Caribbean Environment Programme
United Nations Environment Programme
UNEP

Sea Turtle Recovery Action Plan for Aruba

Prepared by:

WIDECAST
Wider Caribbean Sea Turtle Recovery Team and Conservation Network

CEP Technical Report No. 25

1993

Note:

The designations employed and the presentation of the material in this document do not imply the expression of any opinions whatsoever on the part of UNEP concerning the legal status of any State, Territory, city, or area, or its authorities, or concerning the delimitation of their frontiers or boundaries. The document contains the views expressed by the authors acting in their individual capacity and may not necessarily reflect the views of UNEP.

For bibliographic purposes this document may be cited as:

Barmes, T., K. L. Eckert, and J. Sybesma. 1993. WIDECAST Sea Turtle Recovery Action Plan for Aruba (Karen L. Eckert, Editor). CEP Technical Report No. 25 UNEP Caribbean Environment Programme, Kingston, Jamaica. xiv + 58 pp.

Caribbean Environment Programme

UNEP United Nations Environment Programme

Sea Turtle Recovery Action Plan for Aruba

Tom Barmes [1]
Karen L. Eckert [2]
Jeffrey Sybesma [3]

[1] Department of Agriculture, Husbandry and Fisheries
Country Coordinator, WIDECAST-Aruba
[2] Executive Director, WIDECAST
[3] Executive Coordinator, WIDECAST-Netherlands Antilles

Karen L. Eckert, Editor

Prepared by:

WIDECAST
Wider Caribbean Sea Turtle Conservation Network

CEP Technical Report No. 25

1993

PREFACE

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

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

This CEP Technical Report is the eighth in a series of Sea Turtle Recovery Action Plans prepared by the Wider Caribbean Sea Turtle Recovery Team and Conservation Network (WIDECAST), an organization comprised of a regional team of sea turtle experts, local Country Co-ordinators, and an extensive network of interested citizens. The objective of the recovery action plan series is to assist Caribbean governments in the discharge of their obligations under the SPAW Protocol, and to promote a regional capability to implement scientifically sound sea turtle conservation programs by developing a technical understanding of sea turtle biology and management among local individuals and institutions. Each recovery action plan summarizes the known distribution of sea turtles, discusses major causes of mortality, evaluates the effecttiveness 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.

ACKNOWLEDGEMENTS

This report would not have been possible without the kind assistance and participation of many people. The ongoing support of Minister Ing. Edison Briesen (Ministry of Economic Affairs and Tourism), Ing. S. M. Vrolijk, Director, Department of Agriculture, Husbandry and Fisheries (LVV), Drs. H. Baarh (Head, Department of Foreign Affairs and UNEP/CEP National Focal Point), and Cornelius Wilson, Director, Department of Housing, Physical Development and Environment (VROM) is deeply appreciated. We are especially grateful to Drs. Roeland de Kort (Zoologist, VROM; FANAPA), Drs. E. Armando Curet (Policy Adviser, VROM), and the staff of the Costa Linda Hotel for technical information and field assistance. Aldrich Hunt (Fisheries Officer, LVV), Drs. Byron Boekhoudt (Chief Fisheries Officer, LVV), Tim Duncan (dive instructor), John Wardlaw (Operations Mgr., Shore Tours), Frans Weller and Mario Britten (Inspectors, Veterinary Service, Department of Public Health), and Pieter van Grinsven (Chief Engineer, Aruba Beach Club) also generously provided data and participated in habitat and/or interview surveys. *Atlantis Submarines* kindly provided support in marine habitat surveys offshore Oranjestad. We are grateful to TeleAruba, Radio Carina, and newspaper media for coverage of sea turtle conservation issues and for informative interviews with Dr. Karen Eckert during her visits to Aruba. The Coordinator (TB) extends his particular appreciation to residents who regularly accompanied him on field surveys. The selfless efforts of Olinda van der Linden-Rasmijn in providing schools with sea turtle conservation lectures have been quite appreciated by the community. Aruba has made significant progress in the arena of sea turtle conservation in the past year, and we are indebted to the regional WIDECAST project 1/.

1/ The WIDECAST regional Recovery Team provided impetus for this document and critiqued earlier drafts. These persons are the following: Lic. Ana Cecilia Chaves (Costa Rica), Dr. Karen L. Eckert (USA), Jacques Fretey (France), Lic. Hedelvy Guada (Venezuela), Dr. Julia A. Horrocks (Barbados), Dr. Peter C. H. Pritchard (USA), Dr. James I. Richardson (USA), and Dr. Georgita Ruiz (Mexico). The IUCN/SSC Marine Turtle Specialist Group (Dr. Karen A. Bjorndal, Chair) and UNEP-CAR/RCU (Dr. Richard Meganck, Co-ordinator) reviewed an earlier draft. Major financial support for WIDECAST has come from the UNEP Caribbean Environment Programme, the U. S. National Marine Fisheries Service (Office of Protected Resources), and the U. S. State Department (Bureau of Oceans and Intl. Environmental and Scientific Affairs/Office of Ocean Affairs). Chelonia Institute provided travel assistance to Dr. K. L. Eckert and to Dr. J. I. Richardson for technical visits during 1993. Special appreciation is due Milton Kaufmann (President of Monitor International and Founder of WIDECAST) for his unwavering personal commitment to WIDECAST since its inception more than a decade ago.

