reduction de cette espece en nidation dans les iles aujourd'hui par rapport a des decennies auparavant. Le marche legal pour ce produit a effectivement disparu (bien que le marche noir entre les iles persiste), depuis que le Japon a interdit l'importation en decembre 1992 de la carapace de la tortue a ecaille.

Pour retablir l'abondance des populations de tortue marine autour de Saint-Vincent et les Grenadines, deux approches sont a adopter. Premierement, il faut leur accorder une plus grande protection car la legislation actuelle n'est pas adequate pour assurer cette protection. Par exemple, bien qu'il existe une saison de fermeture allant du 1er mars au 31 juillet, celle-ci ne comprend pas la haute saison de nidation pour la tortue a ecaille. Jusqu'a la mise en place d'un moratoire sur la capture de la tortue a ecaille, il est vivement recommande dans le present plan d'action que la legislation relative a la peche soit modifiee afin d'accorder une protection totale a toutes les especes pendant leur nidation (ce qui impliquera la prolongation de la saison de fermeture jusqu'au 30 novembre). Le plan d'action recommande egalement une protection totale pour la tortue a ecaille et des limites de taille maximales (plutot que des limites minimales) pour les tortues capturees. La protection totale existante pour les oeufs dans le Reglement de 1987 sur la peche devraient etre retenues. Deuxiemement, des habitats importants de nidation et d'alimentation doivent etre identifies et proteges de facon efficace. Il y a tres peu de donnees sur le nombre de tortues marines qui font leur nid a Saint-Vincent et les Grenadines ainsi que sur la repartition et l'abondance des tortues qui s'y alimentent. Les informations ainsi recueillies faciliteront la selection de plages "temoins" appropriees et de zones d'alimentation ou des programmes de surveillance a long terme pourront etre mises en place afin d'etablir le nombre de tortues de nids et de jeunes tortues nees. Dans les cas ou les habitats importants se trouvent deja dans les zones de protection marine ou dans les sanctuaires de vie sauvage, des ressources supplementaires sont necessaires pour s'assurer que la reglementation relative aux activites dans ces zones est appliquee.

Le developpement du tourisme n'a pas encore atteint celui des autres pays des Caraibes et par consequent, beaucoup des effets negatifs sur l'environnement ne sont pas encore ressentis. Il est donc possible de prendre en compte les ressources naturelles, telles que les tortues de mer et leurs habitats, lors de l'elaboration de nouveaux projets. En protegant ces ressources de base, Saint-Vincent et les Grenadines sera mieux place pour assurer un developpement durable. Le present plan d'action propose des lignes directrices qui permettront le developpement de la zone cotiere sans qu'il y ait d'effets negatifs sur les tortues marines. Des recifs coralliens et des bancs d'algues sains beneficent non seulement aux tortues marines, mais ameliorent egalement la peche pres des cotes ainsi que le tourisme croissant. La prevision du gouvernement a cet egard se traduit par une legislation qui permet aux habitats critiques d'etre totalement proteges dans les zones de protection marines, reserves de vie sauvage, reserves forestieres et, suite a l'approbation de l'Acte de Parcs Nationaux, dans les parcs nationaux aussi. Néanmoins, l'efficacite de ce concept depend de l'allocation par le gouvernement des ressources necessaires a une gestion adequate (y compris l'application des reglements), et de l'interdiction a toute exploitation ayant des implications negatives dans ces zones protegees. Nous proposons que des etudes independantes d'impact sur l'environnement soient des composantes obligatoires du processus du developpement pour permettre aux communautés gouvernementales et non gouvernementales de passer en revue les

avantages (souvent a court terme) et les inconvenients (souvent a long terme) des projets proposes avant qu'ils soient definitivement acceptes.

Un Programme national pour la protection des tortues marines a ete propose qui visera a ameliorer la sensibilisation du public et leur participation a la protection de la tortue, controlera l'abondance et la distribution des tortues marines et encouragera l'exploitation durable et rationnelle des ressources de tortues marines.

I. INTRODUCTION

St. Vincent and the Grenadines is a multi-island state which lies between 61°05'-61°30' W and 12°30'-13°5' N (Figure 1), covers a total land area of 344.6 km², and supports a human population of about 125,000. St. Vincent is the largest island in the nation. The Grenadines once belonged wholly to Grenada, but they were divided by Great Britain in 1791 for administrative purposes. The northernmost Grenadines became part of St. Vincent and the southernmost islands (including and south of Petit Martinique) remained with Grenada. The islands of St. Vincent and the Grenadines were originally inhabited by the Arawaks, who were dispossessed by a group of South American Indians known as Caribs. These Caribs supplied European settlers with foodstuffs in exchange for manufactured items. Among these food items was sea turtle meat, which apparently was a favorite among the French and English settlers (Adams, 1980). One of the Grenadine islands, Canouan, was named by the Caribs for its sea turtles, suggesting their particular abundance around this island.

European historians visiting these islands in the 17th and 18th centuries observed that Carib males were skilled fishermen, excellent divers, and fearless seamen. They caught turtles by turning the nesting female on her back, or by harpooning them at sea with a retrievable wooden spear (Adams, 1980). These historians indicated that sea turtles were abundant, of large size, and easy to catch. As a result, they became an important nutritional staple for slaves, poor settlers and seamen in the islands during the colonial period. Two species were extensively exploited: the green turtle, "tortue franché" (*Chelonia mydas*) and the hawksbill turtle, "caret" (*Eretmochelys imbricata*). The most popular for eating was the green turtle. The meat of the hawksbill was less prized but its hard translucent shell was valued for veneers and toilet articles. The hawksbill shell was also used to fashion fish hooks by the Caribs.

Throughout the early colonial period, large quantities of live green turtles and hawksbill shell were exported to Western Europe. Though few, turtle fishermen formed the vanguard of European settlement in the Caribbean. Virtually all of the Lesser Antilles (including St. Vincent and the Grenadines) were inhabited by European fishermen before the arrival of the planters. In the 17th century French fishermen catching turtles in the Grenadines were known as "verrards", and they caught turtles at sea using a 2.5 m harpoon called a "varre" (J. Daudin, pers. comm., 1993). Thus sea turtle catching is among the oldest forms of commercial fishing in the Grenadines. By the late 18th century, rapid population increases created an increased local demand for turtle meat. While the meat was mainly consumed domestically, the shell was exported. By the 20th century, several Caribbean islands, including Trinidad and Barbados, were receiving turtle products from St. Vincent. Annual export of turtle shell averaged 500 lb (227 kg) during the first quarter of the present century (Adams, 1980).

The commercial trade resulted in significant declines in the abundance of local sea turtle stocks, prompting the passage of legislation in 1901 to protect sea turtles. This was ten years after Grenada had passed similar legislation. Despite legal protection, enforcement was problematic (Adams, 1980). At the present time, three centuries of unrelenting exploitation of sea turtles have left their mark. Fishermen today continue to report declining numbers, yet the harvest persists. Turtle meat is widely consumed locally and, until recently, much of the shell was exported to Japan

(though not to the extent that Japanese Customs data suggest, see section 3.3). Sea turtle conservation is a challenge in St. Vincent and the Grenadines, not only because of the economic benefits derived from turtle fishing, but also because "old habits die hard". Local people who make their living by fishing have simple rules. To them, the sea will always provide for their needs. This is particularly true in the Grenadines where fishing, tourism or both are the life blood of most people. The issue here is not simply one of resource exploitation, but also of culture and heritage.

Despite the challenges, it is increasingly clear that some form of comprehensive protection is needed. Sea turtles are declining throughout the Caribbean and the world and, while declines cannot be measured with precision in St. Vincent and the Grenadines, the same trends are evident here. If the turtles disappear, this will have profound implications for the livelihoods of fishermen and those who have traditionally benefitted from sea turtle exploitation. Furthermore, living sea turtles now have a potentially important role to play in the development of the tourism industry, the economic benefits of which will spread further than could be achieved solely from fishing for sea turtles. Tourism in the Grenadines, in particular, is dependent on a healthy marine environment and abundant marine life. In this context, it is disturbing that during interviews conducted for this Action Plan, a dive operator based in Union Island reported that he had not seen a single turtle whilst diving around Union and in the Tobago Cays in the previous six months, and a turtle fisherman reported that he had not heard of a single nest in Mustique since 1990.

As a result of the efforts of WIDECAST and other organizations, the plight of sea turtles is increasingly recognised in the Wider Caribbean. One result of this increased awareness was the June 1991 unanimous decision by the Conference of Plenipotentiaries for the Adoption of the Annexes to the Protocol concerning Specially Protected Areas and Wildlife (SPA) in the Wider Caribbean Region to include all six Caribbean-occurring species of sea turtle on Annex II, offering them full protection from harvest (direct and incidental), commercial trade, and, to the extent possible, "disturbance", particularly during breeding (Eckert, 1991; UNEP, 1991). St. Vincent and the Grenadines has recently signed this Protocol (see section 4.32). The future for residents of St. Vincent and the Grenadines lies in formulating and adopting creative alternatives to the harvest of depleted species so that the current needs of the people can be met, whilst at the same time these and other coastal resources which are so important to the development of the nation are not irreparably degraded.

This comprehensive Sea Turtle Recovery Action Plan is designed to provide policy-makers and non-government groups with detailed information requisite to make informed conservation decisions. This Action Plan is one of a region-wide series developed by WIDECAST and is tailored specifically to the circumstances of St. Vincent and the Grenadines. Our intentions in developing the plan are to summarise the status and distribution of local sea turtle populations, examine threats to their survival, and recommend conservation and management actions. The Action Plan is well suited to serve as a basis for the sea turtle section(s) of the national Fisheries Management Plan, currently being drafted by the Fisheries Division (in conjunction with CFRAMP and the OECS Fisheries Unit), as called for by the OECS Harmonised Fisheries initiative. The consensus is that sea turtles in St. Vincent and the Grenadines are fewer today than at any time during recorded history. In order to promote the survival of remaining stocks, a detailed national Sea Turtle Conservation Programme is proposed (see section 4.6).

II. STATUS AND DISTRIBUTION OF SEA TURTLES IN ST. VINCENT

In the Caribbean Sea and Gulf of Mexico, five species of sea turtle are recognized as *Endangered* and a sixth, the loggerhead turtle, as *Vulnerable* by the World Conservation Union (IUCN) (Groombridge, 1982). Sea turtles are harvested throughout this region for meat, shell, oil, skins, and eggs. In addition, they are accidentally captured in active or abandoned fishing gear, resulting in the death of tens of thousands of turtles each year (e.g., National Research Council, 1990). Oil spills, chemical waste and persistent plastic debris, as well as the ongoing degradation of important nesting beaches and feeding grounds, also threaten the continued existence of Wider Caribbean populations.

Data on sea turtles in St. Vincent and the Grenadines are almost non-existent. There has never been an in-depth study of these animals under our jurisdiction, and there are no monitoring programmes. A few details are known, however, such as the fact that four species occur (some only on a seasonal basis), populations are depleted, and no fishermen fish exclusively for sea turtles. Most catches are made in the Grenadines, and especially in the Southern Grenadines where turtle meat supplements the otherwise limited variety of protein in the diet and provides a source of income when sold to hotel restaurants (see section 3.3). The following sections provide biological background on the species present, as well as summarise available published and anecdotal data. Please refer to Figures 2a and 2b for locations (e.g., nesting beaches) cited in the text.

2.1 Caretta caretta, Loggerhead Sea Turtle

The adult loggerhead is recognised by its large head, thick and somewhat tapered carapace (=shell), five pair of lateral plates (=scutes) on the carapace (Figure 3), and typically heavy infestation of barnacles, mostly on the head and carapace. The colour is reddish-brown, sometimes tinted with orange. Hatchlings are uniformly brown or grey. The large head and strong jaws, for which the species is named, are necessary adaptations to a diet of mollusks and hard-shelled crabs. Jellyfish, small fishes, and plants are also sometimes eaten (summarised by Dodd, 1988). Pritchard et al. (1983) report that adults reach a size of 120 cm (straightline carapace length) and weigh up to 200 kg (440 lb). Based on data collected elsewhere in the Western Atlantic, each female would be expected to deposit 1-6 clutches averaging 120 eggs each at 12-14 day intervals during the nesting season (summarised by Dodd, 1988). Individual turtles do not generally nest every year. Most females return to the nesting beach every second or third year, although remigration intervals as long as seven years have been reported (Richardson et al., 1978; Bjorndal et al., 1983).

Loggerheads have a wide oceanic distribution. In the Atlantic Ocean, 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 located in temperate latitudes, with the greatest numbers of nesting females recorded in Florida (USA) and Masirah Island (Oman). An estimated 14,150 females nest annually on the Atlantic coast of Florida (Murphy and Hopkins, 1984; Ehrhart, 1989), where the peak nesting season extends from mid-May to mid-July. Moderate nesting populations are also found in Mexico, where Gulf and Caribbean coasts support some 380-400 females per annum (Ehrhart, 1989). Loggerheads nest occasionally during the summer months

on islands in the eastern Caribbean (Rebel, 1974; Dodd, 1988; Ehrhart, 1989). There are only two documented local nestings, both on Palm Island in the Grenadines (verified by Carr et al., 1982, because hatchlings were retained in captivity). In addition, there are verbal reports of nesting on Mahault beach in Canouan. The turtle is sometimes sighted in offshore waters, mainly in the Atlantic Ocean between the months of January and June (Morris, 1987). These sightings are made by local fishermen whose activities on the continental shelf are limited to those months, hence the data should not be construed to indicate that the species is not present in the latter half of the year.

No detailed size or weight data are available for St. Vincent and the Grenadines, nor is there any information concerning size classes present or seasonal distribution and abundance. Carr et al. (1982) noted that subadult loggerheads, seldom less than 70-80 lb (32-36 kg), were "very common" in the Grenadines and that juveniles were not seen. In contrast, Rainey and Pritchard (1974) reported that very few loggerheads were caught in the central and southern Lesser Antilles. It is difficult to reconcile these observations. During interviews conducted for this Action Plan, we could not confirm that loggerheads of any size had ever been "very common" in Grenadine waters. At the present time loggerheads (known locally in some areas as hammerheads) are rarely seen in the Grenadines. As is the case in nearby Barbados (Horrocks, 1992), loggerheads are considerably rarer than either the green turtle or the hawksbill. Contemporary data indicate that all four locally-occurring sea turtles are harvested, including an occasional loggerhead.

2.2 Chelonia mydas, Green Sea Turtle

The genus Chelonia is readily distinguished from other sea turtle genera by a single pair of prefrontal scales (two large scales between the eyes). With very rare exceptions, the carapace (=shell) has four pairs of lateral scutes and five vertebral scutes (Figure 3). The carapace is light to dark brown, sometimes shaded with olive, with radiating wavy or mottled markings of darker colour or with large blotches of dark brown. The plastron (=underbelly) is whitish to light yellow. The upper surfaces of the legs and tail are coloured like the shell above and are yellowish white beneath (Carr, 1952). In contrast to the hawksbill turtle (section 2.4), the carapace scutes do not overlap one another. The carapace is generally devoid of barnacles. Green turtles can attain weights of 230 kg (about 550 lb) (Pritchard et al., 1983) and mature adults measure 95-120 cm straightline carapace length (Bjorndal and Carr, 1989). Hatchlings are distinct in that they are jet-black above and pure white on their underbellies.

This species is recorded nesting on St. Vincent and in the Grenadines (Morris, 1984), but occurrences are rare. Indeed, folklore has it that their tracks are seldom seen and their nests seldom found because "the females nest in the surf" (Canouan fisherman, pers. comm., 1993). The nesting season appears to extend from April to August (see section 4.112 for details). Both juvenile and adult green turtles are present year around along the west coast of St. Vincent, "but not in substantial numbers [and] hawksbills are more numerous" (Carr et al., 1982). The opposite is true in the Grenadines, where green turtles are more abundant than hawksbills (J. Laidlow (Canouan), D. Ollivierre (Union), pers. comm., 1993). Most turtles are taken at sea in turtle nets, by spear-guns, by a noose (loop) attached to a pole and line, on the beach, or opportunistically while trolling offshore for large pelagic fishes (Morris, 1987; L. Ollivierre, D. Ollivierre, pers. comm., 1993). Based

on questionnaires and interviews with fishermen, Morris (1987) concluded that there has been a decline in numbers of this species in the waters of St. Vincent and the Grenadines, although they are still quite common relative to other species around the Grenadines (J. Laidlow, D. Ollivierre, pers. comm., 1993).

Green turtles are herbivores and in the Caribbean they feed primarily on the sea grass Thalassia testudinum (e.g., Bjorndal, 1982b). Many of the Grenadine Islands have extensive turtle grass meadows and algal beds, perhaps explaining the relative abundance of green turtles compared to hawksbills around these islands. Green turtles are also reported from areas of sea grass/algal beds around St. Vincent (e.g., Blue Lagoon on the southwest coast). Studies indicate that individual turtles maintain "feeding scars" by returning to the same area of sea grass meadow to forage everyday (e.g., Ogden et al., 1983). The scars are maintained by regular cropping for several months and the new growth, rich in nutrients and low in lignin, is preferred. When the cropped grasses show signs of stress (blade thinning, increased distance between blades), the turtle abandons the scar and moves on to forage in another area. Individual turtles can be sighted in the same area for many months, and sometimes several years (based on capture-recapture studies in the U. S. Virgin Islands), but green turtles are highly migratory and during their subadult years they may travel several thousand kilometres and feed in many different Caribbean nations. Green turtles require 25-35 years to reach sexual maturity (Frazer and Ladner, 1986).

The following text is taken from Rebel (1974), who based his information on personal communication from L. Errol Ollivierre. "The fishing season lasts for eight months. During the closed season (May through August) [N.B. today the season is closed 1 March-31 July, see section 4.21], catching turtles and removing eggs are prohibited. Green and hawksbill turtles are the only species on which the fishery is based; other species are rarely caught. ... No fishermen are engaged in the turtle fishery on a full-time basis, so estimating the number of individuals involved is difficult. Most of the turtles are caught with turtle nets, but some hawksbills are turned while nesting. About 65-70% of the total catch comes from the island of Bequia." Fewer turtles are now caught around Bequia than in former days and Bequian fishermen now fish throughout the Grenadines as far south as Petit St. Vincent, over periods lasting several months. They sell turtle meat and shells (both green and hawksbill) locally to islanders or to passing yachts, or to boats that export products to Martinique (see section 3.3).

2.3 Dermochelys coriacea, Leatherback Sea Turtle

The leatherback or "river turtle", the largest of the marine turtles, is known to nest in St. Vincent and the Grenadines, particularly on the high energy Atlantic beaches of the east and southeast coast of mainland St. Vincent (Morris, 1984). Nesting is also reported occasionally from the leeward (west) coast of St. Vincent (Carr et al., 1982; Morris, 1984); see section 4.112 for details. In the Grenadines, leatherbacks have been reported to nest "occasionally" in Pasture Bay, Mustique and Mahault Bay, Canouan. A female was turned on Grand Bay beach, Canouan in June 1993. Sightings of adults have also been made at sea both on the Atlantic and Caribbean side of mainland St. Vincent. They are sometimes harpooned in deep waters by pilot whale (Globicephala macrorhynchus) fishermen from Barrouallie (Carr et al., 1982). Leatherback meat is not favoured

because of its oily nature and "fresh" smell. However, once salted it apparently tastes similar or better than the meat of humpback whales (Megaptera novaeangliae), a meat which is very popular with the people of St. Vincent and the Grenadines (S. Laidlow, pers. comm., 1993).

Juveniles have never been reported, but two specimens (19 cm and 28.5 cm straightline carapace length) have washed ashore in neighbouring Barbados (Horrocks, 1987, 1992). Adults are probably seasonal visitors. Local fishermen associate them with periods of heavy flow from the Orinoco River in Venezuela (Carr et al., 1982). Some Vincentian fishermen believe that leatherbacks live in rivers, and are washed into the sea after heavy rains. This is perhaps the origin of the local name, "river turtle". In reality, however, the leatherback is entirely marine in habit and does not frequent freshwater rivers. The scenario in other parts of the Caribbean, and it is most likely true for St. Vincent as well, is that the gravid females leave their foraging grounds in northern latitudes (North Atlantic waters off Canada and the USA) and arrive in the Caribbean each year between February and July to lay their eggs (cf. Eckert and Eckert, 1988).

Leatherbacks are easily identified because of their great size (250-500 kg, or 550-1100 lb); males sometimes exceed 900 kg (2000 lb) (Morgan, 1989). The leatherback lacks a hard shell and its smooth, black skin is spotted with white. The moderately flexible carapace is raised into seven prominent ridges and is strongly tapered to enhance streamlining. Powerful flippers extend nearly the length of the body. Nesting females usually measure 130-165 cm straightline carapace length (summarised by Eckert, 1992). Hatchlings are distinct in that they are entirely black with rows of small white scales extending head to tail; the underbelly is mottled black and white. Clutch size and frequency are unknown for St. Vincent and the Grenadines, but studies elsewhere in the eastern Caribbean indicate that 80-90 yolked eggs are generally laid per clutch, an average of 5-7 clutches are laid per season (March-July) at 9-10 day intervals and females return to the nesting beach every 2-4 years (Tucker, 1989; Eckert and Eckert, 1990). Age at maturity and life span are unknown.

Leatherbacks are known to feed primarily on jellyfish and other soft-bodied prey (Hartog and van Nierop, 1984; Davenport and Balazs, 1991). The turtles are deep-diving in the Caribbean, with some dives exceeding 1000 m in depth (Eckert et al., 1986, 1989). Eckert et al. (1989) proposed that interesting dive behaviour may reflect nocturnal feeding on vertically migrating zooplankton, chiefly siphonophore and salp colonies. Exceptionally deep dives may represent predator escape tactics since adults are preyed upon by killer whales (Orcinus orca) and other large oceanic predators. Caldwell and Caldwell (1969) reported that three killer whales taken simultaneously by a commercial fishing boat on 13 May 1968 off the leeward side of St. Vincent contained pieces of leatherback turtle in their stomachs. Deep diving behaviour may explain why leatherbacks are so seldom seen offshore. At the present time, neither the behaviour nor the distribution of leatherbacks in local waters has been satisfactorily quantified.

2.4 Eretmochelys imbricata, Hawksbill Sea Turtle

This species is the most common nester both on St. Vincent and throughout the Grenadines. The turtle is often called "oxbill", a corruption of the name hawksbill. The hawksbill is distinguished by a narrow, pointed beak with which it presumably pries sponges and other soft-bodied invertebrates from coral reefs. The carapace is often posteriorly serrated and the carapace scutes

overlap, like shingles on a roof (Figure 3). Adults rarely exceed 80 kg (176 lb) and a straight carapace length of about 90 cm (Pritchard et al., 1983). Bright mottled colouration (brown, orange, gold) is common in juveniles and adults. Hatchlings are uniformly reddish-brown, brown, or grey above and below. Preliminary studies of growth rate have been undertaken in Caribbean waters, but age at maturity is unknown [N.B. studies in Australia suggest that maturity is reached only after 30-plus years; C. Limpus, Queensland Turtle Research, pers. comm., 1992]. The turtle specialises on sponges in the Caribbean. Sponges contributed 95.3% of the total dry mass of all food items in digestive tract samples from 61 animals from seven Caribbean countries (Meylan, 1988). Hawksbills of all sizes are present year around, particularly along the west coast of St. Vincent, "but not in substantial numbers"; fewer are encountered in the Grenadines where green turtles predominate in nearshore waters (Carr et al., 1982).

According to Morris (1987), the nesting season extends from March to September. However, recent discussions with fishermen and other residents in Union Island and Canouan suggest that nesting peaks in September-October and continues into December (R. Charters, D. Ollivierre, pers. comm., 1993). Clearly, survey data are needed to resolve this important question. Carr et al. (1982) concluded that hawksbills were the predominant nesters in St. Vincent, emerging "on nearly every stretch of beach, but everywhere in reduced numbers." Nesting is also reported from the Grenadines (see section 4.112). Quantitative data are not sufficient to determine which beaches are most important. Behavioural data are lacking, but there is no reason to believe that nesting patterns and nesting seasons for this species in St. Vincent should differ significantly from the situation in neighbouring Barbados, 160 km to the east. Hawksbills in Barbados deposit an average of 127 eggs per clutch (Horrocks and Scott, 1991) and the nesting season peaks June to August (Horrocks, 1992). In Antigua, an intensive tagging programme has shown that hawksbills typically nest 4-6 times per year at intervals of approximately 14 days (Corliss et al., 1989). It is likely that individual turtles do not nest every year, but rather every 2-5 years.

Hawksbills are considered easier turtles to catch than green turtles (D. Ollivierre, pers. comm., 1993), both because they nest in greater numbers than green turtles and because they are slower and easier to approach underwater than are green turtles. The meat is eaten locally, although one restaurateur reported that it was generally too tough to sell to tourists in his restaurant (L. Baptiste, pers. comm., 1993). The shells are often polished and sold locally to passing yachts (see section 3.3). Historically, St. Vincent has exported hawksbill shell to Europe, Asia, and to other Caribbean islands. For example, in the early 1970's approximately 1,500 lb (680 kg) of hawksbill shell, derived from hawksbills caught at sea and on the beach, were exported to St. Lucia each year (Rebel, 1974). According to Milliken and Tokunaga (1987), St. Vincent has been a significant supplier of raw hawksbill shell (tortoiseshell, or 'bekko') to Japan in recent decades (see section 3.3).

2.5 Lepidochelys kempi, Kemp's Ridley Sea Turtle

The Kemp's ridley is confined to the Gulf of Mexico and the temperate northern Atlantic. Thus it does not nest in St. Vincent and the Grenadines, and has never been documented in these waters. This diminutive turtle is grey in colour when immature and primarily olive green as an adult (Pritchard et al., 1983). According to Ross et al. (1989), adults weigh 60-90 lb (27-41 kg)

and have a shell length of 23-30 inches (58-76 cm). The carapace is round, often as wide as it is long, and the scutes do not overlap each other (cf. hawksbill turtles, section 2.4). The species is carnivorous and eats mostly crabs, but also preys upon other crustaceans, shellfish, jellyfish, sea urchins, starfish, and fish. A single nesting ground remains in the Wider Caribbean, and that is at Rancho Nuevo in the state of Tamaulipas, Mexico. 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 have reduced the species to fewer than 500 nesting females per year (R. Byles, U. S. Fish and Wildlife Service, pers. comm., 1993).

2.6 Lepidochelys olivacea, Olive Ridley Sea Turtle

This species is not known to nest in St. Vincent and the Grenadines, and has never been documented in these waters. However, nesting occurs in the southernmost nations of the Wider Caribbean, notably in Suriname but with diffuse nesting in northwest Guyana and in French Guiana (Reichart, 1989). It is therefore possible that olive ridleys pass through the waters of St. Vincent and the Grenadines occasionally. They are a comparatively small turtle, similar in appearance to Kemp's ridleys, and rarely exceed 45 kg (100 lb) (Pritchard et al., 1983). Olive ridleys nesting at Eilanti, Suriname, range in size from 63-75 cm shell length, are grey-green to olive-green in colour, and can be distinguished from the other sea turtles by a relatively high and often asymmetrical number of lateral scutes, mostly 6-7 on each side and sometimes eight or nine (Schulz, 1975). Carapace scutes do not overlap one another (cf. hawksbills, section 2.4). Olive ridleys nesting in Suriname have declined considerably in recent years, from about 3,000 nests per year in the late 1960's to fewer than 500 nests per year today (Reichart and Fretey, 1993).

III. STRESSES ON SEA TURTLES IN ST. VINCENT

3.1 Destruction or Modification of Habitat

Habitat important to sea turtles includes nesting beaches, marine foraging grounds, and migratory corridors. Nesting beaches can be spoiled for sea turtles by coastal development that does not take into account the fact that artificial lighting can disorient adults and hatchlings (section 4.132), beach cleaning and general recreation can disrupt incubating eggs (section 4.134), and groynes and jetties built to stabilise beaches can instead lead to serious erosion (section 4.133). Foraging grounds consist mainly of sea grass beds, coral reefs, and hard bottom habitat in general. Sea grass areas and coral reefs are adversely affected by domestic, industrial, recreational and agricultural pollution (sections 4.143, 4.146), the indiscriminate dumping of garbage (section 4.144), anchoring and dredging (section 4.147), etc.