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

AHATA	Aruba Hotel and Tourism Association
CARMABI	Foundation CARMABI (formerly, Caraibisch Marien Biol. Instituut)
CITES	Convention on International Trade in Endangered Species
ECNAMP	Eastern Caribbean Natural Areas Management Programme
EIS	Environmental Impact Statement
FANAPA	Fundacion Arubano pa Naturaleza y Parke (Aruban Foundation for Nature and Parks)
IUCN	World Conservation Union
LVV	Directie Landbouw, Veeteelt en Visserij (Department of Agriculture, Husbandry and Fisheries)
MARPOL	International Convention for the Prevention of Pollution from Ships
SPAW Protocol	Protocol concerning Specially Protected Areas and Wildlife
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
USNPS	United States National Park Service
USVI	United States Virgin Islands
VROM	Directie Volkshuisvesting Ruimteliyke Ontwikkeling en Milieu (Department of Housing, Physical Development and Environment)
WATS	Western Atlantic Turtle Symposium
WEB	Water en Energie Bedrijf (Water and Energy Company)
WIDECAST	Wider Caribbean Sea Turtle Conservation Network
WWII	World War II

LIST OF TABLES AND FIGURES

ABSTRACT

Aruba (12°30'N, 70°W) is located 32 km north of Venezuela and 67 km west of Curaçao, Netherlands Antilles. Until recently, Aruba was one of six islands comprising the Netherlands Antilles. As of 1 January 1986, Aruba became an autonomous entity within the Kingdom of the Netherlands. Aruba is very dependent economically on tourism. Tourism is a fast-growing market and is the biggest employer on the island. The major attractions are a favorable climate and extensive white sandy beaches, especially along the western and southwestern shores where most of the largest hotels are situated. Most hotels are built right at the beach edge (or on the beach) and a coastal highway provides easy access to once remote areas. Lighting and general activity may inhibit turtles from coming ashore to lay their eggs in these high density development areas, but nesting appears to be so rare that trends are difficult to quantify.

Very little is known about the distribution or abundance of sea turtles in Aruba. Four species may nest: the loggerhead or (in Papiamento) *cawama*, Caretta caretta; the green turtle or *tortuga blanco*, Chelonia mydas; the leatherback or *driekiel*, Dermochelys coriacea; and the hawksbill or *caret*, Eretmochelys imbricata. Low density nesting occurs on the large sandy beaches of the western and southwestern coasts, as well as on selected pocket beaches along the north shore. Offshore, hawksbills and green turtles of varying sizes are present year-around and presumably feed in local waters. Sea grasses and/or coral reefs (providing food and shelter to hawksbills and green turtles) are situated along the relatively calm western and southern coasts; the north shore is characterized by rough seas. The extent to which Aruba provides forage for loggerheads and olive ridleys is not known. The rare leatherback is a seasonal visitor, arriving from northern waters only for the purpose of egg-laying.

Preliminary beach surveys in 1993 indicate that, despite high density commercial development, most nesting may occur on the west coast and on Eagle Beach and Arashi in particular. More in-depth surveys are planned for 1994 to document the timing and distribution of nesting. It is likely that fewer than 30 nests (all species combined) are laid in Aruba each year. Our records indicate that the leatherback is the most common nester, but this may be a reflection of the fact that leatherback tracks are the easiest of all the sea turtles to identify.

All species of sea turtle have been protected in Aruba since 1987; eggs have been protected since 1980. There are no turtle fishermen. An unquantified (but probably low) level of accidental catch occurs, mostly in nearshore nets set along the west coast. The clandestine catch is nearly impossible to quantify since fishermen will not discuss it with Fisheries Officers. Two boutiques in the capital were selling tortoiseshell jewelry during recent market surveys, and 15 whole shells were confiscated by police in September 1993 from a gift shop on the north coast. The jewelry is reportedly fashioned locally, but the shells were imported from Venezuela. A few restaurants are selling turtle meat (mostly purchased from Venezuelan fishing boats selling their wares in Oranjestad Harbor), but this activity is expected to decline since the Prime Minister sent a letter to all local restaurants in April 1993 reiterating that the possession, purchase, and/or sale of sea turtle products was forbidden by law.

The most common threats to sea turtles coming ashore to nest in Aruba are beachfront lights, obstruction of nesting habitat by recreational equipment (lounge chairs, sailboats), and, in

some cases, harassment by onlookers. The most common threat to eggs is compaction and embryo death due to vehicles driving on the beach. In the case of hatchlings, beachfront lighting from hotels and the coastal boulevard poses the greatest danger. In at least three cases in 1993, hatchlings were collected from inland sites and returned the sea after having been misdirected by beachfront lighting. At sea, there are indications that turtles are sometimes struck by boats and other pleasure crafts. Coral reefs are damaged by indiscriminate anchoring (especially at popular dive sites) and pollution is significant in some areas, most notably San Nicolas Bay.

Despite a variety of factors that threaten our sea turtles and their habitats, it is clear that Aruba is starting from a very strong position with regard to sea turtle conservation. Full legal protection is already in place, there is no economic dependency on sea turtles or their products, there are plans to designate the entire west and south coasts a Marine Park (including a system of moorings to protect coral reefs), and there is considerable interest on the part of hoteliers to play a positive role in the conservation of turtles and their nest sites. Conservation groups and government agencies are increasingly involved in public awareness campaigns and materials provided by WIDECAST have significantly aided this effort.

The Sea Turtle Recovery Action Plan for Aruba describes the following priorities: (a) to strengthen public awareness initiatives, (b) to encourage greater activism on the part of law enforcement officials in the confiscation of contraband and prosecution of offenders, (c) to determine the distribution and timing of the breeding effort, (d) to eliminate vehicle traffic on the beaches (driving on beaches is already illegal in Aruba), and (e) to promote full involvement of all beachfront hoteliers in reducing beachfront lighting on the nesting beaches and rescuing (and releasing to the sea) disoriented hatchlings.

SAMENVATTING

Aruba (12°30'N, 70°W) ligt 32 km. ten noorden van Venezuela en 67 km. ten westen van Curaçao, Nederlandse Antillen. Tot voor kort was Aruba één van de zes eilanden van de Nederlandse Antillen. Met ingang van 1 Januari 1986 werd Aruba een zelfstandige entiteit in het Koninkrijk der Nederlanden. Aruba is op economisch gebied sterk afhankelijk van toerisme. Toerisme is een sterk groeiende markt en is de grootste werkgever op het eiland. De grootste attracties zijn het gunstige klimaat en de uitgebreide witte stranden, speciaal aan de west en zuidwest zijde waar de meeste grote hotels zijn gelegen. De meeste hotels zijn gebouwd op de grens van het strand (of op het strand) en een kustweg geeft makkelijke toegang tot gebieden die vroeger moeilijk bereikbaar waren. Verlichting en algemene activiteiten kunnen schildpadden verhinderen in deze sterk ontwikkelde gebieden om aan land te komen en hun eie ren te leggen, maar het komt zo sporadisch voor dat het moeilijk is om de ontwikkeling met zekerheid vast te stellen.

Zeer weinig is bekend over de verdeling of hoeveelheid van zeeschildpadden op Aruba. Waarschijnlijk nesten er vier soorten: de "loggerhead" of (in het Papiaments) *cawama*, Caretta caretta; de "green turtle" of *tortuga blanco*, Chelonia mydas; de "leatherback" of *driekiel*, Dermochelys coriacea; en de "hawksbill" of *caret*, Eretmochelys imbricata. Een klein aantal nesten wordt gevonden op de zandstranden aan de west en zuidwest kust en ook op de kleine baaistranden langs de noordkust. In de kustwateren zijn gedurende het gehele jaar "hawksbills" en "green turtles" van verschillende groottes aanwezig, die zich waarschijnlijk in lokale wateren voeden. Zeegras en/of koraalriffen (die het voedsel en de schuilplaats verschaffen aan de "hawksbills" en "green turtles") liggen aan de betrekkelijk rustige west en zuidkust; de noordkust wordt gekenmerkt door een ruwe zee. De hoeveelheid voedsel die Aruba kan voorzien voor "loggerheads" en "olive ridleys" is onbekend. De zeldzame "leatherback" is een seizoen bezoeker, komende uit noordelijke wateren met als enig doel om eieren te leggen.

Voorlopig strandonderzoek in 1993 geeft aan dat ondanks de grote commercile ontwikkeling, de meeste nesten voorkomen op het Eagle strand en bij Arashi. Verdere studies zijn in voorbereiding voor 1994 om de locaties en verspreiding vast te leggen van de nesten. Het is waarschijnlijk dat er minder dan 30 nesten (alle soorten tezamen) per jaar gelegd worden. Onze gegevens tonen aan dat de "leatherback" de meest voorkomende zeeschildpad is die aan land komt om eieren te leggen, maar dit kan zijn omdat haar sporen het makkelijkst te herkennen zijn in vergelijking met de andere soorten.

Alle soorten zeeschildpadden zijn sinds 1987 beschermd in Aruba; de nesten en eieren zijn reeds vanaf 1980 beschermd. Er wordt geen zeeschildpadvisserij beoefend. Een onbekend (maar waarschijnlijk klein) aantal toevallige vangsten komt voor in ringnetten die vanaf de westkust gezet worden. De klandestiene vangst van zeeschildpadden is moeilijk vast te stellen, aangezien de vissers dit onderwerp niet met de visserijcontroleurs van de overheid willen bespreken. Twee boutiques in de hoofdstad verkochten sieraden gemaakt van het schild van deze dieren, tijdens een recent gehouden marktonderzoek, en 15 hele schilden werden in September 1993 in beslag genomen in een souvenirwinkel aan de noordkust. Er werd gezegd dat de sieraden lokaal gemaakt worden, maar dat de schilden uit Venezuela geimporteerd worden.

Enige restaurants verkopen schildpadvlees (meestal ingekocht van Venezolaanse vissersboten die hun waren in de haven van Oranjestad verkopen) maar de verwachting is dat deze activiteiten zullen verminderen, aangezien de Minister President in April 1993 een brief heeft gestuurd aan alle lokale restaurants, om er op te wijzen dat het in bezit hebben, het kopen en/of verkopen van zeeschildpadproducten bij de wet verboden is.