Since tourism development in St. Vincent and the Grenadines is not yet as widespread as in some other countries in the Caribbean, many potential nesting beach problems have so far been avoided. The majority of beaches in St. Vincent and the Grenadines are still undeveloped. However, there are several major developments under construction or being considered. These include Otley Hall Ship Yard, St. Vincent, Ashton Marina Project (Union Island), Bloody Bay Re-

sort (Union Island), and the Canouan Resort Project (Canouan). Land reclamation, hotel and villa construction, and golf courses are involved in some of these projects, and they will have implications for the integrity of sea turtle nesting and foraging habitats. A fisherman interviewed in Mustique was of the opinion that beachfront development had already contributed to the decline in nesting by sea turtles on this island.

Tourism development has been greatly facilitated in some of the islands by the recent construction or enlargement of airstrips (e.g., Canouan, Union, Bequia). Airports in Union and Bequia involved land reclamation and have resulted in some loss of sea turtle foraging habitat (e.g., coral reefs and sea grass beds). At Bequia, the entire airstrip is built on land reclaimed from the sea at the southern end of the island. During its construction, two sea turtles were trapped in large, nearshore enclosures constructed to receive fill-dirt, suggesting that foraging/ refuge habitat of sea turtles had been affected. At Union Island, the airstrip was lengthened and an area of coral reef was destroyed in the process. Unfortunately, since there are few quantitative data on the distribution and abundance of foraging habitat, especially sea grass (CCA/IRF, 1991), and of nesting/ foraging habitat use by sea turtles in the St. Vincent or the Grenadines, it is not possible to fully assess the impacts of these developments. It is important that adequate surveys be undertaken (see section 4.11) in time to assess the impacts of such development on sea turtle habitat in the future.

At present there is no evidence that beachfront lighting has led to the disorientation of nesting females or hatchlings (section 4.132). This may result from a combination of factors; namely, there are relatively few turtles nesting and many beaches are still undeveloped. It may also be that the problem exists, but has never been reported due to a lack of awareness on the part of hoteliers. The potential for lighting problems looms largest in the Grenadines; however, the North Leeward Highway currently under construction on St. Vincent may "open up" the leeward coast (which supports some sea turtle nesting and to date has not attracted beachfront hotels, probably due to poor roads) to coastal development. Another potentially severe disruption to nesting habitat, that of beach sand removal for construction purposes, may have affected countless numbers of nests over the years. This practice is now illegal without a permit, but continues on many isolated beaches with sufficient road access (section 4.131).

Littering of streams, road sides, and beaches is commonplace in St. Vincent and the Grenadines, as is at-sea dumping of garbage. Several islands (e.g., Canouan, Mayreau, Union Island) have no designated disposal sites (CCA/IRF, 1991); this encourages indiscriminate dumping on any unused areas of land. Improved facilities for garbage disposal are perceived by many Vincentians as the highest priority issue for improved environmental management in the country. Petroleum tar occurs on windward beaches throughout St. Vincent and the Grenadines, although the extent of the problem has not been quantified. Litter and tar in the sea pose potentially severe problems for sea turtles, since plastic bags and tar balls can be mistaken for food and ingested. On the beach, litter can create obstacles for newly emerged hatchlings or can prevent hatchlings from emerging at all. Organic matter fouls the sand and encourages fungal and bacterial contamination of eggs.

The amount of boat traffic has increased dramatically over the last ten years, particularly in the Grenadines. In 1983, there were 20,000 sea arrival visitors to the Grenadines compared to al-

most 60,000 in 1987 (CCA/IRF, 1991). Yachts (many registered under the French flag) frequently anchor off nesting beaches, and concern has been expressed that their presence may interfere with the activities of nesting females. However, yacht traffic peaks between January and April, outside of the primary nesting season. Perhaps of more consequence is anchor damage to the seabed (primarily to coral reefs) effected by yachts and cruise ships. Princess cruiseliners pull in to Saline Bay in Mayreau once a week during the tourist season, and Club Med, Windstar and Windjammer vessels anchor off the Tobago Cays and/or Palm Island. Disturbance of the seabed caused by the propellers of these ships may increase sedimentation and damage to foraging habitat, and may scare away turtles. 'Jet skis' and aquascooters, which are noisy and occasionally strike turtles elsewhere in the Caribbean, are banned.

In St. Vincent and the Grenadines there is still the opportunity to take important sea turtle habitat into account as the coastline is increasingly developed for commercial and tourist interests. One of the primary objectives of this Sea Turtle Recovery Action Plan is to highlight potential problems, as well as their solutions, and to recommend ways in which St. Vincent and the Grenadines can develop to its potential while not sacrificing its natural and cultural heritage, including its sea turtles.

3.2 Disease or Predation

There have been no studies to determine the extent to which disease affects the survival of sea turtles in St. Vincent and the Grenadines. However, there is no evidence of disease among sea turtles sighted locally. The tumor disease known as green turtle fibropapilloma which has affected green turtles (sometimes causing blindness and starvation) elsewhere in the Caribbean has not been reported in St. Vincent and the Grenadines. Fishermen should be alert to this disease. Tumors appear as whitish or gray growths, similar to warts, which can be 10 cm or more in diameter. In the southern regions of the Caribbean the disease is reported in Barbados (Horrocks, 1992), Curaçao (Sybesma, 1989), Panama (Jacobson, 1990), Trinidad (Jacobson, 1991), and Venezuela (Guada et al., 1991).

Ghost crabs (Ocypode quadrata) and dogs are likely beach predators on sea turtle eggs and hatchlings. In the Grenadines, predation on hatchlings by laughing gulls (Larus atricilla) has been observed, and it has been suggested that the nocturnal maniocou (=opossum) (Didelphis marsupialis) may be a predator of eggs and/or hatchlings (J. Daudin, pers. comm., 1993). Mongooses (Herpestes auropunctatus) are only found on St. Vincent, not in the Grenadines. Whether they are important sea turtle predators in St. Vincent is unknown, but they are well known to be sea turtle egg and hatchling predators in other Caribbean islands (e.g., Boulon, 1984; Zullo, 1986). Mongooses take eggs from nests broken open by the sea in neighbouring Barbados (Horrocks, 1992).

There is still an abundance of reef fish on the reefs around many of the islands of St. Vincent and the Grenadines, and these are likely predators on hatchlings once they have left the nest and entered the sea. Fishermen have reported observations of adult sea turtles with missing flippers, suggesting attacks by larger marine organisms, possibly sharks. Predation on leatherbacks at sea by killer whales (=orcas) caught off St. Vincent has also been reported (Caldwell and Caldwell, 1969) (see section 2.3).

3.3 Over-utilisation

The absence of data on sea turtle populations in St. Vincent and the Grenadines prevents the unequivocal use of the term "over-utilisation" of sea turtles. However, it is generally agreed among fishermen that there has been a drastic decline in the numbers of nesting turtles, as well as turtles sighted at sea. Most people are of the opinion that the decline is due to over-utilisation. The harvest of sea turtles has occurred for generations (see section I), yet at no time has population size or recruitment potential been taken into account. Some older men who formerly turned turtles on the beach believe that the decline is due to the activities of the younger spear-fishermen. Some younger fishermen in the Grenadines believe that the increased yacht traffic and overnight anchoring adjacent to nesting beaches may be deterring nesting females (section 3.1). Both contemporary harvest and habitat alteration, as well as commercial take in past centuries, are likely to have played a role in reducing population sizes. Sea turtles are slow to mature, meaning that a noticeable decline in the number of females coming ashore to nest may manifest itself only after decades of relentless exploitation. Today most turtles are taken at sea in turtle nets (single layered, large mesh 4-inch gill nets), by spearguns (turtles are usually shot through the flipper or neck), by a noose or "loop" attached to a pole and line, on the beach, or opportunistically while trolling offshore for large pelagic fishes (Morris, 1987; L. Ollivierre, D. Ollivierre, pers. comm., 1993).

The following paragraphs summarise information available in the literature, as well as what we have learned from interviews conducted with fishermen and other informed observers. It is unfortunate that fisheries statistics have not been kept regarding the legal sea turtle catch. As a result, data tend to be fragmented and anecdotal. To the best of our knowledge, considerably fewer turtles are caught at the present time than were landed in past years. A Fisheries data collection officer working at five landing points on the leeward coast of St. Vincent reported that only one turtle had been landed in the two years (1991-1993) that he had been working. An officer working at windward landing sites since May 1993 reported only three turtles, all large hawksbills (shells were observed in October 1993 at Sandy Bay). When questioned about whether landings were few because catches were hidden from Fisheries personnel or because turtles were scarce, there was unanimous support for the latter explanation.

It is difficult to estimate how many turtles are caught each year, how many people are involved, or what proportion of their annual income is derived from sea turtle products. It is clear, however, that (1) at least 120 (and perhaps many more) turtles are landed each year, (2) the fishery is largely seasonal, (3) the fishery is largely concentrated in the Grenadines, (4) the fishery involves take at sea and on the nesting beaches, (5) green turtles, hawksbills and, to a lesser extent, leatherbacks are taken (loggerheads are rare and thus infrequently caught), and (6) no one depends solely on turtle fishing for a livelihood, although the meat may be a welcome alternative and the income in many cases is surely important. The primary markets are Grenadine residents (meat and shells), restaurants (meat), and yachts (shell). Two new fish markets, financed by the Japanese, are planned for Union and Canouan islands (R. Ryan, pers. comm., 1993). The presence of these facilities may increase information on sea turtle harvest.

There appear to be few conservation techniques used by fishermen who harvest sea turtles. Adult females are targeted whilst nesting, usually by older fishermen. Once a hawksbill crawl is

spotted on the beach, the fishermen wait the 14-15 days between nests (or 21 days if it is a leatherback crawl) [N.B. in fact, leatherbacks will re-nest after only 9-10 days] and return to capture the female. Some report using "turtle tracks in the sky" to guide them to the nesting beach. Adult and immature turtles are caught at sea in turtle nets, as well as by speargun and by noose. The latter methods are usually employed by younger fishermen. Turtles are usually held alive until they can be sold. To achieve this, nets are set so that turtles tangle but can reach the surface to breathe, or nets are regularly checked to remove turtles soon after they have been caught. Attempts are always made to spear the turtle through the flipper or neck to wound rather than kill, and to prevent damage to the shell. In Union Island, "loops" are sometimes used, particularly to capture green turtles whilst feeding in open sea grass habitat. The loop consists of a wire noose on the end of a pole that is placed around the turtle's neck and which tightens as it attempts to escape. Once in the boat, the noose can be loosened and the animal kept alive thereafter for several days on its back.

Opportunistic netting (e.g., if a turtle is sighted in an area, a net will be set specifically to catch it) and spearfishing occurs by islanders in their own nearshore waters, but fishermen moving from island to island (particularly Bequian fishermen from Paget Farm) are responsible for a large proportion of the harvest. These fishermen either camp or live in fishermen's quarters on Petit Tabac, Savan, Mustique, Canouan, and Petit St. Vincent and catch lobster, conch, fish and turtle (Y. Chakalall, pers. comm., 1993). Much of the turtle catch apparently comes from waters around Canouan and Union Island. Rebel (1974) reported that 65-70% of the catch once came from Bequia, but this is no longer the case, perhaps because sea turtle populations around Bequia have declined significantly due to over-fishing (diver at Dive Bequia, pers. comm., 1991). [N.B. According to one turtle shell trader, Bequia was a collecting point for shell but was never an important location for harvesting turtles; most hawksbills caught to supply the Japanese shell trade came from Canouan and Balliceaux (J. McDonald, pers. comm, 1993).] It seems likely that under-sized turtles or those caught out of season are covertly sold to family and friends, or to tourists unaware or unconcerned about the closed season. Once the turtle season opens, the markets increase and many turtles are sold to restaurants at this time. The Bequian fishermen also return home with substantial numbers of turtles.

Turtle meat is readily available during the open season (1 August - 28 February) in Union Island, but is apparently less accessible in Canouan. In the latter case, most turtles are caught by Bequian fishermen who stay on Canouan and fish around the island for up to several months. Although they sell some turtle meat to Canouan residents, turtles are carried to other markets by inter-island vessels, or taken back to Bequia for sale. At one time there were as many as eight or nine Bequian fishing boats staying over on Canouan, but in 1993 only a few boats operated from there. Altogether, Bequian fishermen were reported to catch about 20 turtles in Canouan in 1992 (Canouan fisherman, pers. comm., 1993). By the end of September 1993, two months into the turtle open season, Bequian fishermen had already landed about 30 turtles, mainly juvenile green turtles, in Bequia alone (Y. Chakallal, pers. comm., 1993). One large restaurant in Union Island buys 20-30 immature green turtles per season, many of which are caught locally in sea grass beds off Ashton Harbour. There are an additional six smaller restaurants on Union which may purchase about 10 green turtles each per year. In total this represents 80 to 90 green turtles purchased for restaurant sale on Union Island each year.

Since turtle meat fetches about the same price as other fishery products (about EC\$ 3-5/ lb) [N.B. US\$ 1 = EC\$ 2.65], the primary incentive for the harvest in many cases appears to be the price obtained for the shell, primarily the shell of the hawksbill but also that of green turtles. In April 1993, a salesman on Mayreau was selling hawksbill shells (ca. 40-65 cm in length) for US\$ 55-65 each. This was during the closed season and the turtles were below the minimum weight limit for hawksbills (85 lb, or about 38 kg), illustrating the problems that need to be faced to enforce fisheries legislation on some of the Grenadine islands. Up to the end of 1992, hawksbill scutes were worth up to US\$ 60/kg to the fisherman and as much as US\$ 100/ kg to the seller. Now that Japan has enacted a zero quota on shell imports (section 4.31), the local market for turtle-shell is restricted to residents and tourists. Nevertheless, the amount of turtle-shell jewelry and whole polished shells on sale is less than in former years. For example, on Union Island during the 1980's whole shells were often offered to tourists for sale at Clifton (J. Horrocks, pers. obs.) but today shells and jewelry are less readily available on the island (M. Jennett, pers. comm., 1993). Whether this is due to declining sea turtle populations or greater awareness of the endangered status of sea turtles amongst sellers and/or tourists is not clear.

In addition to the harvest of turtles, eggs of all species are taken from nests with little regard for conservation, or for the law since sea turtle eggs are protected at all times (see section 4.21). Because harvest of eggs is illegal, they are never sold on the open market, instead they are passed to friends and family. Some fishermen may leave all or a portion of the clutch of eggs when they capture a nesting female, but others take both the eggs and the female. The number of eggs harvested each year is unknown. There is but a single Fisheries Officer in the Grenadines (where most turtle harvest apparently takes place) and enforcement of sea turtle conservation statutes is virtually nonexistent.

Export: From about 1900 to 1925, the annual export of turtle shell averaged 500 lb (227 kg); fewer than 100 live turtles were exported each year. In 1923, a typical year, 84 live turtles valued at 25 pounds sterling and 511 lb (232 kg) of shell valued at 315 pounds sterling were shipped to Barbados, possibly for re-export to England (Adams, 1980). Carr et al. (1982) reported exports to Barbados and Japan prior to 1970. In the early 1970's approximately 1,500 lb (680 kg) of hawksbill shell, derived from hawksbills caught at sea and on the beach, were exported to St. Lucia each year (Rebel, 1974). According to Japanese Customs data, St. Vincent supplied Japan with 2,235 kg of 'bekko' (raw hawksbill shell) between 1970 and 1986, with export peaking in 1986 at 470 kg (Milliken and Tokunaga, 1987). After 1986, the volume of trade remained high (Table 1). This may have resulted from an increased reliance upon St. Vincent to move bekko shipments obtained elsewhere in the Caribbean region, to Japan. Although St. Vincent became a signatory to CITES in 1989, the Government took a reservation on the hawksbill turtle (see section 4.31). This means that St. Vincent was (and is) able to legally trade in hawksbill products, a fact that unscrupulous traders may have exploited by naming St. Vincent as country of origin for bekko originating elsewhere.

Falsifying trade records is a serious charge, but appears to have occurred in this case. For example, Japanese Customs data indicate that 1,284 kg of bekko was imported from St. Vincent in 1990 (making St. Vincent one of the largest Caribbean suppliers of hawksbill shell), whilst St. Vincent statistics indicate that only 170 kg were actually exported (Table 1). Based on an average

weight of bekko per animal imported into Japan from the Caribbean region (1.34 kg; Milliken and Tokunaga, 1987), Japanese statistics indicate that approximately 2,250 hawksbills were killed to sustain St. Vincent's bekko trade to Japan between 1983 and 1990 (Table 1). In contrast, domestic trade statistics document the export of some 1,382 kg of shell during this period, representing (based on 1.34 kg shell/turtle) about 1,030 turtles. In spite of inadequate sea turtle population data, it is not generally believed that hawksbill stocks in St. Vincent and the Grenadines could support the trade suggested by Japanese Customs statistics. In any event, regardless which data are used, it appears that within the Eastern Caribbean St. Vincent and the Grenadines has served as a prominent supplier of hawksbill shell in recent decades. This has surely contributed to the decline of hawksbills in national waters. In addition to direct export, it is well known that turtle shell products are sold locally to tourists who subsequently take them out of the country.

As an intriguing footnote, a fisherman from Bequia who fishes for sea turtles, conchs, and lobsters around the Grenadine Islands as far south as Petit Martinique (Grenada) reported that hawksbill carapaces were no longer being bought in Bequia, but that the plastrons (=belly plates) were. He described how he removed the calipee first and then sold the plastrons when he had collected sufficient numbers. He understood that the plastrons were processed in some way, but was unable to supply any further details. Recent reports suggest that plastrons and edges of shells were being bought for resale to Japan. The local buyer was apparently willing to pay up to US\$ 83/kg (W. Mulraine, pers. comm., 1993).

3.4 Inadequate Regulatory Mechanisms

Fishery Regulations (1987, Section 17), stipulate that it is illegal to (a) disturb, take, sell, purchase or possess sea turtle eggs, (b) interfere with any turtle nest, (c) take, sell, purchase or possess any under-sized turtle, (d) sell, purchase or possess the shell of an under-sized turtle, or (e) take, sell, purchase or possess any turtle or part thereof during the closed season (1 March-31 July). The legislation is adequate regarding eggs, but is wholly deficient to promote the recovery of depleted sea turtle stocks. First, the closed season does not encompass the breeding seasons of all species of sea turtle reported to nest in the country. Indeed, the peak of nesting activity by the species which nests most frequently (i.e., the hawksbill whose breeding peak is reportedly September-October; see section 2.4), *lies entirely within the open season*. Second, adult turtles (including gravid females) are not protected during the seven-month open season, despite the fact that survival of large juveniles and breeding-age adults is crucial to the recovery of depleted sea turtle populations are (section 4.23).

The Fisheries Regulations (1987) also prohibit the use of tangle nets, designate marine conservation areas where all fishing is prohibited (see section 4.12), and stipulate that permits are required for any speargun used within fishery waters. The tangle net referred to in the Regulations is commonly referred to as the trammel net by the FAO, and is a multi-layered gillnet with each layer having a different hanging ratio and/or mesh size. Turtle nets are single-layered, large mesh (4 inch) gillnets and are not illegal. Turtle nets are set so that ensnared turtles can reach the surface to breathe. This enables fishermen to sort under-sized turtles out of their catch before landing turtles of legal size. Persons convicted of violating any of the Regulations are liable to a fine not exceeding EC\$ 5,000. Legislation notwithstanding, the use of unpermitted spearguns is widespread, and it is well known that fishing occurs in marine conservation areas.

The enforcement of fisheries regulations is a major problem in this multi-island state. Enforcement units are often under-staffed and under-equipped, as is the case throughout most of the Caribbean, and thus effective enforcement remains a challenge to the successful recovery of sea turtle populations (see section 4.22). The Fisheries Act of 1986 allows the Minister to "... designate from time to time ... such persons as he deems fit ... to be authorized officers for the purpose of this Act." Such authorised officers can stop, search or seize without a warrant any vessel (including gear and cargo) believed to have been used in the commission of an offence against the Act. However, Fisheries Officers do not have powers of arrest and thus have to rely on the security forces.

With regard to the protection of habitats important to sea turtles, there is need for comprehensive national legislation pertaining to coastal zone management and the institutional capacity to enforce coastal zone management statutes. The responsibilities of the proposed Department of National Parks (legislation currently under review) will include management of national parks and other natural resources of St. Vincent and the Grenadines. The country has already made significant progress in the designation of Marine Conservation Areas under the Fisheries Regulations of 1987 (Table 2). Nevertheless, enforcement of restrictions and other provisions within the conservation areas is an unmet challenge. This is partly due to the sheer expanse of territory. Jurisdiction extends from St. Vincent in the north to Union Island in the south, a total distance of about 100 km (Figure 1). An additional problem is the potential for overlapping responsibilities of different institutions under the Fisheries Act (1986), the Wildlife Protection Act (1987), and the proposed National Parks Act.

3.5 Other Natural or Man-Made Factors

In addition to habitat destruction (section 3.1) and direct harvest (section 3.3), incidental capture is a problem of unquantified (but probably not large) proportions in St. Vincent and the Grenadines. Virtually all incidental catch would be expected to result from long-lining, since there is no trawling and tangle (trammel) nets are illegal. Drifting gillnets are not considered illegal, but are only occasionally used by Vincentian fishermen; these may result in some incidental catch. One of several new long-lining vessels caught a leatherback turtle in 1992 and brought it back for sale in Kingstown. Leatherbacks are apparently attracted to the bait and lightsticks attached to long-lines. There are several reports of leatherbacks being similarly hooked on long-lines elsewhere in the eastern Caribbean (e.g., BVI: Cambers and Lima, 1990; Antigua: Fuller et al., 1992). The high waves and surges created by tropical storms and occasional hurricanes can degrade both the foraging habitats (coral reefs, sea grass beds) and nesting habitat of sea turtles. Other factors affecting the survival of sea turtles in St. Vincent and the Grenadines have not been identified.

IV. SOLUTIONS TO STRESSES ON SEA TURTLES IN ST. VINCENT

4.1 Manage and Protect Habitat

No systematic surveys have been carried out to date with respect to identifying habitat essential to the continued survival of local sea turtle stocks. It is well known, however, that the waters of St. Vincent and the Grenadines abound with coral reefs and sea grass beds, primarily in

the Grenadines and southern St. Vincent. These provide optimum habitats in which hawksbill, green, and loggerhead sea turtles can forage. Suitable nesting beaches (primarily black sand on mainland St. Vincent, white sand in the Grenadines) are numerous and many of them are undeveloped. In order to recover depleted turtle populations, these habitats must be protected. This can be achieved by designating marine conservation areas (or in the future, national parks under the proposed National Parks legislation), and/or by imposing regulatory guidelines to control potentially harmful activities.

Adverse impacts of inappropriate development could be reduced by adopting legislation through the Town and Country Planning Act (1992) requiring independent environmental impact assessments (EIA) prior to planning permission for all major developments, be they Government or private projects. Currently, it is legislated within the Act that a developer be responsible for conducting an EIA only if requested to do so by the Physical Planning and Development Board. It is a recommendation of this Recovery Action Plan that EIA be undertaken by an independent entity approved by the Government. Indiscriminate anchoring, pollution, sand mining, coastal lighting *inter alia* should be regulated within critical areas (see sections 4.13, 4.14 for regulatory suggestions). Ideally, the protection of habitat important to sea turtles should occur within a larger coastal zone management framework.

4.11 Identify essential habitat

Sea turtles emerge from the sea (generally at night) during certain times of the year to lay their eggs in the warm sand of tropical beaches. Nesting used to be much more common in St. Vincent and the Grenadines than it is today, but there are still many beaches where this activity is believed to occur (Table 3). It is essential for the survival of sea turtles in this country that sandy beaches are carefully preserved to retain them as favourable nesting areas. This does not preclude coastal development, but it does mean that foresight is needed with regard to construction setbacks, artificial beachfront lighting, protection of beach vegetation, etc. (see section 4.122 for details). Without adequate surveys, the habitats most important to protect cannot be properly identified.

In addition to nesting areas, it is vital that important feeding areas be identified and adequately safeguarded. Sea turtles forage predominantly on sea grass, algae and on coral reef-associated animals. ECNAMP (1980a,b) provides preliminary data on the distribution of coral reefs around St. Vincent and the Grenadines (Figures 4a,b), but there has been no mapping of sea grass habitat, which is particularly abundant in the Grenadines. In addition to feeding areas, there may be important refuge sites or migratory corridors in the waters of St. Vincent and the Grenadines. The present thrust for coastal tourism development makes it imperative that nearshore marine communities of the country be identified and surveyed. Only in this way will it be possible to identify and appropriately manage nearshore areas that are important to sea turtles.

4.111 Survey foraging areas

Carr et al. (1982) noted that, with the exception of the southeastern coast, the shelf surrounding St. Vincent is narrow and offers relatively little foraging habitat for sea turtles. An ex-

ception may be Blue Lagoon, off the southwest coast, which appears to be an important foraging area for green turtles. In contrast, aerial observations indicate that sea turtle foraging grounds (sea grass meadows and coral reefs) are extensive around the Grenadines. Both turtle grass (*Thalassia testudinum*) and eel grass (*Syringodium filiforme*) can be found growing in profusion around many of the Grenadine islands. While field surveys are needed to determine precisely which areas are most critical, it is a recommendation of this Recovery Action Plan that useful preliminary data be obtained from resident fishermen well aware of areas where turtles are routinely encountered.

At the present time, knowledgeable observers report that green turtles are relatively more numerous than hawksbills in the waters of the Grenadines, presumably because of the amount of shallow water supporting lush meadows of sea grasses. Foraging by both greens and hawksbills is reported by local fishermen to occur around Baliceaux (61°09' W, 12°57' N), Canouan, (61°20' W, 12°57' N), Union Island (61°27' W, 12°35' N), and Mustique (60°10' W, 12°53' N) (Morris, 1984). Particularly important locations mentioned by fishermen interviewed for this Action Plan were Friendship Bay on the southeast coast of Canouan, off Ashton Harbour near to Frigate Island, Big Sand in Union Island, around Palm Island, and around three islets off the northwest coast of Mustique, called the Pillories (Figure 2b). Until more detailed knowledge is available, it should be assumed that all healthy sea grass meadows and coral reefs are potential foraging grounds for sea turtles and, as such, should be managed with care and foresight.

Recognising the difficulty of surveying underwater habitat for sea turtles throughout this multi-island state, it is a recommendation of this Recovery Action Plan that full advantage be taken of proposed coral reef monitoring programmes. Such initiatives have been proposed both by the Fisheries Division and by Dive St. Vincent, the latter interested primarily in the health of popular dive sites. Standard sea turtle sightings forms (available from WIDECAST) should be provided to monitoring personnel. Data should be centrally compiled (logically by the Fisheries Division) and made available upon request to interested parties.

4.112 Survey nesting habitat

While no comprehensive surveys of beaches for nesting activity have been conducted in St. Vincent and the Grenadines, all beaches on the western coast of St. Vincent are potentially suitable nesting habitats, as are many beaches in the Grenadines (Morris, 1987). Based on interviews with leeward (west) coast residents, Carr et al. (1982) reported that hawksbill nesting (the dominant species nesting in St. Vincent) occurred on the following leeward beaches: Richmond Beach, Rose Bank, Troumaka Bay, Cumberland Bay, Wallilabou Bay, and Barrouallie (Figure 2a). On the windward coast, some hawksbill nesting was reported to occur at Orange Hill, Colonarie Bay, and Stubbs. Leatherbacks were reported to nest occasionally on the leeward coast, especially on Richmond Beach, Dark View, Barrouallie, and Clare Valley; and on the windward coast at Mt. Pleasant. No nesting by loggerheads or green turtles could be documented. In the Grenadines, Carr et al. (1982) reported that hawksbills were the dominant nesters, "using beaches on nearly all of the islands." Green turtles nested only rarely; Palm Island (=Prune Island) was cited as one such beach. Loggerheads nested occasionally but documented records existed for Palm Island only. Leatherback nests were also rare; one definite activity was recorded for Richmond Beach on Union Island.