De meest voorkomende bedreigingen voor het aan land komen van zeeschildpadden zijn strandverlichting, het belemmeren van toegang tot de nestomgeving door recreatiemateriaal (strandstoelen, zeilboten), en, in sommige gevallen, het lastig vallen van de dieren door het aanwezige publiek. De meest voorkomende bedreiging voor de eieren is het aanstampen van het zand en embryosterfte door het rijden met voertuigen op het strand. In het geval de "hatchlings" (pas geboren zeeschildpadjes), zijn de strandverlichting van de hotels en de boulevardverlichting het grootste gevaar. Bij minstens drie gevallen in 1993, werden de "hatchlings" landinwaarts aangetroffen en toen teruggebracht naar de zee, nadat zij door strandverlichting verdwaald waren. Er zijn aanduidingen dat op zee, schildpadden soms door boten en andere plezierva-artuigen worden geraakt. Koraalriffen worden beschadigd door het willekeurig ankeren (speciaal op populaire duikplaatsen) en vervuiling is opvallend, vooral in de baai van San Nicolas.

Ondanks de vele factoren die de zeeschildpadden en hun leefomgeving bedreigen, is het duidelijk dat Aruba uitgaat van een sterke positie wat betreft de bescherming van zeeschildpadden. Volledige wettelijke bescherming bestaat reeds, er bestaat geen economische afhankelijkheid van zeeschildpadden en hun producten, er bestaan plannen om de gehele west en zuidkust aan te wijzen als onderwaterpark (inclusief een systeem van vaste boeien om de koraalriffen te beschermen), en er bestaat interesse van de zijde van de hotels om een positieve rol te vervullen bij de bescherming van schildpadden en hun nestgebieden. Natuurbeschermingsorganisaties en overheidsinstanties zijn steeds meer betrokken bij campagnes met publieke bewustmaking als doel en materiaal verschaft door WIDECAST heeft hieraan een sterke bijdrage geleverd.

De "Sea Turtle Recovery Action Plan" voor Aruba omschrijft de volgende prioriteiten: (a) om de publieke bewustmaking te versterken, (b) om de justitie aan te moedigen om smokkelwaar in beslag te nemen en de overtreders te vervolgen, (c) om de verspreiding en tijdsindeling van de broedactiviteiten vast te leggen, (d) het voorkomen van voertuigverkeer op de stranden (het rijden op de stranden is reeds wettelijk verboden op Aruba), en (e) het bevorderen van een volledige inzet van alle hotels om hun strandverlichting te verminderen bij de nestgebieden en het redden (en het loslaten) van verdwaalde "hatchlings".

RESUMEN

Aruba (12°30'N, 70°W) se encuentra localizada a 32 km al norte de Venezuela y a 67 km al occidente de Curazao, Antillas Neerlandesas. Hasta hace poco, Aruba era una de las seis islas que comprenden las Antillas Neerlandesas. Desde el 1 de enero de 1986, Aruba se convirtió en una entidad autónoma del Reino de los Países Bajos. La economía de Aruba depende mucho del turismo. El turismo es un mercado que aumenta a pasos rápidos y genera la mayor cantidad de empleos en la isla. Las mayores atracciones son un clima favorable y unas playas extensas de arena blanca, especialmente a lo largo de las costas occidental y suroccidental donde están situados la mayor parte de los grandes hoteles. La mayoría de los hoteles se encuentran ubicados a la orilla de la playa (o sobre la playa) y una autopista costera provee acceso fácil a lo que una vez fueron áreas remotas. En estas áreas de alta densidad de desarrollo, la iluminación y la actividad general puede inhibir a las tortugas a que vengan a la playa a poner huevos, pero la anidación parece ser tan rara que es difícil cuantificar las tendencias.

Se conoce muy poco de la distribución o abundancia de tortugas marinas en Aruba. Pueden anidar cuatro especies: la Caguama o la Cabezona o (en Papiamento) *cawama*, Caretta caretta; la Tortuga Verde del Atlántico o *tortuga blanco*, Chelonia mydas; la Laúd o la Tora o *driekiel*, Dermochelys coriacea; y la Carey o *caret*, Eretmochelys imbricata. La anidación de baja densidad ocurre sobre las largas playas arenosas de las costas occidental y suroccidental, así como sobre selectas playas encajonadas a lo largo de la costa norte. En las aguas frente a las costas, las Carey y las Tortugas Verdes del Atlántico de varios tamaños se encuentran presentes durante todo el año y se alimentan, presumiblemente en las aguas locales. Los pastos marinos y/o arrecifes coralinos, que proveen alimento y cobijo a las tortugas Carey y Verde del Atlántico, se sitúan a lo largo de las costas relativamente calmas del occidente y sur; la costa norte se caracteriza por aguas turbulentas. No se conoce en qué grado Aruba proporciona forraje para las Caguamas y las Tortugas Verdes del Atlántico. La rara tortuga Laúd es una visitante estacional, que llega de las aguas del norte con el sólo propósito de poner huevos.

Encuestas preliminares sobre las playas en 1993 indican que, a pesar de la alta densidad del desarrollo comercial, la mayor parte de la anidación puede ocurrir sobre la costa occidental y sobre Eagle Beach y Arashi, en particular. Para 1994 hay planes de realizar encuestas más detalladas con el objetivo de documentar el tiempo y la distribución de la anidación. Es posible que en Aruba se hagan menos de 30 nidos (combinadas todas las especies). Nuestros registros indican que la tortuga Laúd es la que anida más comúnmente, pero esta puede ser una reflección del hecho de que las pistas de la tortuga Laúd son las más fáciles de identificar.

Desde 1987, están protegidas en Aruba todas las especies de tortugas marinas; los huevos están protegidos desde 1980. No hay pescadores de tortugas. No se ha cuantificado (pero es probablemente bajo) el nivel de captura accidental, especialmente en las redes cercanas a las costas a lo largo de la costa occidental. La captura clandestina es casi imposible de cuantificar ya que los pescadores no lo informan a los Oficiales de Pesca. Durante encuestas de mercado recientes, dos "boutiques" de la capital vendían joyas de caparazón de tortuga, y en septiembre de 1993 fueron confiscadas por la policía 15 caparazones enteras en una tienda de la costa norte. Se dice que las joyas se fabricaron localmente, pero que las caparazones se importaron de Venezuela. Unos pocos restaurantes venden carne de tortuga (la mayoría comprada a las em

barcaciones pesqueras de Venezuela que las venden en el Puerto de Oranjestad), pero se espera que esta actividad se reduzca desde que el Primer Ministro envió una carta a todos los restaurantes locales en abril de 1993 reiterando que la posesión, adquisición, y/o la venta de productos procedentes de tortuga marina se halla prohibido por la ley.

Las amenazas más comunes a las tortugas que llegan a anidar en las costas de Aruba son iluminación de la playa, obstrucción de los habitats de anidación por equipos recreativos (reposeras, embarcaciones), y, en algunos casos, el acoso de los observadores. La amenaza más común a los huevos es la muerte del embrión por aplastamiento debido a los vehículos que pasan por la playa. En el caso de las juveniles, el mayor peligro es la iluminación procedente de los hoteles y las avenidas costeras. En el mar, hay indicaciones de que algunas veces las tortugas son golpeadas por botes y otras embarcaciones de recreación. Los arrecifes coralinos se dañan porque las embarcaciones anclan indiscriminadamente (en especial en los sitios populares de buceo) y la contaminación es significativa en algunas áreas, más notablemente en San Nicolas Bay.

A pesar de una variedad de factores que han amenazado nuestras tortugas marinas y sus habitats, está claro que Aruba se encuentra en una posición muy firme con respecto a la conservación de tortugas marinas. Ya se tiene protección legal plena, no existe dependencia económica con respecto a las tortugas marinas y sus productos, hay planes para designar las costas occidental y sur completas como Parque Marino (incluso un sistema de boyas para proteger los arrecifes coralinos), y existe un interés considerable por parte de los hoteleros para desempeñar un papel positivo en la conservación de tortugas y sus lugares de anidación. Los grupos conservacionistas y las agencias gubernamentales se están involucrando cada vez más en las campañas de concientización pública, y los materiales provistos por WIDECAST han contribuído de forma significativa a este esfuerzo.

El Plan de Acción para la Recuperación de la Tortuga Marina para Aruba describe las siguientes prioridades: (a) fortalecer las iniciativas destinadas a la concientización pública, (b) promover un mayor activismo en la confiscación de contrabando, así como sanción a los transguesores por parte de los oficiales encargados de hacer cumplir la ley, (c) determinar la distribución y el tiempo en que se realizan los esfuerzos de procreación, (d) eliminar el tráfico de vehículos sobre las playas (conducir en las playas ya es ilegal en Aruba), y (e) promover la participación plena de todos los hoteleros de la playa en la reducción de iluminación frente a las playas donde ocurre la anidación y rescatar (y liberar en el mar) a las juveniles desorientadas.

RESUME

L'île d'Aruba (12°30'N, 70°O) se trouve dans les Antilles néerlandaises à 32 km au nord du Venezuela et à 67 km à l'ouest de Curaçao. Jusqu'à très récemment, Aruba faisait partie des six îles composant les Antilles néerlandaises. Aruba est devenu, le 1er janvier 1986, une entité indépendante au sein du Royaume des Pays- Bas. L'économie d'Aruba dépend exclusivement du tourisme qui est un marché en croissance accélérée et permet le plus grand nombre d'emplois sur l'île. Les plus grands atouts sont le climat favorable et les plages de sable blanc, très étendues, en particulier le long des côtes ouest et sud-ouest où se situent la plupart des grands hôtels. La majorité de ces hôtels sont construits au bord des plages (ou sur la plage même), une auto-route côtière donnant accès à des zones autrefois éloignées. La forte luminosité et l'activité générale peuvent empêcher aux tortues de sortir de l'eau dans ces zones très exploitées afin de pondre leurs oeufs. La nidation semble être si rare que les tendances sont difficiles à quantifier.