In National Reports prepared for the Western Atlantic Turtle Symposia, Morris (1984, 1987) identified several nesting beaches. Once again, these were considered predominantly hawksbill nesting beaches and included: Richmond Beach, Chateaubelair Bay, Petit Bordel Bay, Troumaca Bay, Cumberland Bay, Wallilabou Bay, Kerton's Bay, Peter's Hope Bay, Mount Wynne Bay, Lowman's Bay, Cablehut Bay, Brighton Bay, Stubbs Bay, Mt. Pleasant Beach, Biabou Bay, North Union Bay, Georgetown Bay, Orange Hill Bay, and Sandy Bay in St. Vincent (Figure 2a). In the Grenadines: North Bay on Baliceaux; Pasture and Obsidian bays on Mustique; Mahault, L'Anse Guyac, Friendship, South Glossy, Dallis, and Carenage bays on Canouan; Petit Tobac on Tobago Cays; Bloody, Miss Irene, Campbell, Raffal, Richmond Beach, Spring Beach and Chatham Bay on Union Island; and Frigate Island were reported as hawksbill nesting beaches (Figure 2b). Green turtles were also reported to nest in the Grenadines on Frigate Island, as well as on Miss Irene, Campbell, Raffal, Richmond Beach, Spring Beach, and Friendship Bay. Leatherback nests were reported on St. Vincent at Richmond Beach, and at Brighton, Stubbs, Biabou, and Georgetown Bays. In June 1993, a leatherback was poached on Colonarie beach on the windward coast.

Recent qualitative surveys (January, April, July 1993) conducted by the present authors of the Grenadine islands of Mustique, Union, and Canouan revealed the following information (see Figure 2b for locations). Nesting of hawksbills used to occur regularly on Pasture, L'Ansecoy, Macaroni, Plantain and Obsidian Bays in Mustique. One turtle fisherman interviewed was of the opinion that no nesting had occurred on Mustique since 1990. In Canouan, most people interviewed were of the opinion that the isolated Mahault Bay beach was the most important nesting beach, with Windward, Glossy, and Friendship bays also supporting occasional nesting. Nesting on these beaches is predominantly by hawksbills but greens, leatherbacks, and perhaps loggerheads were also reported to nest on Mahault beach. Occasional green turtle nesting was reported for Glossy Bay, and a nesting leatherback was killed on Grand Bay Beach in June 1993. All those interviewed acknowledged how few turtles now nest in Canouan compared to previous years. On Union Island, Richmond, Big Sand, and Raffal beaches were considered to still support some hawksbill nesting activity. Finally, informants report that nesting occurs (or once occurred) at Princess Margaret Beach in Bequia.

It is a strong recommendation of this Recovery Action Plan that comprehensive surveys be conducted on all the major islands of the country in order to determine which beaches are still used by sea turtles. While data cited above provide a starting point, without exception these data were obtained by interviewing fishermen and local residents. There is no guarantee that species have been consistently correctly identified, or that beaches which once supported sea turtles *still* support sea turtles. Further, we lack data entirely on the number of turtles that visit the islands each year, the number of nests laid, nest fate, and hatch success. We anticipate that the support of local residents can be solicited in this national effort, with persons living near sandy beaches (including hotel security personnel, who are often on duty through the night) agreeing to walk these beaches in the early morning (1 April - 30 November) and record evidence of nesting. With support from WIDECAST, training materials and informal workshops can be offered to assist in the identification of nesting crawls. After a period of two years, it should become clear which sandy beaches are used by sea turtles and which are relatively more important than others.

In the longer term, because it is neither possible nor necessary to systematically monitor (as opposed to simply survey) all sea turtle nesting beaches in St. Vincent and the Grenadines, it is a recommendation of this Recovery Action Plan that Index Beaches be selected for comprehensive study. These areas should encompass important nesting habitat for hawksbills and, to the extent possible, leatherback and green turtles. They should be monitored on a daily basis during the breeding season for nest and hatch success. At least one important nesting beach on each of the main islands should be selected as an Index Beach and protected from activities that compromise the suitability of the habitat to support sea turtle nesting. We suggest that the following beaches be designated for this purpose: Mahault Bay Beach (Canouan), Big Sand Beach (Union), and Pasture Bay and L'Ansecoy beaches (Mustique) (see section 4.291 for monitoring protocol). Additional field work is necessary before such recommendations can be made for St. Vincent and Bequia, although in the latter case Princess Margaret Beach appears a likely candidate.

4.12 Develop area-specific management plans

It is essential that critical nesting beaches and foraging grounds are identified as soon as possible so that area-specific management can proceed. Specific conservation measures may differ among sites and range from designation of an area within which the disturbance or take of turtles and eggs is prohibited, to more elaborate solutions such as the establishment of a hatchery for eggs threatened by erosion, poachers, or animal predators. Visitors to nesting beaches should be supervised at night, lights should not shine on the beach, construction should be set back from the beach (and native vegetation preserved), recreational equipment (sailboats, chairs) should be removed from the beach so as not to obstruct nesting females or emerging hatchlings, beach sand mining restrictions should be vigorously enforced, and the construction of seawalls and jetties should be closely evaluated for negative impacts on resident or migrant sea turtles. In addition to details provided in sections 4.13 and 4.14 of this Recovery Action Plan, useful guidelines are available in the WATS Manual of Sea Turtle Research and Conservation Techniques (Pritchard et al., 1983).

The existing and proposed protected areas in St. Vincent and the Grenadines consist of water catchments, Forest Reserves, Wildlife Reserves, and Marine Conservation Areas (CCA/ IRF, 1991). Although there are no areas set aside for sea turtles specifically, there are 10 Marine Conservation Areas (also known as Fisheries Conservation Zones) designated under the Fisheries Regulations (1987) that include whole islands, island groups, or coastal segments where fishing is prohibited (Table 2; Figures 7a,b). There are also 20 Wildlife Reserves designated under the Wildlife Protection Act (1987) that protect whole islands or coastal areas on islands (Table 2; Figures 7c,d). Within Wildlife Reserves, all wildlife is protected year around. Some islands or coastal segments are designated as Marine Conservation Areas, as Wildlife Reserves, and as proposed National Parks (e.g., Tobago Cays). Such a large area of the coast of St. Vincent and the Grenadines has been designated for reserves that it may actually hinder their successful establishment, both because of a lack of resources to establish all the areas, and because of the perception that the reserves may restrict other options for development (L. Ishmael, pers. comm.). It is a recommendation of this Recovery Action Plan that an early task of the National Parks Department (with advice from the National Parks Advisory Committee which is to be established under the National Parks Act) should be to review all areas that have been designated as reserves to reevalu-

ate the justification for their designation and/or to prioritise them for establishment. It is a strong recommendation of this Recovery Action Plan that important sea turtle nesting or foraging habitat be considered in any prioritisation or re-designation process.

Most of the Fisheries Conservation Zones include sea turtle foraging habitat, and some include nesting habitat. Fishing is prohibited in all conservation areas. Anchoring is not specifically restricted in conservation areas. However, it is illegal to "...destroy any flora or fauna other than fish", which may make prosecution for anchoring on live coral an option. Legislation has also been drafted to make Mayreau and the Tobago Cays a Marine National Park. Although a management plan was written for this park that includes discussion of garbage and sewage disposal, the construction of an interpretive center on Union Island, etc. (Heyman et al., 1988), it has not been implemented. This is largely because the Fisheries Division, which has been assigned responsibility for management until a National Parks Department is established, is under-staffed and personnel are not yet fully trained for effective park management. A priority for the Fisheries Division is to make the Tobago Cays Park a reality, and funding is being sought to send a staff member for training. In the meantime, 60 mooring buoys were placed around the Cays in April 1993 to minimise damage to the reefs caused by heavy yacht traffic.

The east coast of Canouan, including the nearshore waters within the Grand Cois barrier reef was recommended to be designated a National Park by Jackson et al. (1986). This area supports dense sea grass meadows and includes important nesting and foraging habitat for sea turtles. Mahault Bay on the uninhabited north coast is reported to be nesting habitat for leatherback, hawksbill, green, and perhaps loggerhead turtles. Interviews conducted for this Action Plan indicated that Mahault Bay beach is the best nesting beach on Canouan and perhaps one of the best nesting sites in the country. About two-thirds of the island of Canouan has recently been leased to a company for the development of an exclusive resort. The resort will have a hotel, low density luxury villas, and a 9-hole golf course. A hotel training college and a technical training college are also to be built (R. Charters, pers. comm., 1993). The developers were required to conduct an EIA prior to the initiation of Phase I, the results of which were favourable. Notwithstanding this EIA, it is a strong recommendation of this Recovery Action Plan that the developers be strongly encouraged to plan for the effective long-term protection of the extremely sensitive and virtually pristine nearshore communities and threatened wildlife such as sea turtles.

Of particular concern in the Canouan development is the construction of a golf course. The island has no natural source of freshwater, apart from rainwater. In order to meet the demands of the resort (including maintaining golf greens), a second desalination plant is to be built. Apart from irrigation, the golf course will require liberal use of herbicides and fungicides. Polluted runoff can be expected to damage nearshore marine communities unless water can be caught, channelled and recycled. While such development on Canouan may serve to reduce illegal catch of turtles on hitherto isolated beaches (and the potential reduction in poaching due to development is certainly welcomed), it is essential in light of the importance of Canouan (Carib for "sea turtle") as sea turtle nesting and foraging habitat that developers tailor their plans to safeguard nesting and foraging habitat. Guidelines for developments adjacent to important sea turtle nesting and foraging habitats are summarised in section 4.122.

In addition to public conservation areas and reserves, quasi-private reserves have also been established. The Mustique Company Limited Act (1989) makes the Mustique Company (the lease-holders of Mustique Island) custodians of the Mustique Conservation Area. The Conservation Area Regulations (1989) of the Act, expand the area of protection to the whole island and to a minimum of 1000 yd offshore. Fishing; taking of turtle eggs; destruction of beach vegetation; dredging; harvest or damage to corals; and disturbance, alteration or destruction of the natural environment is prohibited without written permission from the Company. Enforcement will be similar to that of regulations under the Fisheries Act 1986. It is a recommendation of this Recovery Action Plan that whenever this type of area-specific marine protection is legislated, full protection to all species of sea turtle be included. It is further our recommendation that private lease-holders be required to hire surveillance staff to enforce the terms of the lease; i.e., protection to coral reefs, turtles, etc. It is clear that fisheries personnel (who do not have powers of arrest) and under-staffed law-and-order police are not in a position to effectively enforce conservation legislation throughout the Grenadines.

In summary, it is essential that critical nesting beaches and foraging grounds be identified so that area-specific management can proceed. In particular, it is a recommendation of this Recovery Action Plan that management plans be developed for all designated Marine Conservation Areas and that park managers and wardens be sufficiently trained and equipped. At the very least, marker buoys should be put in place to advise the fishermen and yachtspeople of the boundaries of conservation areas, as well as signs which inform people of relevant restrictions. Fact sheets recently produced by the Ministry of Tourism for yachtspeople and by the Fisheries Division for fishermen are important steps in disseminating regulatory information. Finally, island lease-holders should be required to take sea turtles into account prior to development.

4.121 Involve local coastal zone authorities

A recommendation of the Environmental Country Profile for St. Vincent and the Grenadines (CCA/IRF, 1991) was that there be an integrated approach to protected areas development. The proposed National Parks Act includes provision for the creation of a National Parks Department which will be responsible for management of national parks, including management plans and enforcement mechanisms. National Parks officers and members of the Police Force will be authorised to enforce the provisions of the Act as well as Fisheries regulations where Marine Conservation Areas fall within national park boundaries.

At present, the Fisheries Division is solely responsible for administering and managing Marine Conservation Areas. Under the proposed National Parks Act, it will also become responsible for overall management of marine national parks until the National Parks Department has been established and officers appointed. The Division currently lacks the financial resources and sufficient numbers of trained personnel to undertake additional responsibilities. The Division has put forward a reorganisation plan elevating it to a Department of Fisheries (CCA/IRF, 1991). The proposal calls for the number of staff to be increased, and includes a management position responsible for conservation. It is a recommendation of this Recovery Action Plan that the Fisheries Division receive the resources and training necessary to strengthen its implementing capacity, especially given the additional responsibilities that may ensue following passage of the National Parks Act.

4.122 Develop regulatory guidelines for management areas

A strong recommendation arising from the Country Environmental Profile for St. Vincent and the Grenadines (CCA/IRF, 1991), and a view shared by this Action Plan, is that a comprehensive coastal zone management plan be formulated to regulate development and encourage sustainable use of the coastal zone. Certainly in areas especially critical to the survival of remaining sea turtle stocks, regulatory guidelines need to be drafted and implemented to establish a framework within which appropriate land use and development (commercial, recreational, residential) can occur. Under the Town and Country Planning Act (1992), the Minister may make regulations in relation to the "proper control of the height, density and setback" of developments. At present, the standard setback requirement is 40 feet from the high water mark, although this may vary depending on the stability of the beach and its exposure (B. Browne, pers. comm.). The Fisheries Act (1986) also allows for the creation of implementing regulations, and agreements between the Government and island lease-holders (e.g., the Mustique Company Limited Act of 1989) may allow for the issuing of locally applicable controls (in consultation with the Government) to conserve, protect or maintain the environment. It is a recommendation of this Recovery Action Plan that the specific recommendations made below be incorporated into regulations and guidelines.

In terms of nationwide coastal development and attending regulatory guidelines, a system of zoning to protect sensitive areas should be designed. The country has already moved admirably in this direction with the designation of reserves and conservation areas (Table 2), as well as national parks pending under the proposed National Parks Act. Any regulations, in order to be effective, must be enforceable. This is problematic in St. Vincent and the Grenadines because of the extent of sovereign territory. Nevertheless, it is an issue that must be addressed. In many cases coastal zone management regulations, including recommendations discussed below which are particularly relevant to the conservation of endangered sea turtles, are common sense measures useful not only in defending important habitat for the benefit of sea turtles, but also ensuring that sensitive areas are properly safeguarded for the future.

1) *Sand mining*: Commercial mining of beach sand should not be permitted under any circumstances (section 4.131). The persistent removal of beach sand disrupts stabilising vegetation, exacerbates erosion, and can eliminate nesting habitat. Mining pits invite injury to humans and livestock, and accumulate water to serve as breeding areas for mosquitoes and other unwanted insects. Mining sediments offshore should be carefully evaluated for potential effects on coastal beaches, since offshore material is essential for beach maintenance. Whenever possible, extraction sites should be limited to appropriate sites in the interior.

2) *Artificial lighting*: Sea turtles, especially hatchlings, are profoundly influenced by light. Sea turtles freshly emerged from the nest depend largely on a visual response to natural seaward light to guide them to the ocean. In zones of coastal development, sources of artificial light distract hatchlings so that they turn away from the sea and crawl landward. It is essential that artificial light sources be positioned so that the source of light is not directly visible from the beach and does not directly illuminate areas of the beach; if lighting must be seen from the beach, it should emit wavelengths (560-620 nm) which are least attractive to sea turtles (Witherington, 1990). Low pressure sodium lights should be used to the maximum extent possible. Low intensity, ground-

level lighting is encouraged. Nighttime and security lighting should be mounted not more than 5 m above the ground and should not directly illuminate areas seaward of the primary dune or line of permanent vegetation. No lighting, regardless of wavelength, should be placed between turtle nests and the sea.

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

3) *Beach stabilisation structures*: Hard engineering options to beach protection, including impermeable breakwaters, jetties, groynes and seawalls positioned on the beach or in the nearshore zone, should be considered only as a last resort (section 4.133). Throughout the Caribbean region there are numerous examples of beaches lost, rather than secured, as a result of armouring. Sandy beaches are naturally dynamic. The physical characteristics of the coastline should be taken into account prior to coastal construction so that adequate setbacks, rather than expensive and often counter-productive armouring, can be used to provide for the long-term conservation of the beach resource.

4) *Design setbacks*: If development of land adjoining a sandy beach is planned, setback limits should be defined that reflect the damage likely to be caused to the beach and backshore environment during a major storm, and that take into consideration beach and backshore characteristics. Setbacks should provide for vegetated areas including lawns and dunes between hotels, homes and similar structures, and the beach proper. Coastal setbacks of "at least 50 m" from the line of permanent vegetation are recommended by CCA/IRF (1991) (section 4.133). Setbacks not only help to protect coastal properties from storm damage, but also reduce over-crowding of the shorezone, lessen the likelihood that local residents will be excluded from the beach, and enhance the probability that artificial lighting will not shine directly on the beach.

5) *Access*: The use of 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) should be positioned so that headlights do not cast light onto the beach at night. Driving on the beach creates unsightly ruts, exacerbates erosion, and lowers sea turtle hatch success by compacting nests (section 4.134). Tyre ruts also present a significant hazard to hatchlings crossing the beach. Where vehicles are needed to transport heavy fishing or recreational equipment, multiple access points should be provided and vehicles parked landward of the line of permanent vegetation. Pedestrian access to beaches should be confined to specific locations and strictly regulated so as to minimise destruction of the beach, including vegetation, by trampling.

6) *Waste disposal*: No dumping should be permitted within the nearshore, beach, dune, or wetland environment of the shorezone. Such dumping as has already occurred should be subject to immediate cleanup. The fouling of beaches runs counter to the economic interests of 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 nest site. Visitors should be required to take with them any garbage or other waste brought to or generated at the beach. Trash cans and regular pickup should be provided at all beaches. To the extent that beach cleanup is necessary, it should be done using hand tools (section 4.134).

7) *Vegetation cover and fires*: All attempts should be made to preserve vegetation above the mean high tide mark. Creeping and standing vegetation stabilises the beach and offers protection against destructive erosion by wind and waves. The beach forest provides important nesting habitat for the hawksbill turtle and offers natural shielding for the beach from the artificial lighting of shoreline development (section 4.132). Fires, either for recreation or charcoal production, should be prohibited on beaches. Fires are a hazard to the surrounding dry forest, create unsightly scars, may scorch sea turtle eggs and hatchlings beneath the surface of the sand, and can disorient hatchlings. Cooking fires should be restricted to designated grill facilities.

8) *Marine pollution*: The dumping of solid or chemical wastes into the sea should be prohibited under all circumstances. In addition to degrading the environment for residents and visitors alike, sea turtles often ingest tar, plastic, rope, and other substances (e.g., Mrosovsky, 1981; Balazs, 1985; Lutz and Alfaro-Schulman, 1991), presumably mistaking these for food, and become weakened or die. It is commonplace for sea turtles to confuse plastic bags with jellyfish and eat them. Polluted effluent from land-based sources should be appropriately treated before its discharge into the sea. Sewage treatment often involves the use of chemicals (e.g., chlorine) which are detrimental to the health of corals, and rarely removes nitrate and phosphate components which are detrimental to both corals and sea grasses. One option therefore is to lightly treat sewage and then deposit the effluent well offshore, away from delicate nearshore habitats. See sections 4.143 to 4.146.

9) *Anchoring and dredging*: Anchor damage is a leading cause of destruction to sea grass meadows and coral reefs throughout the Wider Caribbean. It is essential that yachts and other boats be required to either anchor in designated sand 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 sea grass. Dredging activities should be planned to minimize damage (i.e., sedimentation) to down current coral and sea grass. Severe disruption of the sea bed, especially in living sea grass and coral communities, can ruin actual or potential foraging areas for sea turtles, negatively affect the natural dynamics of the marine environment, and result in the loss of beach sand. See also section 4.147.

10) *Physical destruction of coral and sea grass*: In the absence of the sheltering influence of offshore reefs, shorelines are often severely altered, resulting in great 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 sea grass areas (see above, and section 4.147). Divers should be thoroughly coached on diving etiquette so as to pre-

clude trampling, collecting, and touching living coral. The practices of using chemicals or dynamite (sections 4.141, 4.142) for the purpose of stunning fish for harvest are prohibited under all circumstances. The destruction of reefs resulting from these practices can be irreversible in our lifetime.

4.123 Provide for enforcement of guidelines in management areas

Enforcement of protected area status is problematic everywhere in St. Vincent and the Grenadines. Despite clear prohibitions against fishing, dredging, waste disposal, destruction of flora and fauna, and the construction of any structure "on or over any land or waters within such a reserve" (Fisheries Act, 1986, 22.(2)), it is well known that fishing occurs within established marine reserves and in some cases large-scale development is planned. For instance, sea grass beds off Ashton harbour in Union Island, where green turtles are reported to frequent (section 4.111), are likely to be adversely affected by the construction of a large marina (300 yachts). The development falls within a designated Marine Conservation Area (Ashton Bay Marine Reserve) off the southeast coast of Union Island (Figure 6) and will involve extensive land reclamation that will effectively join Frigate Island to Union Island. Frigate Island itself is a Wildlife Reserve declared under the Wildlife Protection Act. It is a recommendation of this Recovery Action Plan that an active and effective central authority (such as the proposed National Parks Department) be inaugurated to manage parks and reserves and to advocate for their health and spatial integrity.

Effective enforcement of Fisheries legislation will involve the strategic placing of more personnel, especially in the Grenadines. At present there is only one Fisheries Extension Officer responsible for all the southern Grenadine islands (Union Island to Canouan); thus, it is too easy for legislation to be ignored. If it is not economically feasible to employ more full-time fisheries officers and extension officers in the Grenadines, then it is a recommendation of this Recovery Action Plan that a system of deputies (empowered by the Minister under fisheries legislation) be considered. Deputies could consist of senior and/or highly respected fishermen in their own islands, preferably with their own boats, who can supplement their income by working on a part-time basis for the Government. Older men may be more suitable, in that their experience and memory of turtle abundance in previous years will make them more aware of the need for conservation until populations can recover. It is important that they be well-respected people, since they will be enforcing legislation that controls the activities of their friends and families. A tendency to "look the other way" when friends or family are involved in illegal activities is a widespread problem in all small communities. A system that employs former turtle fishermen in sea turtle conservation activities, and their families in sea turtle related tourism activities has met with great success in Brazil (M. Marcovaldi, Projet Tamar, pers. comm., 1992). With regard to conditions imposed on beachfront construction projects, such as setbacks and lighting, a registered architect, professional engineer or other authority designated by the Government should conduct a site inspection, including a night survey with all beachfront lights on.

4.124 Develop educational materials for management areas

It is important to the successful management of any protected area or conservation zone that educational materials be disseminated to the user public explaining the rules and regulations associated with the area. The Ministry of Tourism has produced a fact sheet for yachtspeople summar-

ising the salient points that yachtspeople should know about conservation zones, including waste disposal and anchoring restrictions. Unfortunately, these leaflets do not discuss sea turtle legislation specifically. This information should be added for subsequent printings. The fact sheet is available at customs stations in Wallilabou, Kingstown, Bequia, Union Island, and Mustique. It is a recommendation of this Recovery Action Plan that the fact sheet be made more widely available by placement in beachfront restaurants heavily frequented by yachts-people. We further recommend that the conservation zones be demarcated with buoys as soon as possible. Where practical it would be useful to place explanatory signboards at selected sites, construct a pertinent display at the airport, or arrange for local guides to lead tours to protected areas to enable tourists to snorkel and learn about the marine environment.

4.13 Prevent or mitigate degradation of nesting beaches

4.131 Sand mining

The chronic removal of sand from nesting beaches accelerates erosion and degrades or destroys beach vegetation by extraction or salt water inundation. In severe cases, saline ponds are formed in unsightly pits left by mining operations, shoreline trees are lost to the sea, and entire beach habitats are eliminated. With their loss, the coast's potential to support recreation, wildlife (sea birds, turtles), tourism, and commercial development is reduced. Transport trucks driving on the beach can also accelerate erosion, in addition to scarring the terrain. In the past, coastal sand mining was legal in St. Vincent and the Grenadines, but following passage of the Beach Protection Act (1981), it became illegal to remove sand without permission from the Minister of Agriculture. Unfortunately, regulations were never enacted and the legislation has not been enforced (CCA/IRF, 1991). Moreover, mining is still reported to occur on most isolated beaches with accessibility by road, including nesting beaches (e.g., Colnarie, St. Vincent). Sandstone has been exposed by extensive mining on the turtle nesting beach at Brighton Bay.

To relieve pressure on beaches, sand is imported from Trinidad and regulations have been drafted to restrict commercial mining to designated beaches (i.e., the Diamond and Brighton sand dunes, the Rabacca Dry River, and the Wallibou Dry River). No beaches in the Grenadines are to be designated for sand mining (B. Browne, pers. comm.). In the future, sand mining for construction purposes may be totally prohibited in St. Vincent and the Grenadines, and instead sand will be imported from Guyana (OECS Sand Mining Project; B. Browne, pers. comm.). Sand mining is already prohibited in designated Marine Conservation Areas under the Fisheries Act (1986) and in areas under the jurisdiction of the Mustique Company Ltd. Act (1989); further, it will be prohibited under the proposed National Parks Act. Since illegal sand mining still occurs, it is a recommendation of this Recovery Action Plan that existing relevant legislation be strenuously enforced. If additional beaches are to be designated for mining under the Beach Protection Act, we urge that sea turtle nesting beaches be avoided (see Table 3).

4.132 Lights

Extensive research has shown that sea turtle hatchlings and adults orient from the nesting beach to the sea using light as an important cue. The open ocean horizon is typically considerably

brighter than the landward horizon, which often consists of dense vegetation. Using the brightness differential between the land and the sea, the turtles are able to find the water even though, especially in the case of small hatchlings, they cannot see the waves. This orientation mechanism is very sensitive and can be fooled. Consequently, beach lighting (security lights, residential lights, commercial lights) can disorient hatchlings, leading them inland to be eaten by dogs, hit by passing vehicles, or to die in the morning sun. Artificial lighting can also persuade a nesting female to journey inland, or deter her from landing on the beach in the first place.

Fortunately, this does not appear to be a problem (yet) in St. Vincent and the Grenadines. Beaches are usually not well lit, and many are completely undeveloped. However, development is inevitably going to occur on an increasing number of beaches, and it is essential that this issue be addressed at the time a developer is granted permission to construct. It is generally possible to incorporate "turtle-friendly" lighting into coastal development schemes. It is a recommendation of this Recovery Action Plan that the Planning Department be fully aware of the problem that beachfront lighting poses to endangered sea turtles and that they impose, in consultation with the developer, an acceptable scheme to preclude lights from shining on nesting beaches, at least from 1 June - 31 December (peak hatching seasons). The WIDECast Country Coordinator has already been provided with background information on lighting solutions and WIDECast will continue to make technical materials available to the Coordinator (to share with regulatory agencies) as they become available.

An absence of lighting is the best guarantee that hatchlings will safely find the sea. Where this is not an option, Witherington (1990) proposes several "next-best" solutions, including (1) time restrictions (lights extinguished during evening hours when hatching is most likely to occur; e.g., 1900-2300 hrs), (2) area restrictions (restrict beach lighting to areas of the beach where little or no nesting occurs; the effectiveness of this is diminished, however, since sources of light several km away can disrupt hatchling orientation), (3) motion sensitive lighting (sensor-activated lighting comes on only when a moving object, such as a person, approaches the light; this might be effective in low traffic areas), (4) shielding and lowering light sources (low intensity lighting at low elevations can be both attractive and adequate for most purposes; the glow can be shielded from the beach by ornamental flowering hedges or other barriers), (5) using low-pressure sodium vapor luminaires, which emit light in the 590 nm range (yellow) and do not attract hatchlings to the extent that full-spectrum white light does.

It is a recommendation of this Recovery Action Plan that owners of existing hotels as well as developers of new resorts on nesting beaches be targeted for education with regard to this potential problem. Letters should be mailed by the WIDECast Country Coordinator, in collaboration with the Fisheries Division, to all beachfront restaurants and hotels asking that lights be appropriately modified to take sea turtles into account, nesting and hatching be reported, and the grounds be checked each morning to "rescue" hatchlings misoriented landward. 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 get their proper bearings. The trek to the water is important, and hatchlings should not be placed directly in the sea but allowed to crawl unassisted.

4.133 Beach stabilisation structures

Most beaches are naturally dynamic. In order to protect commercial investments such as beachfront hotels, beach stabilisation typically involves the use of breakwaters, jetties, impermeable groynes, and/or seawalls. These structures are expensive and rarely effective in the long-term. Because they interfere with the natural longshore transport of sediment, the armouring of one beach segment can result in the "starvation" and eventual loss of other beach segments down-current. Stabilisation structures constructed parallel to the shore can hinder natural beach regeneration and prevent access by female sea turtles to the nesting beach. Groynes were built at Young Island and in the Calliaqua and Indian Bays, St. Vincent, following sand loss attributed to the passage of Hurricane Allen in 1980. While such structures are not widespread on the beaches in St. Vincent and the Grenadines, it is important that currents and other oceanographic features be carefully evaluated before permitting such structures. It is a recommendation of this Recovery Action Plan that hard engineering options to beach protection, such as breakwaters and groynes, be regarded only as a last resort and that solid structures, be disallowed in favour of permeable structures.