On connait très peu la distribution ou l'abondance des tortues de mer à Aruba. Quatre espèces y font leurs nids: la tortue caouanne ou (en Papiamentou) *cawama*, Caretta caretta; la tortue verte ou *tortuga blanco*, Chelonia mydas; la tortue luth ou *driekel*, Dermochelys coriacea et la tortue imbriquée ou *caret*, Eretmochelys imbricata. La nidation se fait dans une faible mesure sur les vastes plages sablonneuses sur les côtes ouest et sud-ouest ainsi que sur quelques petites plages de la côte nord. En mer, les tortues imbriquée et les tortues vertes de différentes tailles sont présentes toute l'année et s'alimentent dans les eaux locales. Les bancs d'algues et/ ou les récifs coralliens (qui servent de nourriture et d'habitat aux tortues à écaille et aux tortues vertes) se trouvent tout au long des côtes ouest ou sud qui sont assez calmes. On ignore jusqu'à quel point Aruba représente une source d'alimentation pour la tortue caouanne et la tortue olivâtre. La tortue luth, espèce rare, est un visiteur saisonnier, arrivant du nord uniquement pour pondre ses oeufs.

Des études préliminaires en 1993 indiquent que, malgré la densité du développement commercial, la plupart de la nidation se fait sur la côte ouest et en particulier sur la plage Eagle et à Arashi. Des études plus détaillées sont prévues pour 1994 afin de rassembler des documents sur la périodicité et la répartition de la nidation. Il se peut que moins de 30 nids (toutes les espèces combinées) soient faits à Aruba chaque année. Selon les informations disponibles, la tortue luth est celle qui fait le plus souvent un nid; néanmoins, ceci peut sembler parce qu'il est très facile de suivre les traces de la tortue luth.

Toutes les espèces de tortues ont été protégées depuis 1987 et leurs oeufs depuis 1980. Il n'existe pas de pêcheurs de tortues. Un nombre indéterminé (mais peut-être très faible) de prises accidentelles se produit surtout dans les filets tendus près des côtes de l'ouest. La prise clandestine est presque impossible à quantifier car les pêcheurs ne veulent pas en parler aux responsables de la Division de la Pêche. Lors des récentes études de marché, deux boutiques dans la capitale vendaient des bijoux en écaille de tortue. En septembre 1993, 15 carapaces entières ont été confisquées par la police dans une boutique de la côte nord. Les bijoux seraient fabriqués localement mais les carapaces auraient été importées du Venezuela. Quelques restaurants vendent la chair de tortue (achetée en grande partie auprès des bateaux vénézueliens vendant leurs marchandises dans le port d'Orenjestad) mais cette activité devrait diminuer grâce à la lettre

envoyée par le premier ministre en 1993 interdisant la possession, l'achat ou la vente de tout produit lié à la tortue marine.

L'éclairage des plages, l'obstruction de la zone de nidation par les équipements de loisirs (chaises longues et yatch), et dans certains cas, le harcèlement par les badauds constituent les principales menaces à la montée sur les plages des tortues. En raison des véhicules qui roulent sur les plages, les oeufs courent le risque d'être écrasés, occasionnant la mort de l'embryon. Les jeunes tortues, elles, sont le plus souvent dérangées par l'éclairage des plages, et les routes construites sur les côtes. Dans au moins trois cas en 1993, de jeunes tortues ont été ramassées dans des sites à l'intérieur et retournées à la mer car elles ont été mal dirigées par l'éclairage des plages. En mer, les tortues seraient parfois heurtées par les bateaux de plaisance et autres. Les récifs coralliens sont détruits par l'ancrage hasardeux (surtout dans les sites populaires destinés à la plongée) tandis que la pollution est importante dans certaines zones, notamment dans la baie de Saint Nicolas.

Malgré les nombreux facteurs qui menacent nos tortues marines et leurs habitats, il est évident que le programme de protection de la tortue marine en Aruba repose sur une structure bien établie. Une protection juridique totale est déjà assurée et il n'y a aucune dépendance économique exclusive sur la tortue marine ou ses produits. Il est prévu que les côtes ouest et sud, soient désignées comme Parc marin, en y ajoutant un système d'ancrage pour protéger les récifs coralliens. Les hôteliers sont eux-mêmes prêts à jouer un rôle positif dans la protection des tortues et de leurs nids. Les écologistes et les agences gouvernementales participent de plus en plus activement aux campagnes de sensibilisation du public et le matériel fourni par WIDECAST a été très utile à cet égard.

Le Plan d'action pour la sauvegarde de la tortue de mer à Aruba s'est fixé les priorités suivantes: a) renforcer les initiatives de sensibilisation du public; b) encourager une action plus militante de la part de ceux chargés de l'application des lois pour qu'ils confisquent les produits illégaux et poursuivent en justice les délinquants; c) déterminer la répartition et la période de reproduction; d) éliminer la circulation de véhicules sur les plages (cette pratique est déjà illégale à Aruba); et e) encourager la pleine participation de tous les hôteliers ayant des constructions sur la plages pour réduire l'éclairage des plages de nidation, rattraper et retourner à la mer les jeunes tortues qui sont desorientées.

I. INTRODUCTION

Until recently, Aruba was one of six islands comprising the Netherlands Antilles. As of 1 January 1986, Aruba became an autonomous entity within the Kingdom of The Netherlands. It now has its own constitution based on the same principles as The Netherlands. A Governor appointed by the Queen of Holland for a six year period acts as her representative. Legislative, executive and judicial powers are established along parliamentary democracy guidelines. The parliament, comprised of 21 members elected every four years by universal suffrage, legislates. The party (or parties) obtaining legislative majority is asked by the Governor to form a seven-member Council of Ministers vested with executive powers and headed by a Prime Minister.

Aruba ($12^{o}30'$N, 70^{o}W) is located 32 km (19 miles) north of Venezuela and 67 km (42 miles) west of Curaçao, Netherlands Antilles (Figure 1). It is situated outside of the hurricane belt and its climate is of a semi-arid type. The average temperature is 27^{o}C (81^{o}F), annual rainfall and humidity average 43.2 cm (17 in) (mostly in the months of November-January) and 75.9%, respectively. Aruba is a small, flat island measuring 32 km (20 miles) long by a maximum width of 10 km (6 miles); total area is 193 km^2. Its highest point is Mount Yamanota (190 m). The resident population is about 70,000, but this is considerably increased by the influx of tourists, especially during the winter months (Table 1).

Aruba is very dependent economically on tourism, especially since it became separated from the Netherlands Antilles. Today tourism is a fast-growing market and is the biggest employer on the island (AHATA, unpubl. statistics). The major attractions are a favorable climate and extensive white sandy beaches, especially along the western and southwestern shores where most of the largest hotels are situated. Most hotels are built right at the beach edge (or on the beach) and a coastal highway provides easy access to once remote areas. Lighting and general activity may inhibit turtles from coming ashore to lay their eggs in high density development areas, but nesting appears to be so rare that trends are difficult to quantify.

Along the south shore, small coral islands protect the coastline from rough seas. Surrounding these small islands are fringing coral reefs, although the reefs are less developed than those in Curaçao and Bonaire. Unlike its closest neighbors, Curaçao and Bonaire, Aruba lies entirely within the confines of the South American continental shelf and the sea separating it from the mainland does not exceed 135 m in depth (average depth is 50 m). To the north, the sea bottom drops off to depths of 200 m and more. A strong east tradewind renders the north coast largely unsuitable for swimming and recreation. Sandy beaches suitable for sea turtles to come ashore and nest were surveyed in 1993 for signs of egg-laying. This was the first time such a survey had been conducted.

In a global review of the status of green turtles (*tortuga blanco*) and hawksbills (*caret*), Groombridge and Luxmoore (1989) concluded that nesting and foraging may occur in Aruba, but there were no data to indicate where such activities might take place. In preparing this Recovery Action Plan we interviewed government officials, conservationists, fishermen, and coastal residents, initiated preliminary habitat surveys, and involved ongoing projects (such as the current UNDP fisheries project) that may yield insight into the distribution of sea turtles. With this information, we have attempted to identify habitats important to sea turtles and factors threaten-

ing their survival. While a great deal of effort has gone into preparing the Recovery Action Plan, its publication is only the beginning of our conservation efforts.

Because of our involvement in WIDECAST, sea turtle conservation in Aruba is now a national commitment rooted in an understanding of sea turtle biology and an awareness of conservation techniques and options. This Recovery Action Plan summarizes what is known, identifies important gaps in existing knowledge, and provides policy-makers and non-government groups with detailed information needed to make informed decisions regarding the conservation and recovery of depleted sea turtle stocks. It is clear that our priorities should be to refine our knowledge of important nesting and feeding areas, promote public awareness of the plight of en-dangered sea turtles, and implement specific management initiatives (such as the protection of eggs in zones of high beach use) to enhance survival prospects.

II. STATUS AND DISTRIBUTION OF SEA TURTLES IN ARUBA

In the Caribbean Sea, five species of sea turtle are recognized as *Endangered* and a sixth, the loggerhead turtle, as *Vulnerable* by the World Conservation Union (IUCN) (Groombridge, 1982). There is ample evidence that all six species have declined from former levels of abundance in many parts of the region. The factor most clearly responsible for their demise is the relentless commercial harvest for meat, shell, oil, skins, and eggs which has been ongoing for more than a century. In addition, turtles are accidentally captured in active or abandoned fishing gear, resulting in death to tens of thousands of turtles each year. The continued existence of Caribbean populations is also threatened by oil spills, human and industrial waste, garbage dumped at sea, indiscriminate anchoring, beach sand mining, beachfront lighting, and a variety of other factors that degrade important nesting beaches and feeding grounds.

Very little is known about the distribution or abundance of sea turtles in Aruba. Four species may nest: the loggerhead (*cawama*), green turtle (*tortuga blanco*), leatherback (*driekiel*), and hawksbill (*caret*). Nesting is only very rarely reported, and the species is virtually never identified. Low density nesting occurs on the large sand beaches of the west and southwest coasts, as well as on selected pocket beaches along the north shore. Offshore, hawksbills and green turtles of varying sizes are present year-around and presumably feed in local waters. The extent to which Aruba provides forage for loggerheads and olive ridleys is not known. The rare leatherback is a seasonal visitor, arriving from northern waters only for the purpose of egg-laying. The Kemp's ridley is confined to the Gulf of Mexico and temperate north Atlantic and is not reported in Aruba. Figure 2 summarizes diagnostic features of local species.