The better solution to beach maintenance is an enforced construction setback adequate to reduce or eliminate the risk of losing coastal buildings to routine erosion or violent storms. Because of the undeveloped nature of most of its coastline, St. Vincent and the Grenadines still has the potential to utilise coastal development control as a low cost solution to coastal erosion. If development of land adjoining a sandy beach is planned, it is a recommendation of this Recovery Action Plan that setback limits be defined that reflect the damage likely to be caused to the beach and backshore environment during a major storm, and that take into consideration beach and backshore characteristics. Setbacks should provide for vegetated areas, including lawns and dunes between hotels, homes and similar structures, and the beach proper. Setbacks of at least 50 m are recommended (as proposed by CCA/IRF, 1991). Setbacks not only protect properties from storm damage, but also reduce overcrowding of the shoreline and lessen the likelihood that local residents will be excluded from the beach. Making exceptions to setback regulations in Barbados has led to the disappearance of "windows to the sea" along the south and west coasts, reducing enjoyment of these areas by residents and visitors alike. It has also restricted public access to the beach for recreational and other purposes, such as hauling up boats for repair (J. Horrocks, pers. obs.).

4.134 Beach cleaning equipment and vehicular use of beaches

Damage to incubating eggs (or hatchlings awaiting an evening emergence) is easily caused by compaction or puncture from mechanised beach cleaning techniques. If raking seaweeds by tractor or other heavy machinery is inevitable, it is a recommendation of this Recovery Action Plan that this activity be confined to beach zones below the mean high tide line in order to avoid the compaction of sand above incubating eggs. Repeated compaction will kill developing embryos and tyre ruts can trap hatchlings crawling across the beach to the sea. Fortunately, mechanical cleaning using heavy equipment is not done in St. Vincent and the Grenadines. Rather, hand-raking (typically to remove Casuarina needles and pods, leaf litter, etc.) is the normal procedure on beaches adjacent to hotels and there is no evidence that the cleaning effort is detrimental to incubating sea turtle eggs.

Beach-driving is not known to occur in St. Vincent and the Grenadines. In order to prevent future problems, it is a recommendation of this Recovery Action Plan that driving cars and trucks on sandy beaches be restricted to designated access points (see section 4.122(5)). Beach-driving exacerbates erosion and can uproot stabilising vegetation. Vehicle weight crushes eggs and can kill developing or newly hatched turtles. In addition, tyre ruts are unsightly and create hazards for hatchlings trying to reach the sea. The tiny turtles fall into the ruts, which generally run parallel to the sea, and because they cannot get out they die in the morning sun or become an easy meal for predators.

4.135 Beach rebuilding projects

Although many beaches along the south coast of St. Vincent, and several in the Grenadines have experienced mild to severe erosion over the last twenty years (CCA/IRF, 1991), beach rebuilding apart from groyne construction has not been attempted. If rebuilding is contemplated, it is a recommendation of this Recovery Action Plan that replacement sand be similar to that which was eroded, thereby maintaining the suitability of the beach for the incubation of sea turtle eggs. Sand brought to a beach from inland or offshore deposits is often of a different constitution (e.g., grain size, organic content). Experience in Florida, USA and elsewhere suggests that this sediment is easily compacted and can become useless for sea turtle nesting. Rebuilding should be confined to non-nesting or hatching seasons [N.B. this will depend on the species nesting; if hawksbills are expected, rebuilding activities should be planned for March-June]. Heavy equipment and activity can deter nesting and crush eggs, and the new overburden can prevent hatchlings from successfully digging out of the nest.

The presence of nearshore reefs and sea grass beds should also be taken into consideration, since increased sedimentation during the rebuilding activity may damage these habitats. Reefs are often an important source of future sand and protect the beach from wave action. Sea grass beds stabilise nearshore sediments. It is important these habitats not be threatened by beach rebuilding projects. Useful information regarding beach rebuilding in sea turtle nesting habitat can be obtained from the Florida Department of Environmental Protection, 19100 SE Federal Hwy, Tequesta, Florida 33469-1712 USA.

4.14 Prevent or mitigate degradation of marine habitat

4.141 Dynamiting reefs

The use of explosives is forbidden under the Fisheries Act (1986). Section 24 reads, "Any person who 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 carries or has in his possession or control any explosive, poison or other noxious substance for any of the purposes referred to in the preceding paragraph is guilty of an offence and shall be liable on summary conviction to a fine not exceeding 2,500 dollars."

According to persons interviewed for this Action Plan, the use of dynamite (typically in coral reefs) for fishing still occurs clandestinely in the Grenadines, though certainly to a lesser ex-

tent than in the past. It is a recommendation of this Recovery Action Plan that efforts be made to stop this illegal practice whenever and wherever it occurs. The destruction of coral reefs by explosives not only destroys forage and refuge for sea turtles, but also permanently diminishes the capacity of Vincentian waters to support local fishing industries. One of a series of new Fisheries Division posters informs fishermen that it is illegal to use explosives and poisons.

4.142 Chemical fishing

The use of chemicals for the purpose of catching fish is illegal in St. Vincent and the Grenadines (see section 4.141). However, it has been reported that deliberate poisoning of St. Vincent (mainland) streams with Sevin (an insecticide) to catch fish and crayfish is widespread (CCA/IRF, 1991). Since polluted stream water ends up in the sea, it may have an adverse impact on nearshore reefs and sea grass beds. It is a recommendation of this Recovery Action Plan that the Fisheries Division make every effort to inform the public of the dangers of using poisons in stream and marine habitats, and of the penalties for violations.

4.143 Industrial discharges

It is known that effluent from the rum distillery at Georgetown on the east coast of St. Vincent is released into the Caratal river, and ultimately discharges into the sea. This area is not known for its coral reefs, but such effluent could otherwise damage the marine habitat. Other sources of industrial effluent include the coconut oil factory at Arnos Vale (south coast, Figure 5) and waste oil from the diesel power stations and motor vehicle repair garages. Effluent from these industries is discharged into rivers and storm drains and ultimately into the sea. Heated effluent is also released from the hydroelectric power station at Richmond, north of Chateaubelair, on the west coast. Campden Park industrial site reportedly dumps waste dyes and high nutrient wastes into Campden Park Bay (CCA/IRF, 1991). While not strictly industrial in nature, it is important to note that chlorine discharges from hotel swimming pools have probably affected the coral reefs in the Villa-Indian Bay area on the south coast of St. Vincent. It is a recommendation of this Recovery Action Plan that baseline surveys be undertaken in order to assess habitat quality in these areas. Of particular concern to sea turtles is the Campden Park Bay area. This area is relatively close to the Lowman's Bay area indicated by Morris (1984, 1987) as a hawksbill nesting site.

There are no known sites of industrial discharge in the Grenadines, although oil leaks from electricity generators reaching the sea are probably not uncommon.

4.144 At-sea dumping of garbage

Indiscriminate waste disposal is a widespread problem, both at sea and on land. According to CCA/IRF (1991), "The proper collection and disposal of solid waste is perceived by many Vincentians, including members of the National Environmental Protection Task Force, to be the highest priority issue for improved environmental management in St. Vincent and the Grenadines."

Inland dumping of garbage into rivers and streams results in such waste eventually getting into the marine environment. The problem is further complicated by the fact that this is a multi-is-

land state. This means that there is frequent movement of ships between mainland St. Vincent and the islands of the Grenadines, and thus frequent disposal of litter into the sea. Such ships include not only locally owned vessels, but also foreign yachts and cruise liners. St. Vincent and the Grenadines is not alone in this problem; the volume of garbage released into the Wider Caribbean annually by ships, as well as by landfills, general litter, and river transport, is enormous. Fortunately the issue is receiving international attention, prompting governments to implement and support public awareness campaigns, as well as the enforcement of anti-dumping laws. The current OECS Solid Waste Management project will hopefully address these issues. The disposal at sea of plastic bags and discarded fishing gear (line, netting) is particularly harmful to turtles; the bags are mistaken for jellyfish and ingested and turtles (and other sea creatures) become entangled in abandoned fishing gear.

The Department of Tourism issues flyers to visitors and inter-island travellers, promoting the proper disposal of garbage. In 1992, the Government passed an Anti-Litter Act (1992); however, enforcement is problematic and improper disposal of garbage continues. Much of the litter dumped at sea returns to the beaches. As a result, beach clean-ups are very important. The Youth Environment Service (YES Club) formed as part of the UNEP effort in collaboration with the JEMS Progressive Youth Organisation has organised beach clean-ups on some south coast beaches near their base in Stubbs. It is hoped that more of these YES clubs will be formed in the secondary schools throughout the country to complement this effort. It is a recommendation of this Recovery Action Plan that YES clubs integrate their clean-ups with the International Coastal Clean-up Campaign of the Center for Marine Conservation. In this way, the important information collected can be included in an international database. The WIDECAST Country Coordinator (Nigel McA. Scott, P. O. Box 1584, Kingstown) has literature on this subject; further information can be obtained by writing the Center for Marine Conservation, International Beach Clean-Up Campaign, 1725 DeSales Street, Washington D. C. 20036 USA.

4.145 Oil exploration, production, refining, transport

There are no known offshore oil deposits in St. Vincent and the Grenadines. However, tar ball deposits have been observed on some beaches. Possible sources include oil tankers washing out their holds at sea, or the washing out of onshore storage tanks located on the south coast of St. Vincent. International cooperation is needed to address the issue of pollution from tankers transporting oil and related products through our waters. At present there is no National Oil Spill Contingency Plan. Since the country is near major oil transportation routes of tankers leaving Trinidad and Tobago and Venezuela, the risk of a spill is high. Indeed, there was a minor oil spill in the region of the Grenadines in early 1993 that resulted in oiled beaches on Mustique. An oil tanker washing out its hold at sea was suggested by some as a possible source of the oil. The Mustique Company Ltd., lease-holders of Mustique, undertook the responsibility of cleaning the beaches. Tarball fouling is also very common along windward beaches in St. Vincent and the Grenadines (e.g., Windward Bay, Canouan). It is a recommendation of this Recovery Action Plan that a contingency plan be drawn up to cope with a serious spill, and that efforts be made to prosecute offending oil tankers using "fingerprinting" of tar balls, perhaps at the National Hydrology Research Institute, Saskatchewan, Canada.

4.146 Agricultural run-off and sewage

This is a problem, particularly on mainland St. Vincent. The country's economy has an agricultural base, with bananas being the chief crop. Marketing pressures on this crop to maintain high quantity and quality yields has led to increases in cultivated land area and increased use of pesticides, herbicides, and fertilizers. This in turn has resulted in farmers cultivating nearer to rivers and streams, and in the process clearing away previously virgin land. Bananas do not have a very extensive root system and so offer poor soil holding ability. This has meant an increased amount of sediment and chemical run-off into rivers and streams, ultimately running into the sea. This problem is not likely to be remedied soon, as the pressure on the industry will surely be maintained and there are ongoing efforts to bring about agricultural diversification. Since severe damage to nearshore ecosystems is possible as a result of the increasing use of agricultural poisons, it is a recommendation of this Recovery Action Plan that monitoring programmes, perhaps as part of a national water quality programme, be implemented.

Sewage treatment in St. Vincent and the Grenadines is an unmet challenge. At present, only some parts of downtown Kingstown and about 40 houses in the Arnos Vale suburbs are sewered (CCA/IRF, 1991). Most households use water closets with a soakaway. In the case of sewered areas, no sewage treatment is done. Raw sewage is pumped directly into the sea; the outfall pipe at Old Women's Point (Kingstown harbour) has been broken twice by storms (Figure 5). Although no studies have been done, there are apparently strong currents in the Kingstown harbour which disperse the effluent from the system quickly (CCA/IRF, 1991). How well sewage effluent disperses from the Arnos Vale area is unknown. The problem of sewage disposal is particularly serious in the Grenadines, where increasing numbers of hotels are being constructed in pristine areas. Already the effects are being felt; e.g., Clifton Harbour (Union) is "dead", partly because of sewage, yacht waste, and other effluents (J. Daudin, pers. comm., 1993). With increased population densities and an increased emphasis on coastal tourism, solutions to the problem need to be sought. It is a recommendation of this Recovery Action Plan that water quality and habitat quality in nearshore waters be monitored on a routine basis, particularly in regard to the negative effects of untreated sewage on public health and on the health of nearshore marine communities, and that an environmentally-sound sewage disposal strategy be identified and implemented as soon as possible.

4.147 Others (anchoring and land reclamation)

A large number of yachts visit the islands every year and damage has been done to reefs due to careless anchoring by yachts and dinghys, especially in the Tobago Cays. The systematic demolition of coral by heavy anchors severely degrades potentially important sea turtle foraging and resting habitats. The damage and threat of damage to the spectacular reefs in the Tobago Cays has led to the placement of 60 permanent moorings. Unfortunately, there are no enforcement authorities on site to ensure that people use the moorings and there are no mooring fees to support the system. It is a recommendation of this Recovery Action Plan that a nation-wide system of moorings be developed. Inexpensive and effective mooring systems are currently available (see Halas, 1985). In the British Virgin Islands, Eckert et al. (1992) describe how local dive operators raised the money necessary to install more than 200 Halas-type moorings, donated time and labour

toward the installation, and took the lead in drafting supporting legislation. User fees are paid directly to the BVI National Parks Trust and are earmarked for mooring maintenance, as well as conservation and law enforcement in sensitive marine areas. Moorings are not only vital to the protection of coral reef habitat, but can also provide much-needed revenue in support of protected areas. Low-flying private aircraft frequently fly between the islands of St. Vincent and the Grenadines, and it may be possible to devise a scheme whereby pilots report yachts not using moorings in protected areas to relevant enforcement authorities.

Land has been reclaimed and the sea floor dredged in Bequia and Union Island to facilitate the building of an airport and the extension of a runway, respectively. In the case of Bequia, coral reefs and sea grass beds in the area were destroyed (see section 3.1). Apparently a preliminary study had suggested that the reefs and sea grass beds were already dead. However, this was not the case and these important habitats have now been lost. It is not clear how the new airport will affect current movements or other oceanographic features, and hence any adjacent beaches. Reclamation on a large scale is planned in the process of building the marina, golf course and residences at Ashton Harbour in Union Island. This construction will probably impact negatively on the sea grass beds off Ashton and any nesting on Frigate Island. Land reclamation has serious environmental implications and, as is the case with any largescale development in an environmentally sensitive area, it is a recommendation of this Recovery Action Plan that a thorough EIA be conducted before permission to reclaim land is given.

4.2 Manage and Protect all Life Stages

In addition to managing and protecting habitat, it is necessary to improve national legislation that presently offers only partial protection to sea turtles. In this section, existing legislation will be reviewed and changes proposed to promote the recovery of depleted sea turtle stocks. Since sea turtles are highly migratory by nature, international efforts are also needed; these are discussed in section 4.3. In particular, with regard to international law, it is important that the Government rescind its "reservation" on international trade in hawksbill products under the CITES treaty (section 4.31).

4.21 Review existing local laws and regulations

The Fisheries Regulations (1987, Section 17 and schedule 10), stipulate that it is illegal for any person to:

- (a) disturb, take, sell, purchase or have in his possession any turtle eggs;
- (b) interfere with any turtle nest; or
- (c) take, sell, purchase or have in his possession any under-sized turtle;
- (d) sell, purchase, or have in his possession the shell of an under-sized turtle;
- (e) take, sell, purchase or have in his possession any turtle or part thereof during the period of a close season for that species of turtle (1 March - 31 July).

Minimum weights for sea turtles (schedule 10) are as follows:

1. Leatherback turtle (*Dermochelys coriacea*) -- 350 lb (158 kg)

2. Green turtle (Chelonia mydas) -- 180 lb (81 kg)
3. Hawksbill turtle (Eretmochelys imbricata) -- 85 lb (38 kg)
4. Loggerhead turtle (Caretta caretta) -- 160 lb (72 kg)

The penalty upon conviction for a first offence is a fine not exceeding EC\$ 5,000. There is no provision for the confiscation of gear used in an offence. Most turtles are caught using turtle nets and spearguns. Tangle (trammel) nets are prohibited (see section 3.4), but single layered, large mesh (4-inch) gillnets set for turtles are not. Speargun use is prohibited "without first having obtained written permission from the Minister" (Fisheries Regulations, 1987, Section 21). This regulation is, however, not enforced and speargun use is widespread and essentially unregulated.

The Wildlife Protection Act of 1987 prohibits hunting in designated Wildlife Reserves (see Table 2) without a license. "Hunting" is defined as seeking, stalking, shooting at, killing, wounding, pursuing, capturing, or molesting by any method. The penalty upon conviction for a first offence is a fine not to exceed EC\$ 2,000. The penalty upon conviction for a second or subsequent offence is a fine not to exceed EC\$ 4,000 or imprisonment for a term of one year, or both. Wildlife Protection Officers may also seize any equipment, including boats, which they have reasonable cause to suspect was used in connection with commission of the offence. Several Wildlife Reserves (e.g., Prune (=Palm) Island, Petit St. Vincent) encompass sea turtle nesting beaches. Thus it appears that sea turtles are fully protected at *all* times of the year while within the confines of Wildlife Reserves (e.g., on reserve beaches). This interpretation has never been tested in court.

4.22 Evaluate the effectiveness of law enforcement

Law enforcement agencies do not have the personnel necessary to properly enforce the environmental legislation in this multi-island state. This is particularly true for enforcement of Fisheries legislation. There are no wardens to patrol beaches and word of a turtle catch may reach authorities long after the turtle has been butchered. Also, there are so many secluded beaches that no one need know when or where a turtle was butchered. This problem is compounded in the Grenadines. Since enforcement is largely in the hands of police officers who are also charged with maintaining general law and order, it is unlikely that the presently under-staffed agencies will be able to offer effective enforcement. A lack of understanding about the need to conserve marine resources and an unwillingness to prosecute low-income offenders may be contributing factors to inadequate enforcement.

It is clear that in order to have more effective law enforcement, more resources need to be channeled to the appropriate agencies. Many Caribbean countries have game wardens, fisheries officers, or other natural resource enforcement personnel. While understaffing is a persistent problem, the presence of these officers means that natural resource law is enforced to a greater degree than if over-worked public law and order officers are forced to dedicate time and energy to beach patrol, sea patrol, and other activities necessary to adequately protect sea turtles and their habitats (curb sand mining, reduce marine dumping, enforce mooring rules, etc.). In addition to enforcement personnel, equipment, especially sea-worthy boats to make the rough inter-island crossings characteristic of the Grenadines, is badly needed. The Fisheries Division presently has only two boats, one on the mainland and one in the southern Grenadines.

To augment efforts of law enforcers, public awareness campaigns might be very effective in encouraging people to report violations, and the media should give the issue more attention as well. To address the challenge at the institutional level, we recommend that a Division of Environmental Enforcement be created (section 4.24).

4.23 Propose new regulations where needed

Wildlife management laws and regulations pertaining to sea turtles must reflect biological realities. The Fisheries Regulations (1987) do not reflect a current understanding of sea turtle biology and do not respond to the needs of diminishing sea turtle numbers in St. Vincent and the Grenadines. Traditional management view has focussed on the protection of small turtles, permitting harvest only after they have attained a certain size (see section 4.21). Biologists now suggest that sea turtles, like most long-lived organisms, should be managed in just the opposite way (e.g., Crouse et al., 1987; Frazer, 1989). Sea turtle population structure is like a pyramid, with thousands of young turtles at the bottom and only one or two adult turtles at the top. As turtles age (become larger and more armoured), fewer of them succumb to predation. The very few which reach adulthood are in a position to survive for decades, during which time they will produce the thousands of eggs necessary to ensure that, in turn, a sufficient number of turtles in the next generation will survive to maturity.

There are two major deficiencies in the laws as they are now written; first, the closed season does not encompass the breeding season and second, large juveniles and adult turtles (the most important size classes to protect; see sections 4.232 and 4.233) are fair game during the open season. Furthermore, it is necessary to question the wisdom of *any* continued harvest of migratory species which are clearly declining throughout the Wider Caribbean region. It is a recommendation of this Recovery Action Plan that a moratorium be implemented on the capture and sale of sea turtles and their products until such time as there is sufficient information to show that a regulated harvest will not compromise the sustainable recovery of depleted sea turtle stocks [N.B. a "total moratorium" was also recommended in CCA/IRF, 1991]. Interim legislation, if needed, is described in section 4.232. In addition, regulations to conserve important breeding and feeding grounds are necessary (see section 4.14).

4.231 Eggs

It is illegal to take sea turtle eggs or to disturb a nest (see section 4.21). What is needed is consistent and effective enforcement of existing statutes.

4.232 Immature turtles

Considering the decline in sea turtle populations around St. Vincent and the Grenadines, it is a strong recommendation of this Recovery Action Plan that all species of sea turtles be protected for a period of time sufficient to allow populations to return to sizes at which they can be harvested sustainably. If a total ban is politically impossible at the present time, we propose two interim options which, while not likely to promote the recovery of depleted stocks in the long-term, will provide an improvement over the current situation. The first is a far better option than the second. *In both cases, the harvest is restricted to green turtles.*

Option 1: total protection for all species whilst nesting; total protection for hawksbills; closed season to encompass the peak breeding season for all species (1 April-30 November); maximum size limit of 60 cm (24 in) shell length for green turtles during the open season; retain full protection for eggs; single layered, large mesh (4-inch) turtle nets legal (nets should be checked often and set so turtles can surface to breathe, and protected species and size classes can be released unharmed).

Option 2: total protection for all species whilst nesting; total protection for hawksbills; retain existing closed season (1 March-31 July); remove size limits during the open season; retain full protection for eggs; single-layered, large mesh (4-inch) turtle nets legal (see Option 1).

We emphasise that banning the catch of hawksbills is a crucial step toward recovery of this species. The decline in hawksbill numbers has been most noticeable to fishermen. The meat is not particularly favoured, Japan placed a zero quota on the import of hawksbill shell as of 1 January 1993, and sale of shells to French-flag vessels passing through the Grenadines is already illegal (since France is a full signatory to CITES). With regard to green turtles, reversing the size limit is not only biologically sensible, but to some extent reflects the realities of the harvest. Discussions with spear-fishermen suggest that the bulk of green turtles currently taken are below 60 cm curved shell length. Adult green turtles are relatively rare in nearshore waters. Thus, our suggestion to impose a maximum size limit will not severely impact upon the activities of those who make up the bulk of fishermen still actively targeting turtles (i.e., the spear-fishermen). We emphasise that these options are suggested as *interim measures only*, while the fishing community prepares for a full moratorium.

The success of measures to promote the recovery of sea turtles is contingent upon the strict enforcement of protective measures outlined above. All efforts at environmental education, enhancing the effectiveness of law enforcement, and offering alternatives for fishermen should be with the objective of weaning people from dependence on harvesting these endangered species, at least for a period of time sufficient to allow population recovery. The time has also come for people to appreciate the value of living sea turtles to the country's developing tourist industry. Furthermore, the support of St. Vincent and the Grenadines in strictly conserving remaining sea turtle stocks is important to the Caribbean community of nations as a whole, many of which have already pledged a similar commitment. If turtles are protected in one nation but plundered in another (remembering that turtles are highly mobile), then serious conservation efforts may ultimately come to naught.

4.233 Nesting females

It is estimated that fewer than one percent of hatchlings will survive to maturity some 20-40 years later (age at sexual maturity depends on the particular species; the herbivorous green turtle appears to be the slowest growing species). Natural mortality is high, especially in the youngest age classes. In contrast, once a sea turtle reaches adulthood, he or she is fully armoured and quite a formidable opponent for any natural predator. Survival in adult turtles has been shown to be very high; in other words, the probability that an adult turtle will die of natural causes during the reproductive years is low. As a result, adult turtles, which represent several years of selective sur-

vival, are expected to live a long time and produce many thousands of eggs. This is the natural cycle of life for sea turtles. The female has to produce at least enough eggs to replace herself and a mate, or the population will eventually go extinct.

When man preferentially harvests the large turtles, he is doing the worst possible thing for the survival of sea turtles. It is imperative that breeding-age turtles be fully protected. If adult turtles are not adequately protected, the declining populations around St. Vincent and the Grenadines will never recover to their former abundance. Measures to protect habitat and nests are very important, but the protection of adults and large juveniles (see also section 4.232) are also essential. Although legislation protects nesting females during the closed season (1 March - 31 July), there is no protection for nesting females at other times of the year. Given the tremendous importance of nesting females to the maintenance of populations, it is a recommendation of this Recovery Action Plan that regulations be enacted to protect them on the beach at all times. In the interim before a year-around ban can be enacted, it is further recommended that the existing closed season (March 1 - July 31) be changed to reflect the peak nesting seasons of species present in St. Vincent and the Grenadines (i.e., 1 April - 30 November). At present, peak hawksbill breeding season (reportedly September-October) lies entirely within the open season!

4.234 Unprotected species

Fisheries regulations presently cover all species of sea turtles known to nest in St. Vincent and the Grenadines.

4.24 Augment existing law enforcement efforts

Several laws, including the Fisheries Act, Wildlife Protection Act, and proposed National Parks Act, have provisions for the Minister to deputise Officers within the Ministry (or hire enforcement personnel) to enforce regulations. However, primarily because of funding constraints, which are particularly acute for administration of the Fisheries Act, sufficient numbers of officers have not been appointed. Creative approaches to augment official law enforcement capacities are greatly needed. People in St. Vincent and the Grenadines, particularly fishermen and residents in the Grenadines, are very aware of the legislation protecting sea turtles. They are generally supportive of this legislation, especially in light of the declining sea turtle populations. Public involvement in law enforcement is, however, limited. There are persons who live near beaches who sometimes monitor nesting activities, but in the main Vincentians believe that law enforcement is a job for law enforcement officers, not the public. Education is the key to provide information and encourage more public support and involvement. The role of the media will be critical here. The introduction of game wardens or other natural resource enforcement personnel would also be an asset.

Environmental law is becoming increasingly important and increasingly technical in St. Vincent and the Grenadines, as is the case throughout the eastern Caribbean. Therefore, consideration might be given to the creation of a Division of Environmental Enforcement be created within an appropriate Ministry. This initiative could be integrated into the highly visible Government declaration of the 1990's as the 'Decade of the Environment' in St. Vincent and the Grenadines. Division officers should be specifically trained in environmental law and enforcement procedures

and be responsible for regulations concerning mining and minerals, pollution, protected species, fisheries and marine resources, boater safety, game and hunting, coastal zone permits and compliance, etc. Officers would logically coordinate closely with other wardens and officers having enforcement responsibility for conservation zones and other protected areas. One option to ensure adequate coverage of the entire territory is to station extension/enforcement officers on each of the major islands. Island offices will need reliable access to marine vessels and other essential transport.

As an alternative to creating a new Division, four officers could be selected from within the Royal St. Vincent and the Grenadines Police Force. These officers would remain part of the police corps, but would be trained as focal points for the investigation of crimes against environmental statutes. Another alternative might be for Government to hire older, respected fishermen to serve as conservation wardens in their islands of residence (see section 4.123). In order to facilitate enforcement of environmental legislation by Police, Customs, Immigration, and other relevant agencies, it is a recommendation of this Recovery Action Plan that a concise yet comprehensive manual of existing environmental legislation be developed for public distribution. Finally, divers, fishermen, and other residents should be encouraged to participate in law enforcement. Coastal residents are in unique positions to monitor out-of-season catches, capture of protected species, and offshore damage to habitats *inter alia*.

4.25 Make fines commensurate with product value

The fine for contravention of Fisheries Regulations is up to EC\$ 5,000. If enforced, the penalty would be a serious deterrent to most fishermen. It could be made even more of a deterrent by stipulating the confiscation of gear (e.g., vehicles, boats, spearguns, nets), as well.

4.26 Investigate alternative livelihoods for turtle fishermen

Although no one makes a living exclusively from capturing turtles, turtle meat brings important income to some fishermen in the Grenadines who sell the catch to hotel restaurants. Furthermore, the meat offers variety in the diet for people in the Grenadines. Alternative sources of protein often have to be imported and therefore require greater income. However, it is important for fishermen to understand that *living* sea turtles can also be an important revenue-generating resource. As the islands attract more long-stay tourists, former turtle fishermen could lead tourists on tours of important beaches (e.g., Mahault Bay on Canouan, or Big Sand on Union Island). Monitoring of both nesting and foraging populations of turtles will benefit greatly from the involvement of fishermen, and their funded participation should be considered in any management programme.

4.27 Determine incidental catch and promote the use of TEDs

There is no local or foreign shrimping in the waters of St. Vincent and the Grenadines. Commercial trawling does not therefore pose a threat to sea turtles locally and there is no need to promote (domestically) the use of "turtle excluder devices" (TEDs). However, trawling elsewhere in the region may threatened conservation measures imposed in St. Vincent and the Grenadines. Since sea turtles visiting our country are vulnerable to drowning in shrimp nets when they venture

into the territorial waters of trawling nations, it must be a recommendation of this Recovery Action Plan that the Government support measures to encourage trawling nations to use TEDs in their shrimp fleets. A recent study concluded that shrimp trawling killed more turtles in the USA than all other man-induced sources of mortality (National Research Council, 1990). Shrimp trawlers operating in U. S. waters are now required to use TEDs in their nets (Crouse, 1993).

Long-liners operating in St. Vincent and the Grenadines' waters are known to accidentally catch leatherback turtles. In 1992 a leatherback was brought into Kingstown for sale by a long-line vessel. The turtles are apparently attracted to the bait and lightsticks attached to the lines. Similarly, the capture of leatherbacks by long-lines is well documented in the eastern Caribbean (Cambers and Lima, 1990; Tobias, 1991; Fuller et al., 1992), the southeastern U.S. (Witzell, 1984), and the Gulf of Mexico (Hildebrand, 1987). It is a recommendation of this Recovery Action Plan that the extent to which long-line vessels capture sea turtles in the waters of St. Vincent and the Grenadines be determined as soon as possible. Data sheets should be provided to captains by the Fisheries Division and reporting should be mandatory in order to qualify for a fishing licence [N.B. under the Fisheries Act (1986), the Minister can "vary any special conditions attached to any fishing licence."]. Mitigating measures should be imposed should incidental capture be reported.

4.28 Supplement reduced populations using management techniques

Identifying and protecting important foraging areas and natural beaches (section 4.11), revising fisheries legislation to include a moratorium on the harvest of sea turtles and their eggs (section 4.23), and initiating long-term population monitoring programmes on selected Index Beaches (section 4.291) are considered by this Recovery Action Plan to be the highest national management priorities. Second priority should be placed on identifying threatened nesting or foraging populations that would benefit from specific, hands-on initiatives. Implementing management options such as moving eggs threatened by erosion, poaching, or predators, or establishing a hatchery for the secure incubation of eggs should be undertaken as needed with advice of sea turtle experts and pursuant to management techniques described in Pritchard et al. (1983).

An individual sea turtle has the capacity to lay thousands of eggs in her lifetime, yet the probability that a given egg will lead to the production of a mature female is less than one percent. Many hundreds of hatchlings must enter the sea for each female that survives to adulthood. Recognising that there will continue to be productivity losses to predators, erosion, natural levels of infertility, etc., it is important that Government take quick steps to protect eggs from ongoing, illegal consumption by humans. Where necessary to protect eggs from poachers or predators, fenced hatcheries may have to be considered. However, hatcheries should be used only if absolutely necessary. The artificial incubation of eggs and the improper handling of eggs and hatchlings can be disastrous. Incubation temperature is largely responsible for determining hatchling sex, so any attempt to artificially incubate eggs may skew the normal sex ratio of the nest.

The occasional erosion-prone nest should be relocated to a safe place on the natural beach. The decision to do so should be made at the time of egg-laying. If eggs are moved after the first 24 hr, the risk is high of dislodging the tiny embryo from the inner lining of the eggshell and killing it.

Sometimes a compromise has to be made. If, for example, eggs are being washed away, such as by a storm surge, an attempt to salvage the clutch is prudent. There may be a steep decline in the hatch success of the rescued nest, but this would be preferable to a total loss. Eggs should always be handled with great care and reburied on a natural beach, preferably the one where the female made the original nest. The new nest should be dug to the same depth as the original nest and in the same type of habitat (open beach vs. beach forest) so that the temperature of incubation is not altered. Hatchlings should always be allowed to emerge from the nest naturally and traverse the beach unaided as soon as they emerge.

4.281 Sea turtle mariculture

At the present time there is no need to consider farming, ranching, or headstarting (raising turtles for about one year and then releasing them) as conservation or management options in St. Vincent and the Grenadines. Mariculture projects are expensive, requiring elaborate facilities and trained husbandry and veterinary staff. Keeping hatchlings in captivity for a time before releasing them (ostensibly to "protect" them from predators) is especially counter-productive. It is possible that these young turtles will never properly "imprint" on their natal beaches (and thus will not return to nest as adults on our beaches), that their physiological and muscular development will be compromised by being raised in a tank or other small enclosure, and/or that they will not participate fully in the complex life cycle that, for most species, involves an epipelagic (i.e., surface-dwelling in the open sea) stage lasting from one to several years after leaving the nesting beach. Long-term headstarting projects in Florida and Texas (USA) with green turtles and Kemp's ridleys, respectively, have recently been terminated because there was no evidence that the programmes were benefiting wild populations (Huff, 1989; Williams, 1993; Byles, 1993).

There are no functioning sea turtle ranches in the western Hemisphere (except perhaps in Cuba?). 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) [N.B. a sea turtle "farm", on the other hand, is a closed-cycle system such as the Cayman Turtle Farm on Grand Cayman, BWI]. As with any harvest-based scheme, Government should be responsible for accurately determining a sustainable yield so that the ranching initiative does not result in declines in wild populations. In attempting to set a harvest quota, the declining trend in sea turtle populations should be taken into account. With sea turtles already endangered in the Wider Caribbean region (Groombridge, 1982) and nearly everywhere declining, it is not intuitively clear what benefit could be gained by a commercial harvest. As stated earlier (see section 4.23), it is a recommendation of this Recovery Action Plan that a moratorium be implemented on the harvest of sea turtles until such time as there is sufficient information to show that a regulated harvest will not compromise the sustainable recovery of depleted wild stocks.

The "Sea Turtle Conservation Strategy" adopted by the 1979 World Conference on Sea Turtle Conservation concludes that until definitive answers to questions concerning the impact of commercial turtle culture (farming and ranching) on prices of turtle products, on the creation of new markets, on the capture of turtles from wild populations, and on the trade in products derived from wild-caught sea turtles are forthcoming, the following cautions are necessary: (a) commercial

mariculture must be in conformity with all applicable conservation regulations and laws, whether local, national, regional or international, (b) care should be taken that special legal provisions and exemptions for farmed [or ranched] products are not misused by importers and exporters, (c) any effort by commercial mariculture interests to develop markets for new turtle products or to create demand for turtle products where it did not previously exist is insupportable, and (d) the establishment of new commercial mariculture operations must be discouraged until it is certain that such operations will not cause, directly or indirectly, a further decline in turtle populations.

In an earlier treatise, Schulz (1975) described how difficult it would be to assign sustainable harvest quotas (such as would be necessary to provide stock for a sea turtle ranch) because sea turtles are highly migratory. In the absence of data on the long-distance journeys of "Vincentian turtles", how can it be known that harvest in our waters will not compromise conservation initiatives in neighbouring countries? Further, how can "sustainable" quotas be set when we cannot define even the most basic demographic features (e.g., age distribution, total reproductive output, life span, survivability) of Vincentian sea turtle populations? Answers, even crude answers, to these complex questions are presently unavailable. With this in mind, it is important that the Government of St. Vincent and the Grenadines clearly define why sea turtle mariculture (in any form) is a relevant conservation or economic strategy in St. Vincent and the Grenadines, and equally important that the Government be cautious of domestic or foreign commercial interests that may seek to make farming or ranching sound more appropriate or relevant for specific conservation or economic needs in St. Vincent than it is likely to be.

4.29 Monitor stocks

4.291 Nests

While some beaches are traditionally known for nesting activity, no comprehensive programme has ever been carried out to monitor the breeding effort. Such a programme is essential to evaluate the effectiveness of conservation measures, including new legislation proposed in section 4.23 [N.B. positive results may not be seen right away, however, since eggs protected today are not likely to mature into breeding adults for two decades or more]. This cannot be achieved without monitoring the number of females nesting each year and the number of nests laid. In addition, it is not possible to effectively design management and conservation programmes if the problems facing nesting turtles on different beaches are not adequately defined. The solutions may differ depending on whether the dominant threat to nests and incubating eggs is erosion, poaching, domestic dogs, litter, vehicular traffic on the beach *inter alia*.

Since it is neither practical nor necessary (at least from a data collection perspective) to monitor all sandy beaches, it is a recommendation of this Recovery Action Plan that Index Beaches be selected for long-term study. We suggest Mahault Bay (Canouan), Big Sand (Union), and Pasture Bay and L'Ansecoy (Mustique) [N.B. baseline field work is still needed in St. Vincent, Bequia, and the smaller Grenadine Islands in order to identify the most important nesting beaches there]. Alternatively, monitoring of all beaches on one island, possibly Canouan, might be productive. Many local people in the southern Grenadines believe nesting to be most abundant on Canouan. Monitoring the deposition of eggs provides a wealth of useful information, including the

distribution and timing of the breeding effort, the species involved, the location of the most important breeding habitats, and nest fate. The assistance of hotel staff, dive clubs, and pleasure-boat operators should be sought to participate in the monitoring effort.

Index Beaches should be carefully protected from activity that will compromise the suitability of the habitat to support sea turtle nesting. Since these beaches represent the most important nesting areas for endangered sea turtles in St. Vincent and the Grenadines, it is vital to preserve them as focal points for conservation, management, and monitoring. As noted above, the data collected will enable the Fisheries Division to evaluate the success of conservation and recovery measures implemented on behalf of sea turtles. Index Beaches should be monitored on a daily basis for nest and hatch success, by species, during the cumulative peak breeding seasons for all three locally nesting species (i.e., 1 April - 30 November). Data should be centrally compiled, perhaps by the Fisheries Division. Field workers should receive preparatory instruction prior to their survey efforts (see section 4.55).

While it is important, where possible, to reliably differentiate between successful egg-laying (a nesting crawl) and unsuccessful egg-laying (a "false crawl"), such a determination is problematic after the fact. Whether or not eggs are deposited depends on obstacles (erosion bluffs, fallen trees, beach lagoons) encountered by the female during the course of her time on the beach, disturbance (human activity, dogs, lighting), the physical condition of the site chosen (she may encounter impenetrable roots or water or the sand may be too dry to hold a nest cavity), and injuries such as a missing flipper. A nest:false crawl ratio is best determined from all-night patrols or, if erosion and poaching can be ruled out, by returning to the nest site two months hence and verifying a hatch. Some idea of the nest:false crawl ratio is necessary to estimate nest density from crawl tallies obtained during day census efforts. When a crawl has been counted, it should be disguised with a palm frond or a gentle sweeping motion of hands or feet in order to dissuade possible poachers from finding the site and also to prevent the crawl from being counted twice.

It is usually difficult to confirm eggs during day surveys, but in some cases the outcome is obvious. For example, sometimes it is clear that a turtle returned to the sea without attempting to dig. This is a "false crawl" and should be reported as such. Alternatively, when a poacher or predator has exposed eggs, or hatchlings are observed, nesting can be confirmed. When the activity site includes both a crawl and an associated disturbance which may or may not contain eggs, distinguishing a true nest from an unsuccessful attempt is challenging even for an experienced worker. Probing for the eggs with a sharp stick will sometimes confirm the presence of a nest, but this is strongly discouraged because subsequent bacterial invasion of the broken eggs may destroy the entire nest. In the case of hawksbill nests in dense vegetation, even finding a site suitable for probing can be difficult. Thus, while the number of *nests* laid is the best index of beach productivity, in reality it is more typically the number of crawls (i.e., both successful and unsuccessful attempts) that forms the basis for comparison between years and among beaches.

Identifying a fresh crawl to species is easy in many cases, since sea turtles leave either a symmetrical or an asymmetrical track in the sand. In the first case, the pattern is made by the simultaneous movement of the foreflippers. In the second case, the pattern alternates like a zipper,

a result of the turtle moving her front flippers in an alternating rhythm. Leatherbacks leave a deep, symmetrical crawl about 2 m in width. Green turtles also leave a symmetrical crawl, but it is only about 1-1.2 m in width and the nest site is often characterised by a deep, solitary pit a metre or more in depth and breadth. Hawksbills and loggerheads leave an asymmetrical crawl, the hawksbill about 0.7 m in width and the loggerhead about 1-1.2 m in width. The hawksbill crawl is often faint since the animal averages a mere 54 kg (Caribbean Nicaragua: Nietschmann, 1972 *in* Witzell, 1983). Loggerheads are typically twice as massive, averaging about 116 kg in Florida (Ehrhart and Yoder, 1978 *in* Dodd, 1988). Hawksbills will often make their nests deep within the shelter of Coccoloba or other beach vegetation. [N.B. Loggerhead nesting is so rare that species identification should always be verified by examining the hatchlings.]

If the nest:false crawl ratio has been determined and the number of nests laid (per species) is known, a knowledge of the average number of clutches laid per female (which varies slightly amongst species and can be gleaned from well-studied populations elsewhere in the region) can be used to estimate the number of breeding females at that site. As a general rule, leatherbacks average 6-7 nests per summer, hawksbills 5 nests, and green turtles 4-5 nests. As an example, 40 hawksbill crawls on a beach may represent only 30 actual nests, which in turn represent only six adult females. To obtain a more accurate assessment of the number of females nesting per year on a particular beach, all-night patrols must be undertaken by trained personnel. All-night patrols could initiate tagging of nesting females. Tagging, however, is not a technique to be undertaken lightly. It requires careful training so that the few nesting females remaining are not scared away from these important nesting beaches, as well as a long term research commitment in order to gain knowledge beyond that obtained from daily nest counts. Nesting hawksbills are presently being tagged in Barbados and beach patrols and fishermen should be on the alert for flipper tags.

4.292 Hatchlings

In the absence of nest monitoring, hatch success is not possible to assess. Any programme introduced to monitor nests should include a hatchling monitoring programme including hatch success and mortality factors. Hatching occurs some 55-70 days after egg-laying. Hatchlings typically emerge at dusk, so biologists or other trained personnel should be prepared at that time to observe whether or not hatchlings are successfully emerging from their nests and making it to the sea. Subsequent management efforts should be designed to mitigate the dominant threats, including disorientation from artificial lighting shining on the beach, vehicle traffic (creating tyre ruts that trap the small turtles), domestic dogs or other significant predators, litter, etc. Problems must be defined before they can be solved. Hatch success can be estimated by analysis of nest contents following the natural emergence of all hatchlings: estimate the number of hatchlings from the number of broken egg shells in the nest, then estimate total clutch size by factoring in the number of undeveloped eggs, pre-term embryos, hatchlings dead in nest, etc.

4.293 Immature and adult turtles

Technically, it is less difficult to monitor the number of nesting females arriving on beaches each year than it is to monitor the numbers of juvenile and adult turtles using St. Vincent and the

Grenadines' waters. However, given the extremely depleted state of nesting populations here, monitoring of foraging populations becomes very important. Blue Lagoon (St. Vincent), Friendship Bay (Canouan), Ashton Harbour (Union) and the Pillories (Mustique) are considered to be important foraging grounds (section 4.111). Assistance from fishermen and SCUBA dive operators should be solicited for this effort. Study sites should be visited repeatedly and standard sea turtle sightings forms used. Any turtles that can be held should be measured and tagged by trained personnel before being released. If these turtles are subsequently recaptured, spatial and temporal residency patterns and growth rates can oftentimes be determined and/or monitored. Valuable insights on international movements of sea turtles can also be obtained from such tagging programmes (section 4.33). The data collected should be centrally compiled, perhaps by the Fisheries Division.

4.3 Encourage and Support International Cooperation

4.31 CITES

The 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is among the most powerful wildlife treaties in the world. With 120 Parties worldwide, it has been very effective at reducing international commerce in endangered and depleted species, including their parts and products. Appendix I lists endangered species (including all species of sea turtle), trade in which is tightly controlled; Appendix II lists species that may become endangered unless trade is regulated; Appendix III lists species that any Party wishes to regulate and requires international cooperation to control trade; Appendix IV contains model permits. Permits are required for species listed in Appendices I and II stating that export/import will not be detrimental to the survival of the species.

It is an urgent recommendation of this Recovery Action Plan that St. Vincent and the Grenadines, which acceded to CITES in 1989, join the international community of nations in removing its "reservation" on the hawksbill sea turtle (*Eretmochelys imbricata*) and cease all international commerce in this globally endangered species. Repeal of the reservation is especially important because it appears that some wildlife traders are falsifying shipping documents to indicate this country as the point of origin for sea turtle products illegally exported to Japan from CITES parties. This is seen in the fact that St. Vincent and the Grenadines' export data do not correspond with Japan's import data (Table 1). Because St. Vincent can legally trade hawksbill products under the reservation, the sovereignty of St. Vincent and the Grenadines is being abused by unscrupulous traders. The argument put forward to justify the reservation is that since hawksbills are being caught in the country anyway, why not also supplement the financial income from shell trade as well. While this argument is not totally without merit, the fact is that Japan (the primary market), announced a zero quota for the importation of raw hawksbill shell at the end of December 1992, and will withdraw its treaty reservation in July 1994 (Donnelly, 1991; TRAFFIC International, 1991). Soon, there will be *no* legal international market for local turtle shells and thus no incentive for the continuing harvest.

In addition to the political aspects, the biological argument for ending the international trade is also a strong one. Hawksbills are endangered and declining the world over. Remaining populations in the Caribbean and elsewhere no longer appear to be able to withstand current levels of

either subsistence or commercial harvest. In a recent global review of the status of hawksbill sea turtles, Groombridge and Luxmoore (1989) concluded that about half of the known nesting populations are known or suspected to be in decline; in particular, "the entire Western Atlantic-Caribbean region is greatly depleted." In total, since 1970, Japan has imported sea turtles products representing a minimum of 2,250,000 sea turtles, many of them hawksbills caught in Caribbean waters (Canin, 1991). Amongst Eastern Caribbean islands, St. Vincent and the Grenadines has been a major trading partner for Japan over the years, supplying (according to Japanese import data) 2,235 kg of raw hawksbill shell between 1970-1986 (Milliken and Tokunaga, 1987) and a further 2,005 kg between 1987-1990 (data courtesy of TRAFFIC). Based on a Caribbean average of 1.34 kg shell scutes per animal (Milliken and Tokunaga, 1987), more than 4,000 hawksbill turtles may have been killed in the last 20 years to service this trade. While data supplied by our Government indicate lower export volumes, the trade is clearly substantial. Fishermen interviewed for this Action Plan were nearly unanimous in their reports that hawksbills have declined noticeably in the Grenadines during the last few decades.

Since it is the view of WIDECAST that all sea turtles should be fully protected as soon as practicable in all Wider Caribbean countries, and the purpose of this Action Plan is to support St. Vincent and the Grenadines in efforts to design and implement scientifically sound management plans to encourage the recovery of local sea turtle populations, it must be a recommendation of this Recovery Action Plan that the Government withdraw its CITES reservation on the hawksbill sea turtle prior to the November 1994 Meeting of Parties.

4.32 Regional treaties

A regional environment Convention that shows great promise is the United Nations Environment Programme's (UNEP) Regional Seas Convention in the Caribbean, known as the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (or, the "Cartagena Convention"). In March, 1983, a Conference of Plenipotentiaries met in Cartagena, Colombia to negotiate this convention. Representatives from 16 states participated; St. Vincent and the Grenadines did not attend. The Conference adopted both the convention and a Protocol Concerning Cooperation in Combating Oil Spills in the region. Article 10 is of special interest to sea turtles in that it addresses the responsibilities of contracting parties to "individually or jointly, take all appropriate measures to protect and preserve rare or fragile ecosystems, as well as the habitat of depleted, threatened or endangered species, in the convention area". St. Vincent ratified the convention on 11 July 1990.

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

bation, estivation or migration, as well as other periods of biological stress. Annex III denotes species in need of "protection and recovery", but subject to a regulated harvest.

On 11 June 1991, Plenipotentiaries again met in Kingston, Jamaica, to formally adopt the Annexes. The Conference voted to include all six species of sea turtle inhabiting the Wider Caribbean (i.e., Caretta caretta, Chelonia mydas, Eretmochelys imbricata, Dermochelys coriacea, Lepidochelys kempii, and L. olivacea) in Annex II (UNEP, 1991; Eckert, 1991). The unanimous vote on this issue is a clear statement on the part of Caribbean governments that the protection of regionally depleted species, including sea turtles, is a priority. It is a recommendation of this Recovery Action Plan that St. Vincent and the Grenadines ratify the SPAW Protocol with its Annexes at the earliest possible opportunity, in this way sending a strong signal that the Government stands willing to participate in cooperative efforts to conserve the region's rich natural heritage.

The 1973 MARPOL treaty (with 1978 Protocol) is also important to the survival of sea turtles. This Convention has five Annexes that give detailed technical specifications regarding the way in which a ship must be built and equipped to prevent major pollution of the marine environment in case of accidents, and also norms and technical requirements to minimize operational discharges. The five Annexes are for oil, chemicals in bulk, packaged chemicals, liquid sewage, and garbage. Regarding Annex 5 (garbage), it has been proposed to the International Maritime Organization (IMO) by the nations of the Caribbean that the Caribbean Region be declared a "Special Area". This proposal has been accepted, but will only come into force when the nations have put into place adequate facilities to receive garbage on shore. It is a recommendation of this Recovery Action Plan that St. Vincent and the Grenadines ratify MARPOL as soon as practicable. The 1978 Protocol was ratified by the Government in September 1984 (UNEP, 1989).

4.33 Subregional sea turtle management

Sea turtles are highly migratory, as evidenced by the fact that tagged turtles are often recovered hundreds and sometimes thousands of kilometres distant from the point of tagging. Hatchlings leaving the beaches of St. Vincent and the Grenadines embark on a journey that will likely take them to dozens of nations over the course of their juvenile years (most sea turtles do not reach sexual maturity for 20 years or more). A comprehensive tagging programme initiated jointly with St. Lucia, Barbados and Grenada would illustrate the extent to which foraging turtles are shared amongst our neighbours. A joint proposal for funding to initiate such a tagging programme was submitted by WIDECAST Country Coordinators in these four countries and forms part of the draft IUCN Global Action Plan for Sea Turtles.

A moratorium on sea turtle harvest has been repeatedly endorsed by member OECS states and is mandated by the SPAW Protocol to the UNEP Cartagena Convention (see section 4.32). The Government could participate meaningfully in the regionwide conservation of sea turtles by ratifying the SPAW Protocol and terminating its trade in hawksbill sea turtle shell (see section 4.31). Hawksbills are a regional resource and their continued capture in St. Vincent and the Grenadines undermines efforts of other Caribbean countries to protect this endangered species.

4.4 Develop Public Education

4.41 Residents

It appears that sea turtle populations have become depleted to such an extent that catches or sightings in some areas are really quite infrequent. One consequence of this is that only the older people remember the former abundance of sea turtles. An educational campaign to heighten awareness of the need to conserve what remains of local sea turtle populations should be initiated. An increased understanding by the public may be necessary before the Government will see strengthening of the legislation protecting sea turtles as a priority, or before existing legislation can be effectively enforced. As one option, it is a recommendation of this Recovery Action Plan that the network of YES clubs be extended more widely through the Grenadines, and that the clubs initiate projects on sea turtles. These might include "adopting" a nesting beach (keeping it free of garbage), monitoring nesting activity, and/or safeguarding nests.

With the present thrust at environmental preservation (the 1990's having been declared the 'Decade of the Environment' in St. Vincent and the Grenadines), and the increasing recognition of the importance of the marine environment to tourism development, it should be possible to feature sea turtles as part of a campaign to encourage environmental resource preservation. Sea turtles can be used not only to exemplify local endangered species, but also the importance of conserving essential coastal habitat (coral reefs, sea grass beds, sandy beaches) and eliminating garbage on the beach and in the marine environment. The schools must be specific target areas, since children tend to be most responsive to the idea of conservation. Many adults still find it hard to accept the fact that sea turtles are becoming extinct, even if they acknowledge reduced stock sizes. Education toward adults should seek to emphasise that stock sizes are reduced not just in St. Vincent and the Grenadines, but regionally and globally.

The Fisheries Division has already produced fact sheets, posters and stickers that include sea turtles and which put across messages very effectively. Extension officers on the mainland also regularly visit schools and community groups and talk to the students about sea turtle conservation as part of the activity. Extension officers use WIDECAS species identification sheets which are available from the WIDECAS Country Coordinator, Mr. Nigel Scott (Arnos Vale). It is a recommendation of this Recovery Action Plan that extension officers travel more often to the Grenadines to talk to schools and community groups there. Since turtles live for many decades, perhaps about a human life span, the results of our conservation and recovery efforts will be slow in coming. We cannot afford to wait.

4.42 Fishermen

Increasing awareness amongst fishermen is important. It must, however, be borne in mind that given the economic standing of most fishermen, selling turtle products is an attractive proposition. The challenge of convincing fishermen to conserve remaining sea turtles may lessen considerably now that the Japanese market for shells is lost. Japan ceased to import turtle shell at the end of 1992 (see section 4.31). The fishermen should be made aware of the global standing of sea turtles, and of efforts in neighbouring countries to conserve remaining stocks. If agreements were made with Grenada, for instance, that prohibited sea turtle catch on both sides of the border,

St. Vincent and the Grenadines' fishermen would feel less like they were sacrificing personal income while fishermen in Grenada continued to harvest all the sea turtles they encounter. The burdens, as well as the benefits, of conservation must be equitably shared. When seeking to inform fishermen of the plight of sea turtles, the following points should be made:

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

4.43 Tourists

Until recently, much of the turtle shell obtained in this country was exported to Japan. However, substantial amounts, especially in the form of whole polished shells, are bought by yachts-people passing through the Grenadines (reportedly many of these vessels are French registered). They should be advised about the endangered status of sea turtles and the fact that they could be prosecuted if they return to a country (such as France) that is a signatory to CITES and does not hold reservations with regard to sea turtles (only Cuba, St. Vincent and the Grenadines, and Japan have entered CITES reservations on the hawksbill sea turtle). Efforts by the Ministry of Tourism to

educate tourists are ongoing (e.g., informative flyers have been placed at customs stations, airports and seaports). The development of brochures and other information for hotels and dive shops is a priority. The assistance of WIDECAS in preparing these materials has been solicited.

4.44 Non-consumptive use of sea turtles to generate revenue

Living sea turtles now have a potentially important role to play in the development of the tourism industry in St. Vincent and the Grenadines, the economic benefits of which will spread further than could be achieved solely from fishing for sea turtles. As on-island tourism (as opposed to yacht tourism) becomes more widespread, the demand for water sports will grow. These may include snorkeling, SCUBA, glass bottom boat tours, etc. The importance of living sea turtles as an attraction for tourists, and hence their economic worth, will encourage local people to participate in efforts to conserve them. SCUBA dive operators are frequently requested for dives at sites where turtles may be seen, and many people associate a lack of sea turtles with a disturbed marine environment. At present SCUBA tourists from the Canouan Beach hotel on the south west tip of Canouan and those from Union island are taken to the Tobago Cays to dive in order to enjoy the marine life.

The feasibility of glass-bottom boat trips for less adventurous tourists that pass over deeper sea grass/algal beds to view foraging green turtles could be investigated in both Canouan and Union islands. There is a glass bottom boat operator in Barbados that offers a similar trip, which has given him a competitive advantage over other tours. There is tremendous potential for such activities, but they depend on being able to see turtles on a reliable basis. It may also be an attractive proposition, particularly for hotels in the Grenadines, to have guided "turtle walks" as part of their tourist packages. However, until some monitoring of nesting activity has been completed, it will not be possible to identify which beaches this would be most feasible on. It is essential that turtle walks are led by an experienced guide and that appropriate beach etiquette is maintained (i.e., small groups, no bright torches, no flash photography, an atmosphere of quiet observation). WIDECAS is currently preparing a manual for use in establishing "sea turtle eco-tourism" programmes.

4.5 Increase Information Exchange

4.51 Marine Turtle Newsletter

The Marine Turtle Newsletter (MTN) is a scholarly publication that provides timely information regarding the conservation status of sea turtles around the world, as well as new research techniques and a listing of current scientific publications about sea turtles. English and Spanish editions of the MTN are distributed quarterly, free of charge, to readers in more than 100 countries. At the present time, the Newsletter is received in St. Vincent and the Grenadines by the Fisheries Officer, the WIDECAS Country Coordinator, and the OECS (Fisheries Unit) and CFRAMP offices. We recommend that local readership be broadened to include conservation groups and public libraries in the country. To subscribe, please notify the Marine Turtle Newsletter Editors, Hubbs-Sea World Research Institute, 2595 Ingraham Street, San Diego, California 92109 USA.

4.52 Western Atlantic Turtle Symposium (WATS)

St. Vincent and the Grenadines participated in both WATS I (Costa Rica, 1983) and WATS II (Puerto Rico, 1987). Chief Fisheries Officer Kerwyn Morris represented this country on both occasions. There is no reason to suggest that this country will not continue to participate in future symposia. An important resource book, the Manual of Sea Turtle Research and Conservation Techniques (Pritchard et al., 1983), was a product of WATS I.

4.53 WIDECAST

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

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

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

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

Beyond supporting the local and national efforts of governments and non-governmental organizations, WIDECAST works to integrate these efforts into a collective regional response to a common problem, the disappearance of sea turtles. WIDECAST is supported by the Caribbean Trust Fund of the UNEP Caribbean Environment Programme, as well as by government and non-government agencies and groups. It would be useful to make all governmental and non-governmental organisations with an interest in conservation, aware of the WIDECAST effort in St. Vincent and the Grenadines. This regional programme is unique in providing assistance to governments seeking support in developing and implementing sea turtle recovery actions. The Country Coordinator is Nigel McA. Scott (P. O. Box 1584, Kingstown). Information can also be obtained from Dr. Julia Horrocks, WIDECAST Regional Sea Turtle Recovery Team, Bellairs Research Institute and UWI Department of Biology, St. James, Barbados.

4.54 IUCN/SSC Marine Turtle Specialist Group

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

4.55 Workshops on research and management

Travelling scholarships or fellowships for individuals involved in turtle conservation efforts to join established field conservation projects, such as those at Tortuguero (Costa Rica) or Rancho Nuevo (Mexico), for short periods would be extremely valuable. WIDECAST has supported Caribbean biologists in attending the Tortuguero course in the past, and this kind of support would be very welcome in St. Vincent and the Grenadines. Workshops for subregional groups (e.g., small islands with extensive turtle subsistence problems to overcome, or small islands with extensive tourist associated problems to overcome) where practical solutions (e.g., inexpensive limited man power) to problems can be discussed would be useful. WIDECAST would be in a good position to sponsor such workshops. If such an activity were to be planned, St. Vincent and the Grenadines would be interested in participating.

4.56 Exchange of information among local groups

The JEMS Progressive Youth Organisation already has a good track record as a non-government, environmental conservation organisation. Along with the National Trust (a statutory body established in 1969 to conserve and protect the historical and natural heritage) and the Union Island Association for Ecological Preservation, these organisations could provide a clearinghouse for information exchange among other interested local groups. The aforementioned organisations have already indicated an interest in becoming involved in sea turtle conservation. The publication of this Action Plan will significantly enhance the quality and quantity of sea turtle conservation information available to local groups.

4.6 Implement a National Sea Turtle Conservation Programme

4.61 Rationale

A long history of exploitation of sea turtles around St. Vincent and the Grenadines suggests that it was, until quite recently, one of the most important sea turtle nesting and foraging areas in the eastern Caribbean region. Four species utilise the waters and sandy beaches of St. Vincent and the Grenadines. The hawksbill, green, and leatherback are classified as Endangered by the World Conservation Union (IUCN), and the loggerhead as Vulnerable. Despite the long history of exploitation of local populations, no population monitoring has occurred. However, fishermen and dive operators throughout the country acknowledge the relative scarcity of sea turtles in the waters and nesting on the beaches today compared to previous years. This Recovery Action Plan has discussed the causes of decline of the different species and proposed steps that should be taken as soon as possible if populations are to be saved from complete collapse. Sea turtle conservation in St. Vincent and the Grenadines could be enhanced by the implementation of a national Sea Turtle Conservation Programme based on recommendations in this Action Plan. This programme, articulated below, might be most appropriately integrated with national fisheries management planning.

4.62 Goals and objectives

The primary goals of the Sea Turtle Conservation Programme are to determine the distribution and abundance of sea turtles, to conserve foraging and nesting populations of sea turtles, to enhance public awareness of the need for sea turtle conservation, and to promote the sustainable, non-consumptive use of sea turtles at least until populations have recovered sufficiently for controlled harvest to be resumed. For the goals and objectives of the Programme to be realised, sea turtles and their nesting and foraging habitats must be adequately protected by national legislation.

The specific objectives of the Programme are to:

1. Determine nest density and nest success on important nesting beaches in the major Grenadine Islands and St. Vincent over five consecutive years, based on ground surveys.
2. Determine, as closely as possible, the distribution and abundance of turtles at sea over five consecutive years using sightings data collected from fishermen and dive operators and during proposed coral reef/sea grass monitoring programme.
3. Identify critical nesting and foraging habitats, based on the results of field surveys (see 1. and 2. above) and implement comprehensive conservation/management programmes in these areas.
4. Increase understanding of residency patterns and movements of sea turtles (including an evaluation of the extent to which turtles are shared with neighbouring countries), by initiating a tagging programme.

5. Quantify the current annual exploitation of sea turtles, based on user and fish market surveys. Quantify the number of people currently earning income from sea turtle exploitation. Evaluate alternative non-consumptive means to generate revenue from sea turtles for these resource users.
6. Improve law enforcement by increasing the numbers of trained personnel and boats. Develop educational materials and training sessions to increase awareness of sea turtle conservation and promote greater community involvement in enforcement.
7. Enhance public awareness of the need for sea turtle conservation through the development of educational materials for schools, fishermen, and other sectors of society.
8. Develop educational materials for visitors. Encourage active participation of hotels and visitors in monitoring nesting and hatching and in safeguarding nests.

4.63 Activities

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

1. Appoint/hire a Coordinator for the National Sea Turtle Conservation Programme and establish a centralised data base for assembling, maintaining and updating sea turtle information. It is our view that if a Conservation Officer (or equivalent) position is dedicated within the Fisheries Division (see section 4.121), this individual could serve as the National Sea Turtle Coordinator. The Fisheries Division is also in the best position to coordinate data.
2. Implement a monitoring programme on Index Beaches (Action Plan section 4.291) on the major Grenadine Islands and St. Vincent over five consecutive nesting seasons. WIDECAST will be asked to provide technical support and train employees and volunteers for this purpose.
3. Train employees/volunteers to monitor catch and sale of turtle products whilst turtle fishing remains legal. This will involve monitoring of fish markets and sales of shells to local buyers, yachts, etc.
4. Encourage and facilitate the participation of employees and volunteers in regional training programmes (e.g., the training course at Tortuguero, Costa Rica), ongoing research projects (e.g., Jumby Bay-WIDECAST hawksbill research project on Long Island, Antigua), and/or research and conservation activities at Bellairs Research Institute in neighbouring Barbados.
5. Organise a series of workshops targeting sea turtle fishermen, dive operators and hotel staff on St. Vincent and the major Grenadine islands to inform them of the current state of knowledge of sea turtle biology and conservation, and to request their assistance in monitoring nesting and foraging population sizes.

6. In collaboration with the Fisheries Division, investigate the feasibility and desirability of employing retired or highly respected fishermen part-time (preferably using their own boats) as community-based Deputies to enforce Fisheries regulations.
7. Initiate capture-tag-release studies at important foraging sites. WIDECAST can provide technical support to train fishermen and dive operators for this purpose. Coordinate tagging efforts with ongoing tagging programmes in Barbados (contact Dr. Julia Horrocks, Bellairs Research Institute) and St. Lucia (contact Mr. Crispin d'Auvergne, ENCORE project, Ministry of Planning).
8. Develop holistic management plans for critical nesting and foraging habitats within the context of existing national legislation, taking into account the specific recommendations of this Recovery Action Plan and encouraging the active participation of resource users.
9. Conduct "on-site" demonstrations for planners, developers and architects to reinforce the "sea-turtle friendly" recommendations proposed in this Action Plan.
10. Establish buoys and signs demarcating important sea turtle foraging and nesting beaches in existing marine conservation areas or wildlife reserves.
11. Assist hotel staff with training and educational materials to encourage their own and visitor participation in sea turtle monitoring and conservation activities.
12. Investigate the feasibility of glass bottom boat tours and nesting beach tours in selected areas, as carefully designed components of management plans described in 8. above, and making maximum use of former sea turtle fishermen as key personnel.
13. Initiate a national public awareness campaign making use of posters, brochures, media events, "bumper stickers", school and library programming, narrated slide shows, video productions, etc. The campaign will be targeted at specific sectors of society, including fishers, divers and yachters, coastal planners and developers, visitors, and the general public

4.64 Results and Outputs

1. Employees/volunteers active in the Programme will receive formal training in sea turtle conservation and management, enhancing the nation's ability as a whole to wisely conserve remaining stocks.
2. A Manual to complement this Action Plan will be developed describing how to conduct beach surveys, complete sightings data forms, tag turtles *inter alia*.
3. Data on numbers of turtles nesting, numbers of turtles harvested, and their important nesting and foraging sites will become available for use in addressing deficiencies in the Fisheries Act and other environmental and planning legislation, and in identifying critical habitats needing protection but currently not protected.

4. Sea turtle conservation materials (brochures, posters, videos, slide shows) will be available for public distribution, enhancing both resident and visitor awareness of sea turtle conservation issues in St. Vincent and the Grenadines.
5. At least five Workshops will be conducted to inform and to solicit assistance for the various monitoring programmes. Training and educational materials, including this Action Plan and relevant data forms, will be provided.
6. Annual Reports will be prepared by the Coordinator summarising data collected during nesting beach surveys, sightings accumulated during marine habitat surveys, results of tagging efforts, and any other relevant information arising from research initiatives. The Annual Report will be made available to all interested government and non-government entities.
7. A system of community-based Deputies will be in place to assist in enforcement of Fisheries legislation.

4.65 Budget

The budget proposed below (in US\$) will enable all components of the Sea Turtle Conservation Programme to be conducted over a five-year period.

Item	Year 1	Year 2	Year 3	Year 4	Year 5
Wage: Sea Turtle Programme Coord. (office equip./supplies provided by Government)	12000	12000	12000	12000	12000
Wage: 4 beach patrollers, monitors (catch/sale), taggers for the Grenadines @ \$400/mo, 8 mos/person	12800	12800	12800	12800	12800
Wage: 2 beach patrollers, monitors (catch/sale), taggers for St. Vincent @ \$400/mo, 8 mos/person	6400	6400	6400	6400	6400
Wage: 6 community-based deputies (part-time) @ \$250/mo	18000	18000	18000	18000	18000

Budget, *continued*.

Item	Year 1	Year 2	Year 3	Year 4	Year 5
Boat fuel @ \$200/ deputy	1200	1200	1200	1200	1200
Communication (radios)	5000	---	---	---	---
Field supplies/ accommodations	2000	1500	1500	1000	1000
Flipper tags and applicators	---	1000	500	500	500
Training, workshops and demonstrations, incl. travel/accom- modations for workshop leaders in Year 1)	5000	2000	2000	2000	2000
Overseas travel (training)	3000	2000	---	---	---
Buoys and signage for 5 reserves that contain important nest/foraging areas	5000	5000	5000	5000	5000
Educational mater- ials/media events	2000	2000	2000	2000	2000
Contingencies (10%)	7240	6390	6140	6090	6090
TOTAL	79640	70290	67540	66990	66990
GRAND TOTAL	US\$ 351,450				

V. LITERATURE CITED

- Adams, J. E. 1980. Seafaring Grenadines: An Historical Geography of Traditional Fisheries in the Caribbean. University of Minnesota, USA.
- Balazs, G. H. 1985. Impact of ocean debris on marine turtles: entanglement and ingestion, p. 387-429. *In: Proc. Workshop on the Fate and Impact of Marine Debris* (R. S. Shomura and H. O. Yoshida, Editors). NOAA Tech. Memo. NMFS-SWFC-54. U. S. Dept. Commerce.
- Bjorndal, K. A. (Editor) 1982a. Biology and Conservation of Sea Turtles. Smithsonian Institution Press, Washington D. C.
- Bjorndal, K. A. 1982b. The consequences of herbivory for the life history pattern of the Caribbean green turtle, Chelonia mydas, p.111-116. *In: Biology and Conservation of Sea Turtles* (K. A. Bjorndal, Editor). Smithsonian Institution Press, Washington D. C.
- Bjorndal, K. A. and A. Carr. 1989. Variation in clutch size and egg size in the green sea turtle nesting population at Tortuguero, Costa Rica. *Herpetologica* 45(2):181-189.
- Bjorndal, K. A., A. B. Meylan, and B. J. Turner. 1983. Sea turtles nesting at Melbourne Beach, Florida, I: Size, growth, and reproductive biology. *Biol. Conserv.* 26:65-77.
- Boulon, R., Jr. 1984. National Report for the United States Virgin Islands to the Western Atlantic Turtle Symposium, 17-22 July 1983, Costa Rica, p.489-499. *In: Proceedings of the Western Atlantic Turtle Symposium* (P. Bacon et al., Editors). Vol. 3, Appendix 7. University of Miami Press, Miami, Florida.
- Brongersma, L. D. 1972. European Atlantic turtles. *Zool. Verh. (Leiden)* No. 121.
- Byles, R. 1993. Head-start experiment no longer rearing Kemp's ridleys. *Marine Turtle Newsletter* 63:1-3.
- Caldwell, D. K. and M. C. Caldwell. 1969. Addition of the leatherback sea turtle to the known prey of the killer whale, Orcinus orca. *J. Mammalogy* 50(3):636.
- Cambers, G. and Lima, H. 1990. Leatherback turtles disappearing from the BVI. *Marine Turtle Newsletter* 49:4-7.
- Canin, J. 1991. International trade aspects of the Japanese hawksbill shell ('bekko') industry. *Marine Turtle Newsletter* 54:17-21.
- CCA/IRF. 1991. Country Environmental Profile for St. Vincent and the Grenadines. Prepared on behalf of the Government of St. Vincent and the Grenadines by the Caribbean Conservation Association with the technical support of the Island Resources Foundation. St. Michael, Barbados. 222 p.

- Carr, A. 1952. Handbook of Turtles: The Turtles of the United States, Canada, and Baja California. Comstock Publ. Assoc., Cornell Univ. Press, Ithaca, New York.
- Carr, A., A. Meylan, J. Mortimer, K. Bjorndal, and T. Carr. 1982. Surveys of sea turtle populations and habitats in the Western Atlantic. NOAA Tech. Memo. NMFS-SEFC-91. U.S. Dept. Commerce. 82 p. +maps.
- Corliss, L. A., J. I. Richardson, C. Ryder, and R. Bell. 1989. The hawksbills of Jumby Bay, Antigua, West Indies, p.33-35. *In*: Proc. Ninth Annual Workshop on Sea Turtle Biology and Conservation (S. A. Eckert, K. L. Eckert and T. H. Richardson, Compilers). NOAA Tech. Memo. NMFS-SEFC-232. U. S. Dept. Commerce.
- Crouse, D. 1993. Victory! TEDs required in all U. S. shrimp trawls. Marine Turtle Newsletter 61:3-5.
- Crouse, D. T., L. B. Crowder, and H. Caswell. 1987. A stage-based population model for loggerhead sea turtles and implications for conservation. Ecology 68(5):1412-1423.
- Davenport, J. and G. H. Balazs. 1991. 'Fiery bodies' -- are pyrosomas an important component of the diet of leatherback turtles? Brit. Herp. Soc. Bull. 31:33-38.
- Dodd, C. K., Jr. 1982. Does sea turtle aquaculture benefit conservation? p.473-480. *In*: Biology and Conservation of Sea Turtles (K. A. Bjorndal, Editor). Smithsonian Institution Press, Washington D. C.
- Dodd, C. K., Jr. 1988. Synopsis of the Biological Data on the Loggerhead Sea Turtle, Caretta caretta (Linnaeus 1758). U. S. Fish and Wildlife Service, Biol. Report 88(14). 110 p.
- Donnelly, M. 1991. Japan bans import of hawksbill shell effective December 1992. Marine Turtle Newsletter 54:1-2.
- Eckert, K. L. 1991. Caribbean nations vote to protect sea turtles. Marine Turtle Newsletter 54: 3-4.
- Eckert, K. L. 1992. Five-year Status Reviews of Sea Turtles Listed Under the Endangered Species Act of 1973: Leatherback Sea Turtle (Dermochelys coriacea). Submitted to U. S. Fish and Wildlife Service, Albuquerque, New Mexico. 21 p.
- Eckert, K. L. and S. A. Eckert. 1988. Pre-reproductive movements of leatherback sea turtles (Dermochelys coriacea) nesting in the Caribbean. Copeia 1988:400-406.
- Eckert, K. L. and S. A. Eckert. 1990. Embryo mortality and hatch success in *in situ* and translocated leatherback sea turtle Dermochelys coriacea eggs. Biological Conservation 53:37-46.

- Eckert, K. L., J. A. Overing, and B. B. Lettsome. 1992. WIDECAST Sea Turtle Recovery Action Plan for the British Virgin Islands. CEP Technical Report No. 15. UNEP Caribbean Environment Programme, Kingston, Jamaica. xv + 116 p.
- Eckert, S. A., D. W. Nellis, K. L. Eckert, and G. L. Kooyman. 1986. Diving patterns of two leatherback sea turtles (Dermochelys coriacea) during interesting intervals at Sandy Point, St. Croix, U. S. Virgin Islands. *Herpetologica* 42(3):381-388.
- Eckert, S. A., K. L. Eckert, P. Ponganis, and G. L. Kooyman. 1989. Diving and foraging behavior of leatherback sea turtles (Dermochelys coriacea). *Can. J. Zool.* 67:2834-2840.
- ECNAMP. 1980a. St. Vincent - Preliminary Data Atlas. Survey of Conservation Priorities in the Lesser Antilles. Prepared by the Eastern Caribbean Natural Area Management Program, St. Croix, USVI.
- ECNAMP. 1980b. St. Vincent Grenadines - Preliminary Data Atlas. Survey of Conservation Priorities in the Lesser Antilles. Prepared by the Eastern Caribbean Natural Area Management Program, St. Croix, USVI.
- Ehrenfeld, D. W. 1968. The role of vision in sea-finding orientation of the green turtle (Chelonia mydas) II: Orientation mechanism and range of spectral sensitivity. *Anim. Behavior* 16: 281-287.
- Ehrhart, L. M. 1989. Status Report of the Loggerhead Turtle, p.122-139. *In*: Proc. Second Western Atlantic Turtle Symposium, 12-16 October 1987, Mayag'z, Puerto Rico (L. Ogren, Editor-in-Chief). NOAA Tech. Memo. NMFS-SEFC-226. U. S. Dept. Commerce.
- Ehrhart, L. M. and R. G. Yoder. 1978. Marine turtles of Merritt Island National Wildlife Refuge, Kennedy Space Center, Florida. *Fla. Mar. Res. Publ.* 33:25-30.
- Ferris, J. S. 1986. Nest success and the survival and movement of hatchlings of the loggerhead sea turtle (Caretta caretta) on Cape Lookout National Seashore. CPSU Tech. Rept. 19, U. S. National Park Service. U. S. Dept. Interior. 40 p.
- Frazer, N. B. 1989. A philosophical approach to population models, p.198-207. *In*: Proceedings, Second Western Atlantic Turtle Symposium (L. Ogren, Editor-in-Chief). NOAA Tech. Memo. NMFS-SEFC-226. U. S. Dept. Commerce.
- Frazer, N. B. and R. C. Ladner. 1986. A growth curve for green sea turtles, Chelonia mydas in the U. S. Virgin Islands. *Copeia* 1986:798-802.
- Frazier, J. 1984. Las Tortugas Marinas en el Oceano Atlantico Sur Occidental. *Asoc. Herpetol. Argentina* 2:2-21.

- Fuller, J., K. L. Eckert, and J. I. Richardson. 1992. WIDECAST Sea Turtle Recovery Action Plan for Antigua and Barbuda (K. L. Eckert, Editor). CEP Technical Report No. 16. UNEP Caribbean Environment Programme, Kingston, Jamaica. xii + 88 p.
- Groombridge, B. (Compiler). 1982. Red Data Book, Amphibia-Reptilia, Part I: Testudines, Crocodylia, Rhynchocephalia. Intl. Union for the Conservation of Nature and Natural Resources (IUCN), Gland, Switzerland.
- Groombridge, B. and R. Luxmoore. 1989. The Green Turtle and Hawksbill (Reptilia:Cheloniidae): World Status, Exploitation and Trade. CITES Secretariat, Lausanne, Switzerland. 601 p.
- GSVG (Govt. St. Vincent and the Grenadines). 1986. St. Vincent and the Grenadines development plan, 1986-1988. Growth, diversification and redistribution. Central Planning Division, Min. of Finance and Planning, Kingstown, St. Vincent.
- Guada, H. J., P. J. Vernet, M. de Santana, A. Santana, and E. M. de Aguilar. 1991. Fibropapillomas in a green turtle captured off Peninsula de Paraguana, Falcon State, Venezuela. Marine Turtle Newsletter 52:24.
- Halas, J. C. 1985. A unique mooring system for reef management in the Key Largo National Marine Sanctuary, p.237-242. *In*: Proc. Fifth International Coral Reef Congress (C. Gabrie and B. Salvat, Editors). Vol. 4. Antenne Museum-Ephe, Moorea, French Polynesia.
- Hartog, J. C. den and M. M. van Nierop. 1984. A study of the gut contents of six leathery turtles, Dermochelys coriacea (Linnaeus) (Reptilia: Testudines: Dermochelyidae) from British waters and from the Netherlands. Zool. Verh. 209(1984):1-36.
- Heyman, A., et al. 1988. Development of the Tobago Cays National Park: Project Proposal. Government of St. Vincent and the Grenadines/Organization of American States, Kingtown, St. Vincent.
- Hildebrand, H. 1987. A reconnaissance of beaches and coastal waters from the border of Belize to the Mississippi River as habitats for marine turtles. Final Report to NOAA/NMFS/SEFC Panama City Lab (purchase order #NA-84-CF-A-134). 63 p.
- Horrocks, J. A. 1987. Leatherbacks in Barbados. Marine Turtle Newsletter 41:7.
- Horrocks, J. 1992. WIDECAST Sea Turtle Recovery Action Plan for Barbados (K. L. Eckert, Editor). CEP Technical Report No. 12. UNEP Caribbean Environment Programme, Kingston, Jamaica. xiv + 61 p.
- Horrocks, J. A. and N. McA. Scott. 1991. Nest site location and nest success in the hawksbill turtle, Eretmochelys imbricata in Barbados, West Indies. Mar. Ecol. Prog. Ser. 69:1-8.

- Huff, J. A. 1989. Florida (USA) terminates "headstart" program. *Marine Turtle Newsletter* 46:1-2.
- Jackson, et al. 1986. Action Plan for tourism development in the Grenadines, 1987-1992. Organization of American States Mission, Kingstown, St. Vincent.
- Jacobson, E. R. 1990. An update on green turtle fibropapilloma. *Marine Turtle Newsletter* 49:7-8.
- Jacobson, E. R. 1991. An update on green turtle fibropapilloma, p.61-73. *In: Research Plan for Marine Turtle Fibropapilloma* (G. Balazs and S. Pooley, Editors). NOAA Tech. Memo. NMFS-SWFSC-156. U. S. Dept. Commerce.
- Lutz, P. L. and A. A. Alfaro-Schulman. 1991. The effects of chronic plastic ingestion on green sea turtles. Final Report for U. S. Dept. Commerce, NOAA SB21, WC H06134. 49 p.
- Meylan, A. B. 1988. Spongivory in hawksbill turtles: a diet of glass. *Science* 239:393-395.
- Milliken, T. and Tokunaga, H. 1987. The Japanese Sea Turtle Trade, 1970-1986. A Special Report prepared by TRAFFIC(Japan). The Center for Environmental Education, Washington D. C. 171 p.
- Morgan, P. J. 1989. Occurrence of leatherback turtles (*Dermochelys coriacea*) in the British Isles in 1988 with reference to a record specimen, p.119-120. *In: Proc. Ninth Annual Workshop on Sea Turtle Biology and Conservation* (S. A. Eckert, K. L. Eckert and T. H. Richardson, Compilers). NOAA Tech. Memo. NMFS-SEFC-232. U. S. Dept. Commerce.
- Morris, K. 1984. The National Report for the Country of St. Vincent, p.381-385. *In: Proceedings, Western Atlantic Turtle Symposium I, San José, Costa Rica, July 1983* (P. Bacon et al., Editors). Univ. Miami Press, Miami.
- Morris, K. 1987. The National Report for the Country of St. Vincent and the Grenadines. *Western Atlantic Turtle Symposium II Mayagüez, Puerto Rico, September 1987*. 10 p. (Unpubl.)
- Mrosovsky, N. 1970. The influence of the sun's position and elevated cues on the orientation of hatchling sea turtles. *Anim. Behav.* 18:648-651.
- Mrosovsky, N. 1981. Plastic jellyfish. *Marine Turtle Newsletter* 17:5-7.
- Murphy, T. M. and S. R. Hopkins. 1984. Aerial and ground surveys of marine turtle nesting beaches in the southeast region. Final Report to NMFS-SEFC. U. S. Dept. Commerce. 73 p.
- National Research Council. 1990. Decline of the Sea Turtles: Causes and Prevention. Committee on Sea Turtle Conservation (J. J. Magnuson, Chair), Commission on Life Sciences, U. S. Natl. Research Council. Natl. Academy Press, Washington D. C. 259 p.

- Nietschmann, G. 1972. The exploitation and conservation of hawksbill sea turtles, eastern Nicaragua. Report to the Department of Geography, University of Michigan. 15 p. (Unpubl.)
- Ogden, J. S., L. Robinson, K. Whitlock, H. Daganhardt, and R. Cebula. 1983. Diel foraging patterns in juvenile green turtles (Chelonia mydas L.) in St. Croix, U. S. Virgin Islands. J. Exp. Mar. Biol. Ecol. 66:199-205.
- Pritchard, P., P. Bacon, F. Berry, A. Carr, J. Fletemeyer, R. Gallagher, S. Hopkins, R. Lankford, R. Marquez M., L. Ogren, W. Pringle, Jr., H. Reichart, and R. Witham. 1983. Manual of Sea Turtle Research and Conservation Techniques (Second Edition). K. Bjorndal and G. Balazs, Editors. Ctr. Environmental Education, Washington D. C.
- Rainey, W. E. and P. C. H. Pritchard. 1974. Distribution and Management of Caribbean Sea Turtles. Transactions of the 37th North Amer. Wildl. and Natur. Res. Conf., 12-15 March 1972. Wildlife Management Inst., Washington D.D. 20005.
- Rebel, T. P. 1974. Sea Turtles and the Turtle Industry of the West Indies, Florida, and the Gulf of Mexico (Revised Edition). Univ. Miami Press, Coral Gables, Florida. 250 p.
- Reichart, H. A. 1989. Status report on the olive ridley turtle (Lepidochelys olivacea), p.175-188. In: Proceedings of the Second Western Atlantic Turtle Symposium (L. Ogren, Editor-in-Chief). NOAA Tech. Memo. NMFS-SEFC-226. U. S. Dept. Commerce.
- Reichart, H. A. and Fretey, J. 1993. WIDECAST Sea Turtle Recovery Action Plan for Suriname (K. L. Eckert, Editor). CEP Technical Report No. 24. UNEP Caribbean Environment Programme, Kingston, Jamaica. xiv + 65 p.
- Richardson, T. H., J. I. Richardson, C. Ruckdeschel, and M. W. Dix. 1978. Remigration patterns of loggerhead sea turtles (Caretta caretta) nesting on Little Cumberland and Cumberland islands, Georgia. Fla. Mar. Res. Publ. 33:39-44.
- Ross, J. P., S. Beavers, D. Mundell, and M. Airth-Kindree. 1989. The Status of the Kemp's Ridley. A Report to the Center for Marine Conservation from the Caribbean Conservation Corporation. Washington D. C. 51 p.
- Schulz, J. P. 1975. Sea Turtles Nesting in Surinam. Zoologische Verhandelingen No. 143. Leiden, The Netherlands. 141 p. +plates.
- Squires, H. J. 1954. Records of marine turtles in the Newfoundland area. Copeia 1954:68.
- Sybesma, J. 1989. Sick sea turtle. Curaçao Underwater Park Progress Report April-June 1989. CARMABI, Netherlands Antilles.
- Tobias, W. 1991. Turtles caught in Caribbean swordfish fishery. Marine Turtle Newsl. 53:10-12.

- TRAFFIC International. 1991. Japan withdraws reservations on sea turtles and monitor lizards. TRAFFIC Bulletin 12(1/2):24.
- Tucker, A. D. 1989. So many turtles, so little time: underestimating fecundity and overestimating populations?, p.181-183. *In*: Proc. Ninth Annual Workshop on Sea Turtle Biology and Conservation (S. A. Eckert, K. L. Eckert and T. H. Richardson, Compilers). NOAA Tech. Memo. NMFS-SEFC-232. U. S. Dept. Commerce.
- UNEP. 1989. Register of International Treaties and Other Agreements in the Field of the Environment. UNEP/GC.15/Inf.2. Nairobi. 250 p.
- UNEP. 1991. Final Act. Conference of Plenipotentiaries for the Adoption of the Annexes to the Protocol Concerning Specially Protected Areas and Wildlife in the Wider Caribbean Region. UNEP Caribbean Environment Programme, Kingston, Jamaica.
- Williams, P. 1993. NMFS to concentrate on measuring survivorship, fecundity of head-started Kemp's ridleys in the wild. Marine Turtle Newsletter 63:3-4.
- Witherington, B. E. 1990. Photopollution on sea turtle nesting beaches: problems and next-best solutions, p.43-45. *In*: Proc. Tenth Annual Workshop on Sea Turtle Biology and Conservation (T. H. Richardson, J. I. Richardson, and M. Donnelly, Compilers). NOAA Tech. Memo. NMFS-SEFC-278. U. S. Dept. Commerce.
- Witzell, W. N. 1983. Synopsis of Biological Data on the Hawksbill Turtle, Eretmochelys imbricata (Linnaeus, 1766). FAO Fish. Synopsis No. 137. 78 p.
- Witzell, W. N. 1984. The incidental capture of sea turtles in the Atlantic U. S. Fishery Conservation Zone by the Japanese Tuna Longline Fleet, 1978-81. Marine Fish. Review 46(3):56-58.
- Zullo, E. S. 1986. Sea turtle nesting at Virgin Islands National Park and Buck Island Reef National Monument, 1980-1985. U. S. National Park Service, Final Report. 27 p.

Table 1. St. Vincent and the Grenadines customs export statistics and Japanese customs import statistics for hawksbill turtle shell, 1970-1990.

Year	Quantity (kg) exported from St. Vincent to Japan <u>1/</u>	Quantity (kg) imported to Japan from St. Vincent <u>2/</u>
1970	--	0
1971	--	0
1972	--	0
1973	--	243
1974	--	250
1975	--	191
1976	--	130
1977	--	230
1978	--	144
1979	--	0
1980	--	0
1981	--	0
1982	--	36
1983	219	108
1984	0	242
1985	345	191
1986	0	470
1987	129	510
1988	204	147
1989	315	64
1990	170	1284
TOTAL	1382	4240

1/ St. Vincent and the Grenadines Customs export data

2/ Japanese Customs import data

Table 2. Marine Conservation Areas (Fisheries Conservation Zones) and Wildlife Reserves in St. Vincent and the Grenadines (source: CCA/IRF, 1991). Numbers correspond to locations in Figure 7a (Marine Conservation Areas, St. Vincent), Figure 7b (Marine Conservation Areas, Grenadines), Figure 7c (Wildlife Reserves, St. Vincent), and Figure 7d (Wildlife Reserves, Grenadines).

Marine Conservation Areas	Wildlife Reserves
1. Indian Bay, St. Vincent <u>1</u>/ 2. Calliaqua Bay, St. Vincent <u>1</u>/ 3. Blue Lagoon, St. Vincent <u>1</u>/ 4. parts of east and west coasts of Bequia 5. east coast of Isle de Quatre 6. north and west coasts of Mustique 7. east coast of Canouan 8. east coast of Mayreau and the Tobago Cays 9. waters around Palm Island and southeast of Union Island 10. waters around Petit St. Vincent	1. Young Island 2. King's Hill 3. Falls of Baleine 4. Govt. House Grounds 5. Milligan Cay 6. Pigeon (Ramier) Island 7. Isle de Quatre 8. All Awash Island 9. Catholic Island 10. Battowia Island 11. Catholic Rocks 12. Chateaubelair Islet 13. La Paz Island 14. Frigate Rock 15. Petit Canouan 16. Sail Rock 17. Tobago Cays 18. Big Cay 19. West Cay 20. Petit St. Vincent 21. Prune (Palm) Island 22. Savan Islands 23. Northern end of Bequia

1/ Indian Bay, Calliaqua Bay, and Blue Lagoon (St. Vincent) are all encompassed by the square drawn in Figure 7a.

Table 3. Literature and interview records (largely anecdotal) of sea turtle nesting in St. Vincent and the Grenadines. The data are acknowledged to be fragmentary and preliminary. Field surveys are sorely needed to verify existing records and to quantify both the abundance and distribution of nesting on the islands. CC = loggerhead (*Caretta caretta*), CM = green turtle (*Chelonia mydas*), EI = hawksbill (*Eretmochelys imbricata*), DC = leatherback (*Dermochelys coriacea*). Numbers correspond to locations on Figure 2a (St. Vincent) and Figure 2b (Grenadines).

Island/Beach	Species	Source
ST. VINCENT		
1. Richmond Beach	EI, DC	Carr et al. (1982), Morris (1984, 1987)
2. Chateaubelair Bay	EI	Morris (1984, 1987)
3. Petit Bordel Bay	EI	Morris (1984, 1987)
4. Dark View	DC	Carr et al. (1982)
5. Rose Bank	EI	Carr et al. (1982)
6. Troumaka Bay	EI	Carr et al. (1982), Morris (1984, 1987)
7. Cumberland Bay	EI	Carr et al. (1982), Morris (1984, 1987)
8. Wallilabou Bay	EI	Carr et al. (1982), Morris (1984, 1987)
9. Kerton's Bay	EI	Morris (1984, 1987)
10. Barrouallie	EI, DC	Carr et al. (1982)
11. Peter's Hope Bay	EI	Morris (1984, 1987)
12. Mount Wynne Bay	EI	Morris (1984, 1987)
13. Clare Valley	DC	Carr et al. (1982)
14. Lowman's Bay	EI	Morris (1984, 1987)
15. Cablehut Bay	EI	Morris (1984, 1987)
16. Brighton Bay	EI, DC	Morris (1984, 1987)
17. Stubbs Bay	EI	Carr et al. (1982)
	EI, DC	Morris (1984, 1987)
18. Mt. Pleasant Beach	DC	Carr et al. (1982)
	EI	Morris (1984, 1987)
19. Biabou Bay	EI, DC	Morris (1984, 1987)
20. North Union Bay	EI	Morris (1984, 1987)
21. Colonaire Bay	EI	Carr et al. (1982)
	DC	Morris (1984, 1987)
22. Georgetown Bay	EI, DC	Morris (1984, 1987)
23. Orange Hill Bay	EI	Carr et al. (1982), Morris (1984, 1987)
24. Sandy Bay	EI	Morris (1984, 1987)
GRENADINES		
"beaches on nearly all of the islands"	EI	Carr et al. (1982)

Table 3, *continued*.

Island/Beach	Species	Source
<i>Bequia</i>		
1. Princess Margaret Beach	EI	present report
<i>Baliceaux</i>		
2. North Bay	EI	Morris (1984, 1987)
<i>Mustique</i>		
3. L'Ansecoy	EI	present report
4. Plantain	EI	present report
5. Obsidian Bay	EI	Morris (1984, 1987), present report
6. Pasture Bay	EI	Morris (1984, 1987), present report
7. Macaroni	EI	present report
"no nesting reported on Mustique since 1990"		turtle fisherman, present report
<i>Canouan</i>		
8. Mahault Bay	CM, DC, (CC?) EI	"maybe", present report Morris (1984, 1987); "most important beach", present report
9. L'Anse Guyac Bay	EI	Morris (1984, 1987)
10. Grand Bay Beach	DC	"nesting female killed in June 1993", present report
11. South Glossy Bay	EI CM	Morris (1984, 1987) "occasional", present report
12. Dallis Bay	EI	Morris (1984, 1987)
13. Friendship Bay	EI, CM	Morris (1984, 1987) "occasional nesting", present report
14. Windward Bay	EI	"occasional nesting", present report
15. Carenage Bay	EI	Morris (1984, 1987)
<i>Mayreau</i>		
16. Saltwhistle	EI	"potential, but no data", present report
<i>Tobago Cays</i>		
17. Petit Tobac	EI	Morris (1984, 1987)
<i>Union Island</i>		
18. Bloody Bay	EI	Morris (1984, 1987)
19. Raffal	EI, CM EI	Morris (1984, 1987) present report
20. Chatham Bay	EI	Morris (1984, 1987)

Table 3, *continued*.

Island/Beach		Species	Source
21.	Campbell	EI, CM	Morris (1984, 1987)
22.	Miss Irene	EI, CM	Morris (1984, 1987)
23.	Big Sand Beach	EI	present report
24.	Richmond Beach	EI, CM	Morris (1984, 1987), present report
		DC	Carr et al. (1982)
25.	Spring Beach	EI, CM	Morris (1984, 1987)
<i>Frigate Island</i>			
26.	Unnamed	EI, CM	Morris (1984, 1987)
<i>Palm (=Prune) Island</i>			
27.	Unnamed	EI, CM, CC	Carr et al. (1982)

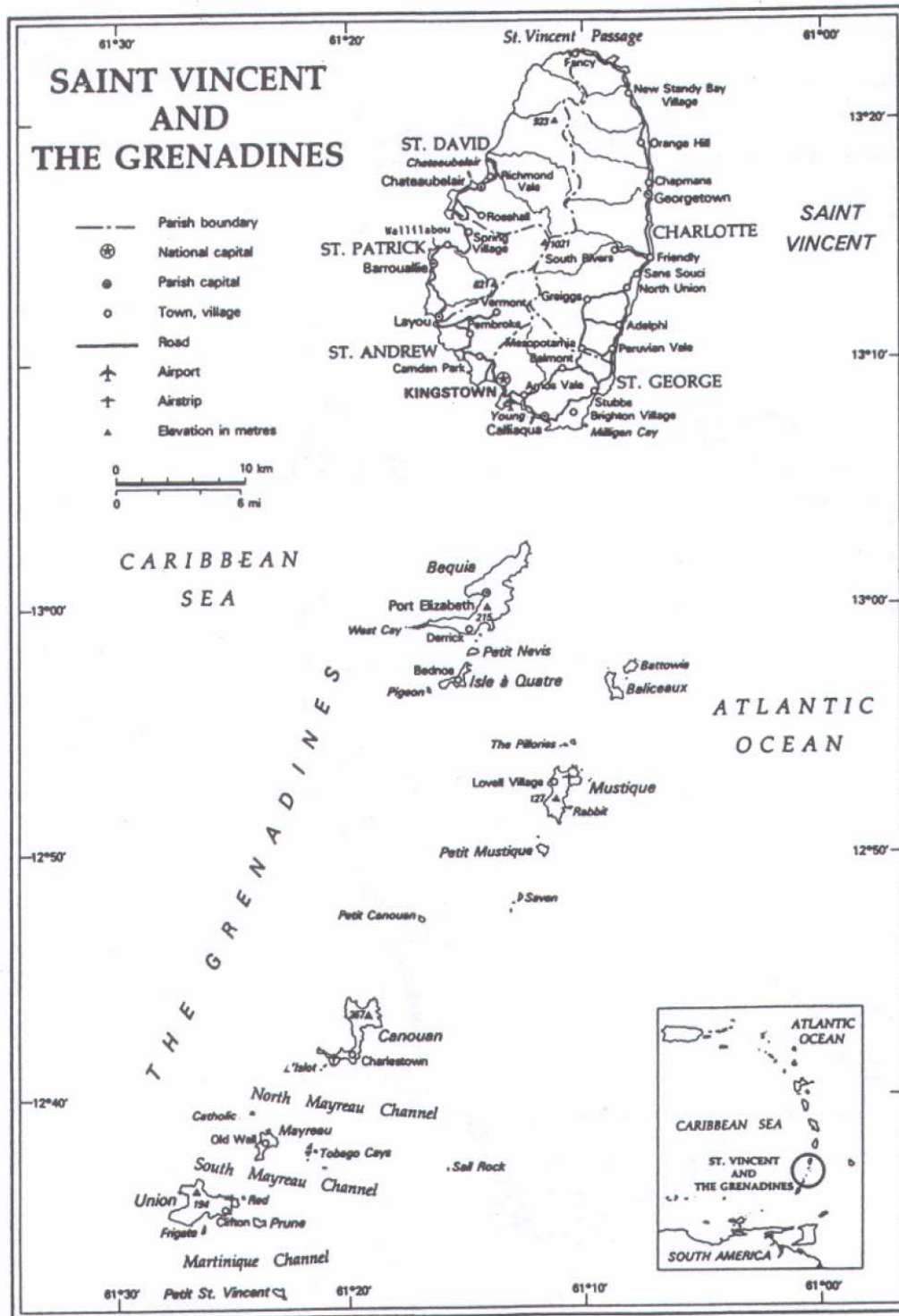


Figure 1. Country location map, St. Vincent and the Grenadines (source: GSVG, 1986 in CCA/IRF, 1991).

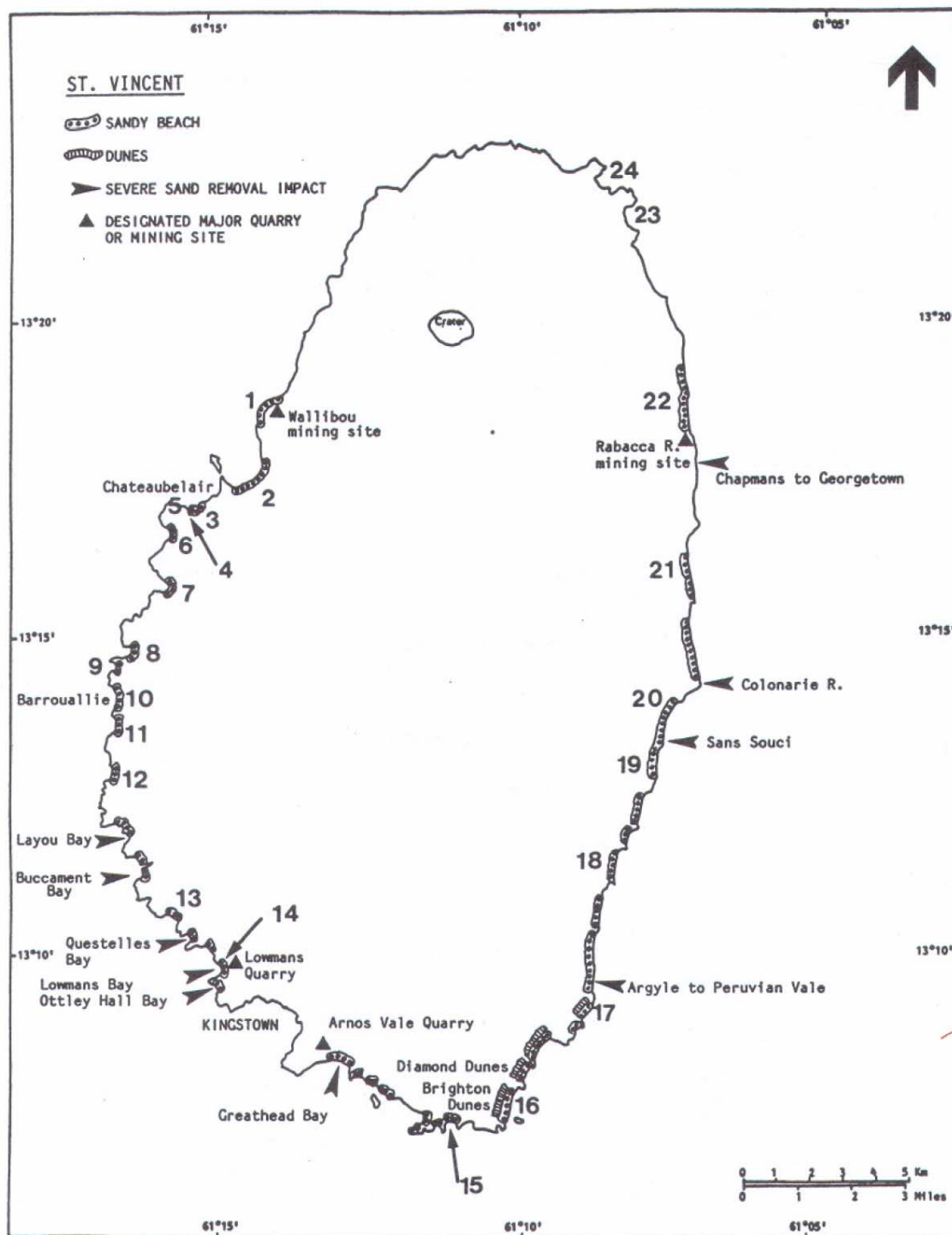


Figure 2a. Reported sea turtle nesting beaches on St. Vincent (source: adapted from CCA/IRF, 1991). Numbers correspond to locations in Table 3.

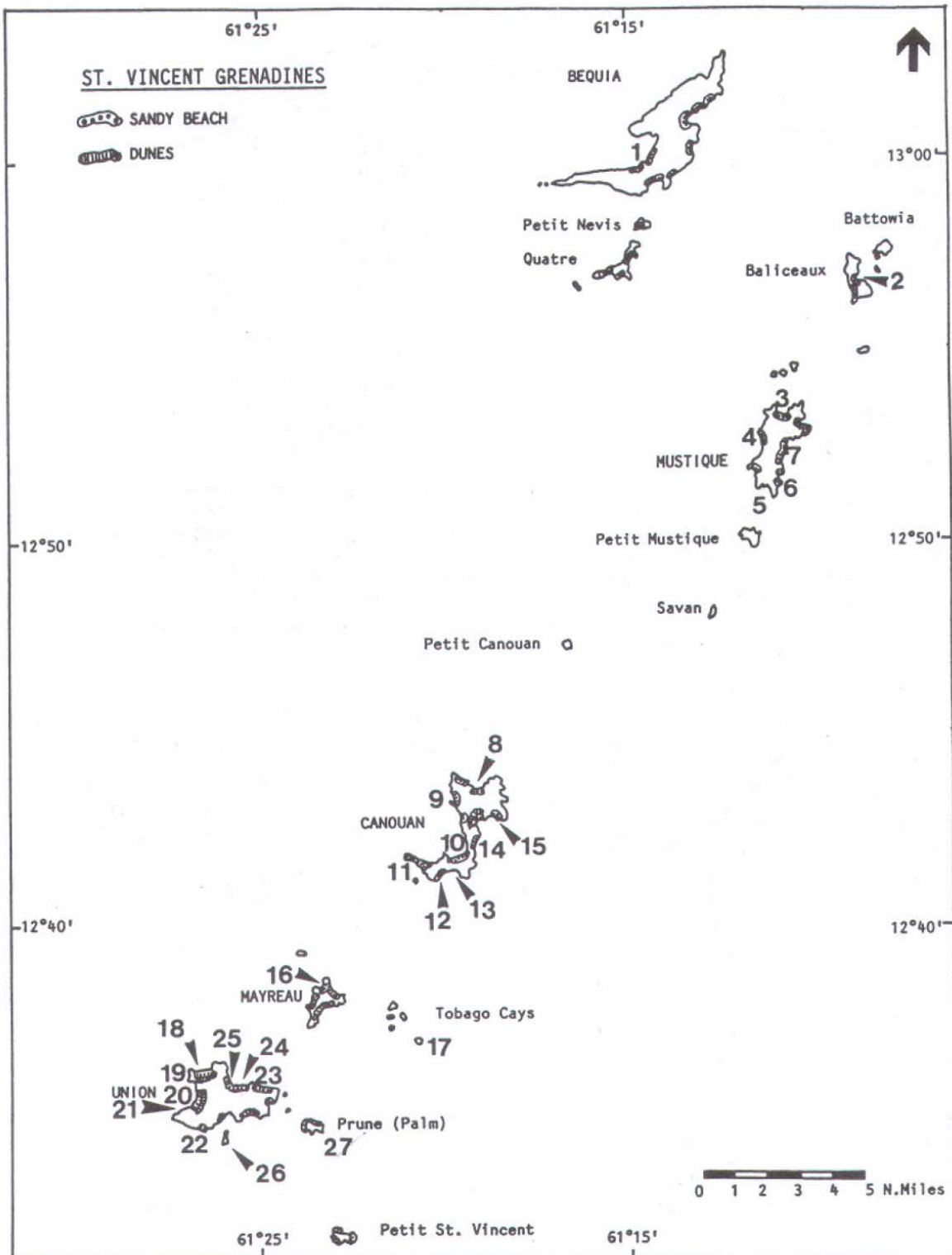


Figure 2b. Reported sea turtle nesting beaches in the Vicentian Grenadines (source: adapted from CCA/ IRF, 1991). Numbers correspond to locations in Table 3.

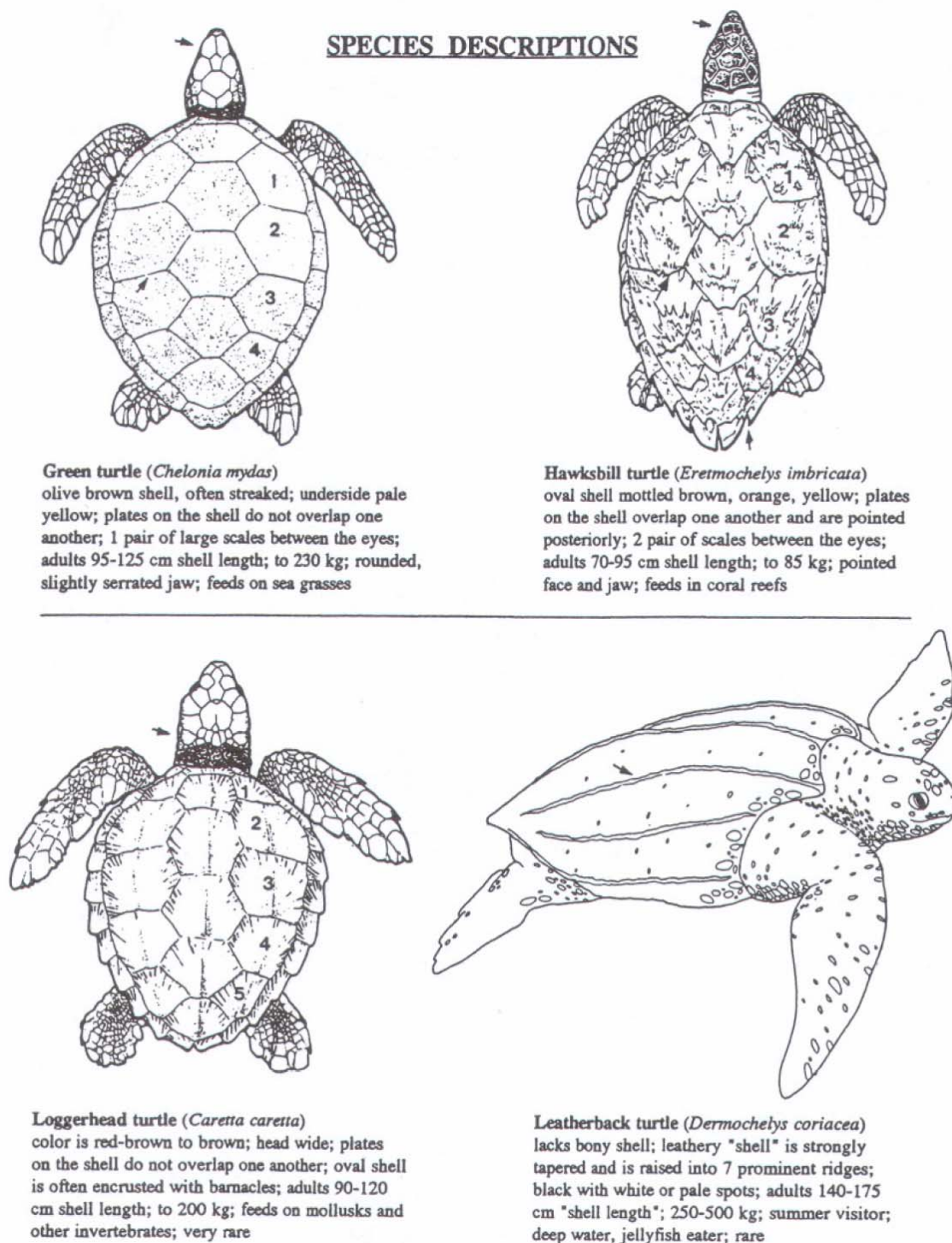


Figure 3. Identification key to the four species of sea turtle found in St. Vincent and the Grenadines. Loggerheads are very rare; leatherbacks are only seasonal visitors.

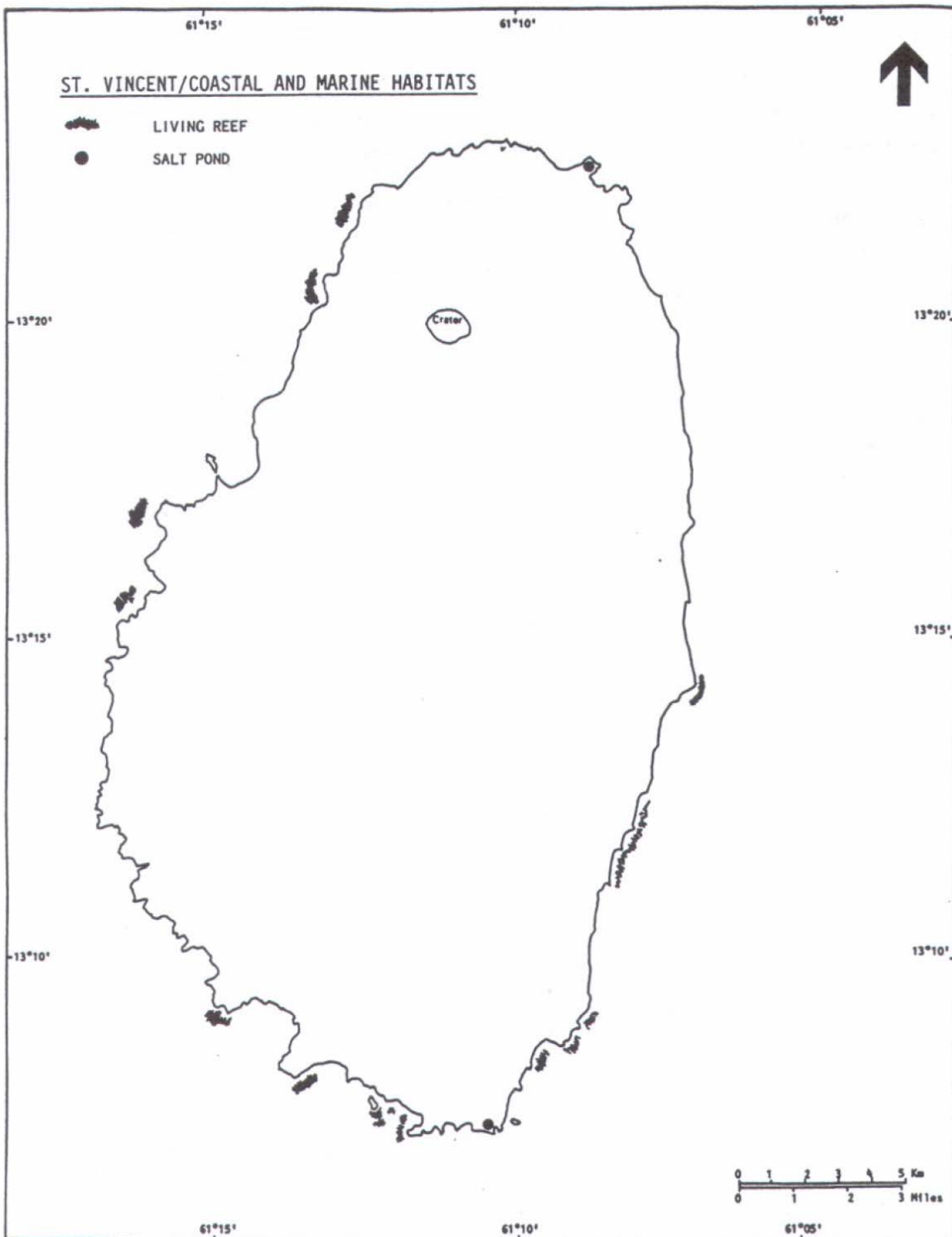


Figure 4a. Coral reefs of St. Vincent (source: ECNAMP, 1980a).

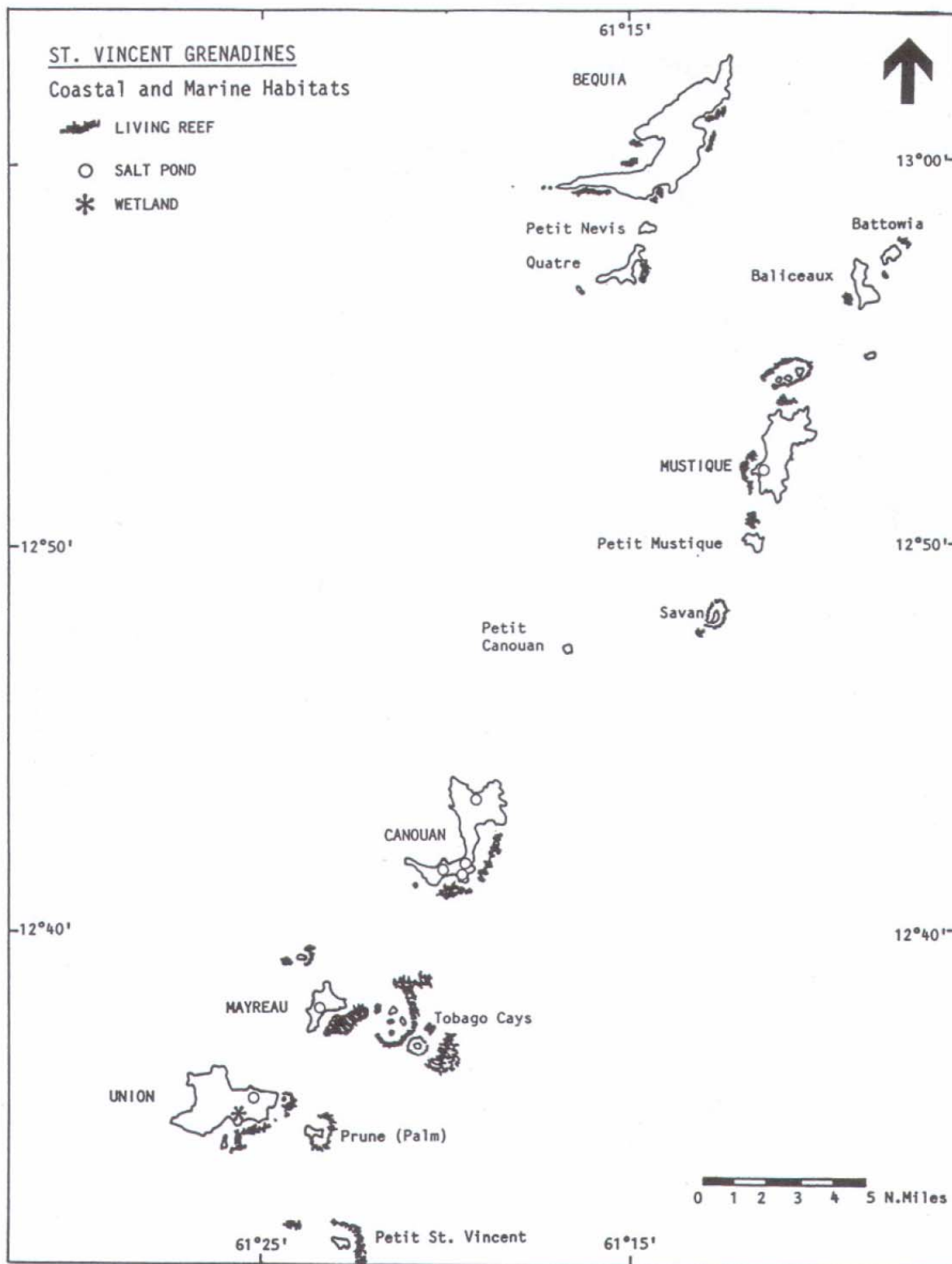


Figure 4b. Coral reefs of the Vincentian Grenadines (source: ECNAMP, 1980b).

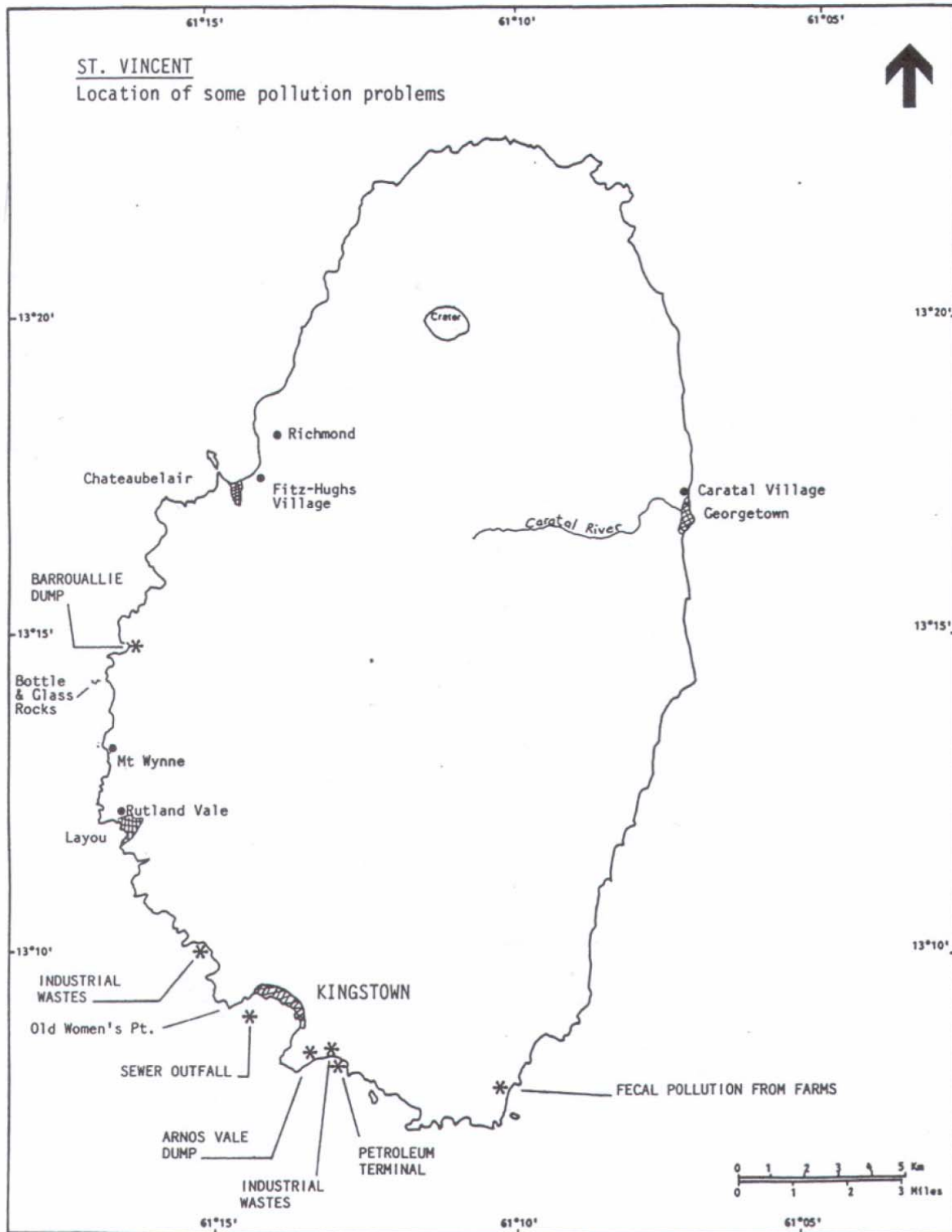


Figure 5. Some pollution problems in St. Vincent (source: CCA/IRF, 1991).

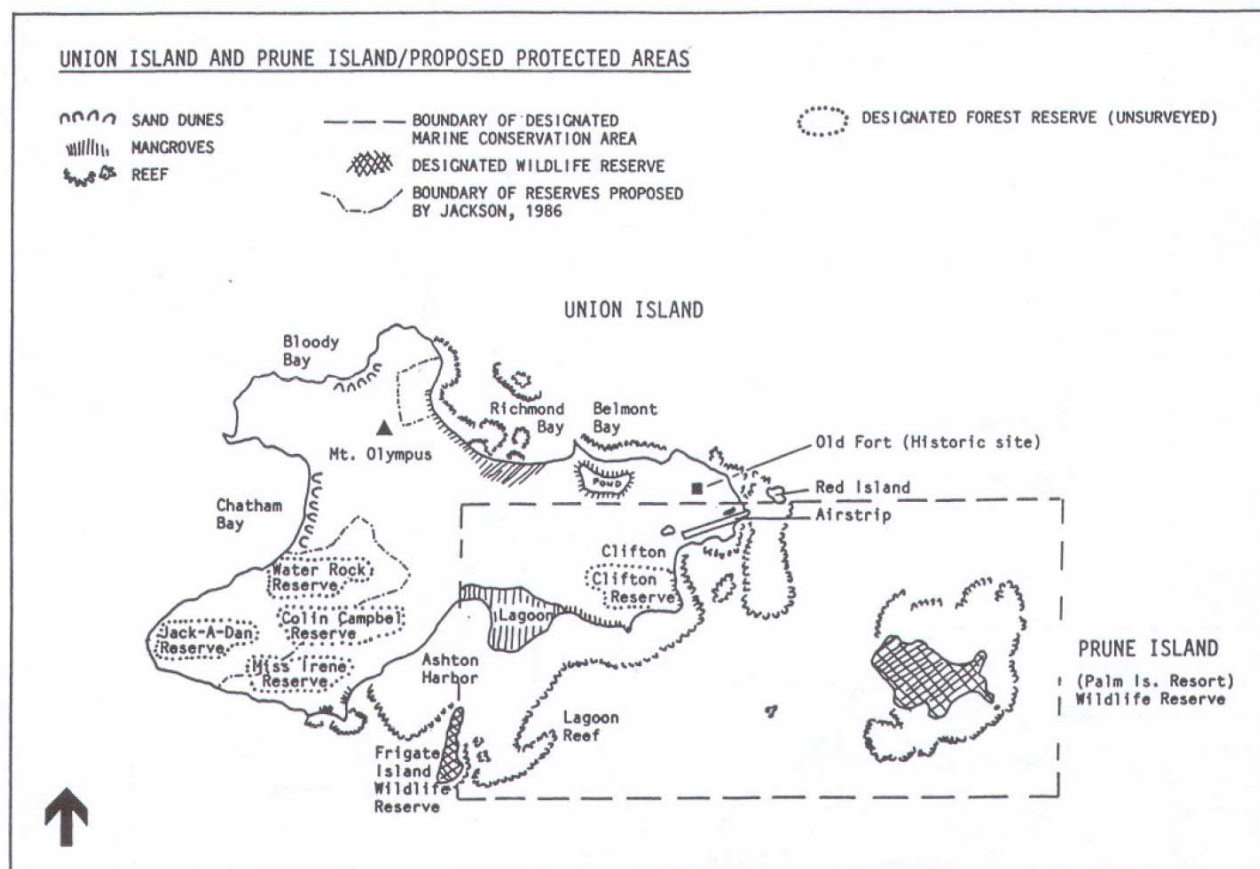


Figure 6. Designated or proposed protected areas in Union Island and Prune (=Palm) Island (source: Jackson et al., 1986).

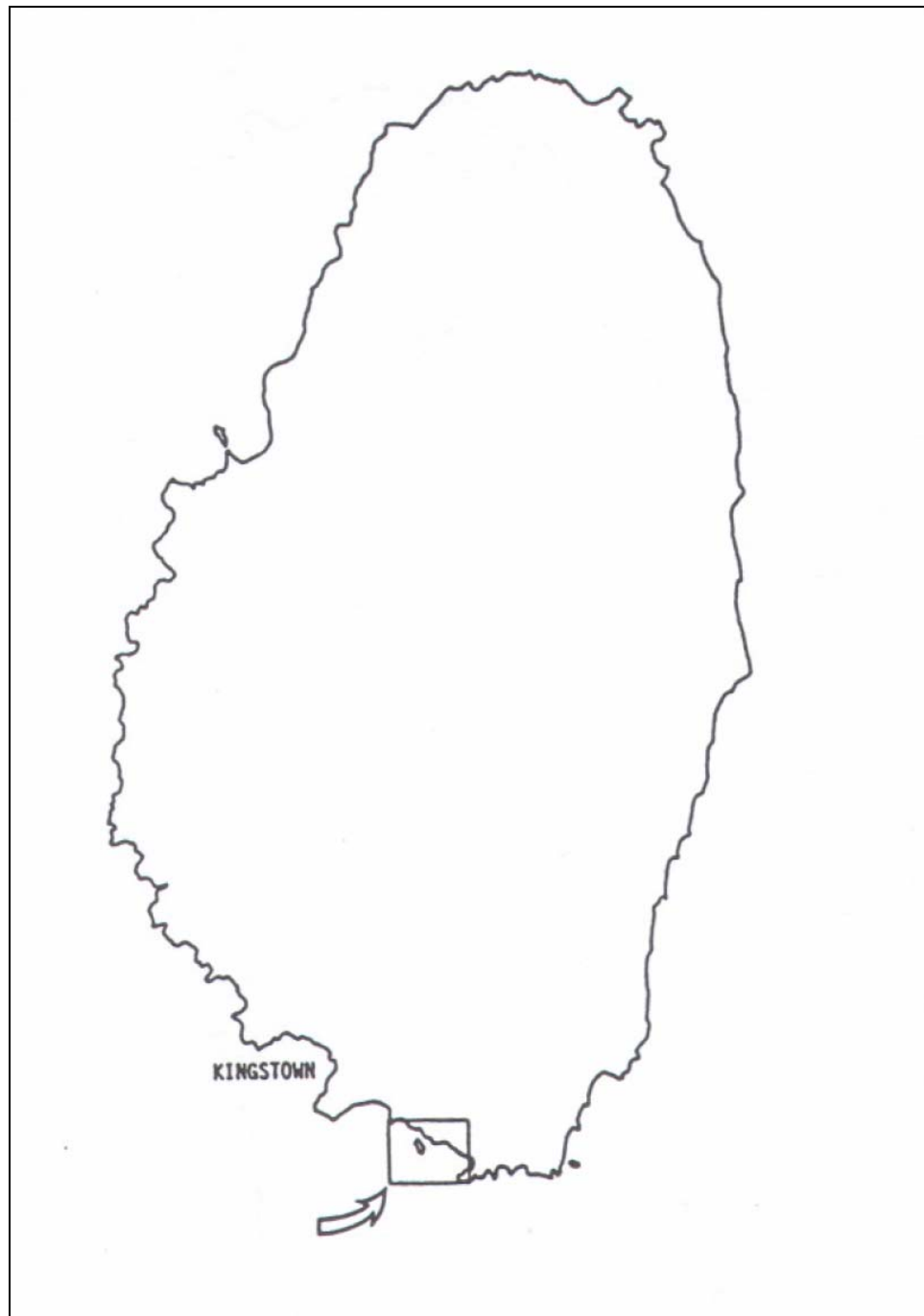


Figure 7a. Marine Conservation Areas (Fisheries Conservation Zones) in St. Vincent (source: CCA/IRF, 1991). Indian Bay, Calliaqua Bay, and Blue Lagoon (see Table 2) are all included in the area delineated.

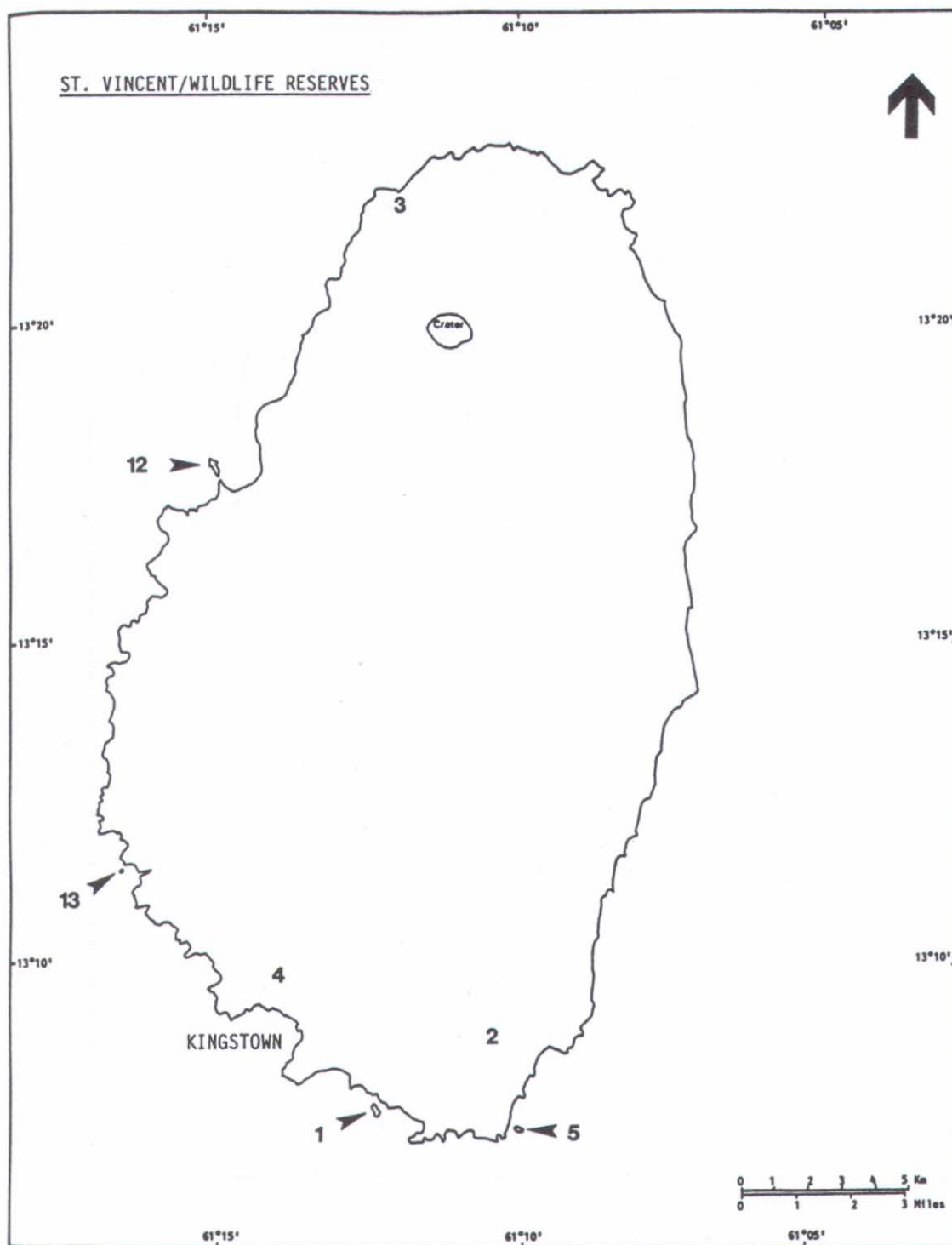


Figure 7b. Marine Conservation Areas (Fisheries Conservation Zones) in the Vincentian Grenadines (source: CCA/IRF, 1991). Numbers correspond to locations in Table 2.

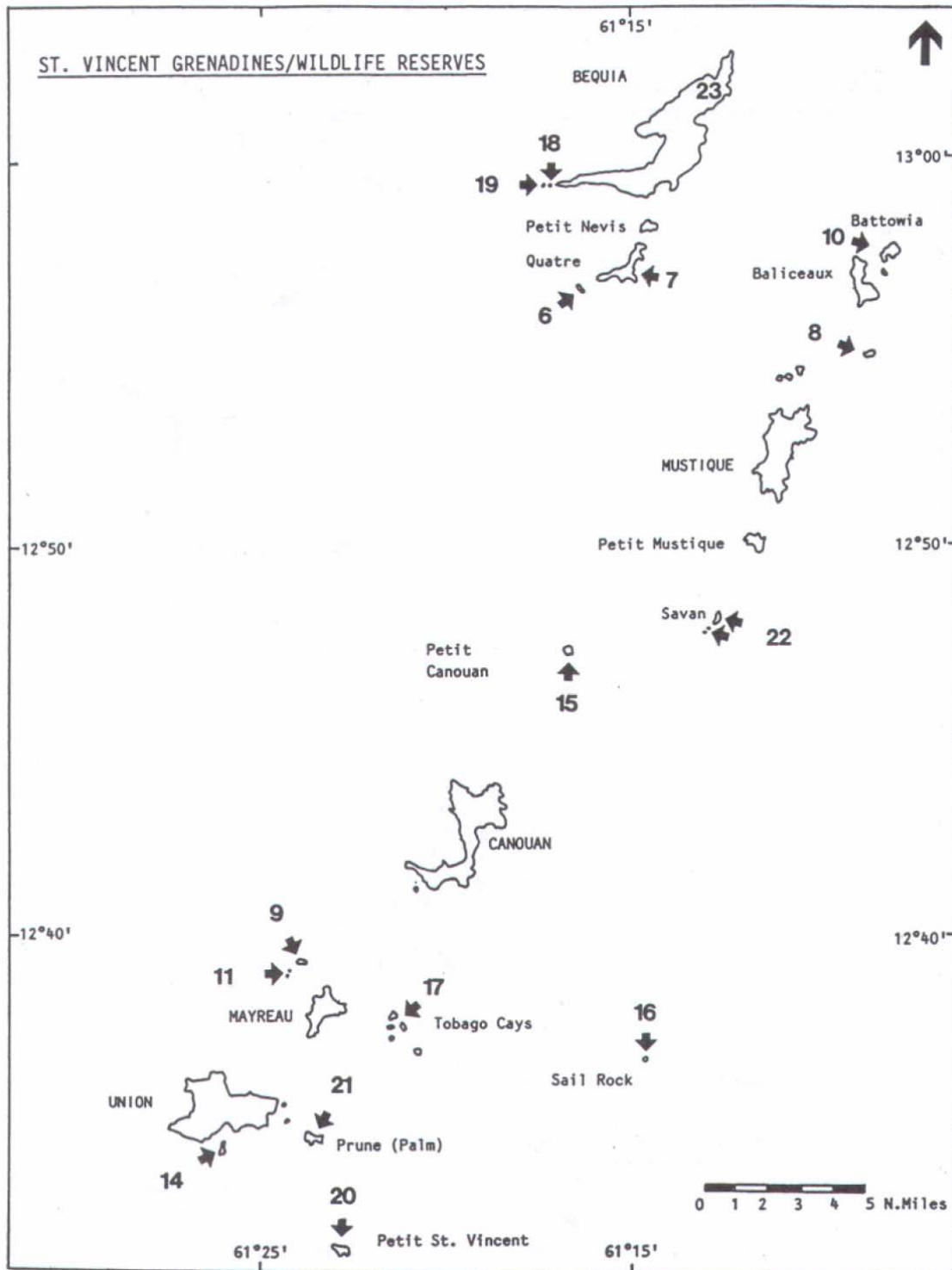


Figure 7c. Wildlife Reserves in St. Vincent (source: CCA/IRF, 1991). Numbers correspond to locations in Table 2.

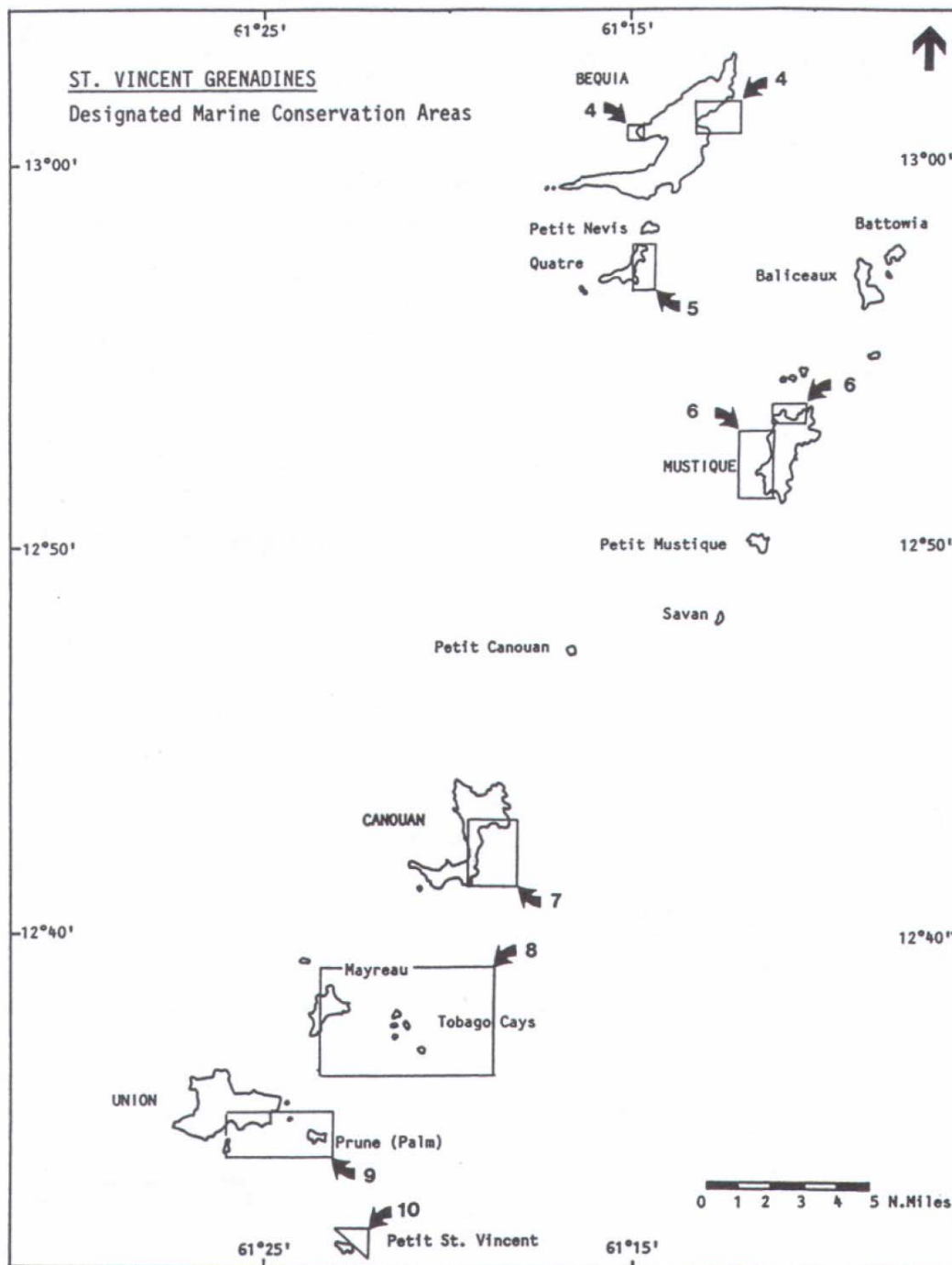


Figure 7d. Wildlife Reserves in the Vincentian Grenadines (source: CCA/IRF, 1991). Numbers correspond to locations in Table 2.

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

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

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

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

*

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

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