2.1 Caretta caretta, Loggerhead Sea Turtle

The loggerhead sea turtle, known as *cawama* in the local language (Papiamento), nests occasionally and is sometimes encountered at sea. The loggerhead is recognized by a large head (to 25 cm wide, according to Pritchard et al., 1983) and thick, somewhat tapered carapace (=shell) with five pairs of lateral plates (=scutes) (Figure 2). The carapace is often encrusted by barnacles. The large head and strong jaws, for which the species was named, are necessary adaptions to an omnivorous diet of mollusks and hard-shelled crabs; tunicates, fishes, and plants

are also eaten (Dodd, 1988). Adults attain a straightline carapace length of 120 cm and weigh up to 200 kg (440 lb) (Pritchard et al., 1983). The color is red-brown to brown; hatchlings are sometimes gray. Like hawksbills, loggerhead hatchlings are uniform in color, top and bottom. Frazer and Ehrhart (1985) estimated age at sexual maturity to be 12-30 years, and predicted that the upper estimate was the more realistic value.

Loggerheads are found as far north as Newfoundland (Squires, 1954) and northern Europe (Brongersma, 1972) and as far south as Argentina (Frazier, 1984), but they have a predominately temperate nesting distribution. The greatest numbers of nesting females are recorded along the Atlantic coast of Florida (USA) and at Masirah Island, Oman. In the Wider Caribbean, nesting is reported on the Caribbean coasts of Mexico and Central America, the Atlantic coast from Venezuela to Brazil, and rarely in the eastern Caribbean (summarized by Dodd, 1988). According to the existing paradigm (at least for the large rookeries in the U. S.), hatchlings leave their natal beaches and are carried passively on the North Atlantic subtropical gyre in Sargassum seaweed rafts to areas of the eastern North Atlantic, including the Azores. After several years of pelagic existence, the juveniles (typically 50-65 cm shell length) return or are returned by currents to the western North Atlantic to become resident benthic (=bottom) feeders on the continental shelf.

It is not known whether the species is resident or itinerant in the waters of Aruba. There are no data detailing which size classes are most common. Foraging presumably takes place, but important feeding areas have not been identified. In November of 1983, in the vicinity of the Diva Hotel, hatchlings emerged from the sand. Based on an average of two months of incubation, these eggs were laid in September [N.B. nesting typically begins in April or May in the Western Atlantic and ends in September (summarized by Dodd, 1988)]. Roberto Hensen, Managing Director of Marcultura in Bonaire, was given a dozen of the hatchlings. Hensen gave seven of these to the Seaquarium on Curaçao (they subsequently died), and kept five. Four are alive to this day and doing well at the Marcultura facility. On 26 April 1993, a loggerhead nested at Eagle Beach between the Manchebo and Costa Linda hotels; hatchlings emerged 26 June (48 hatchlings were counted, 20 unhatched eggs were exhumed). On 17 August 1993, five dead (desiccated) hatchlings were found on northern Arashi Beach. In contrast to the green turtle (section 2.2), the loggerhead leaves an *asymmetrical* nesting crawl (1-1.2 m wide) on the beach because the fore flippers alternate with one another during crawling.

With only three nests reported to LVV in more than a decade, the present level of nesting is sure to be low, perhaps 1-2 females come ashore each year. We have no data as to whether this number has declined over the years. Clutch size and frequency (the number of clutches laid per year per female) are unknown, but 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 (summarized 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 (e.g., Richardson et al., 1978; Bjorndal et al., 1983). The sex of the hatchlings is largely determined by beach sand temperature (e.g., Mrosovsky et al., 1984). Few hatchlings will survive the many years to sexual maturity, but those who do will return to the beaches where they were born to start the cycle anew.

Rebel (1974) reported that eggs were taken opportunistically for personal consumption. Unfortunately, more current information is not available. We are aware of a low level of clandestine harvest of sea turtles in Aruba (section 3.3), but we have no documentation to suggest that loggerheads are involved.

2.2 Chelonia mydas, Green Sea Turtle

The green turtle, referred to in Papiamento as *tortuga blanco*, is one of the two most common turtles seen in the waters of Aruba, the other being the hawksbill turtle. The green turtle is recognized by a single pair of scales on the "forehead" between the eyes and a round, blunt beak serrated for clipping sea grasses. The carapace is smooth and the plates (=scutes) do not overlap one another (cf. hawksbill turtle, section 2.4). The carapace is characterized by four pairs of lateral scutes (Figure 2) and is generally devoid of barnacles. The maximum reported weight of adult females nesting in Suriname is 182 kg (400 lb) (Schulz, 1975). Adults generally measure 95-120 cm in straightline carapace length. Adults and juveniles of varying sizes are present in Aruba throughout the year.

It is likely that individual green turtles do not remain in local waters throughout their lives. Hatchlings emerge from their nests, scurry to the sea, orient offshore in a swimming frenzy that persists over a period of days, and ultimately enter an offshore convergence or weed line. It is well known, for example, that Sargassum seaweed rafts shelter hatchling green turtles and also harbour a diverse, specialized fauna, including many kinds of little fishes, crustaceans, worms, mollusks, tunicates, and coelenterates; these may provide food for the young turtles (Carr, 1987a). The turtles remain epipelagic (surface dwelling in the open sea) for an unknown period of time (perhaps 1-3 years) before taking up residence in continental shelf habitats. Unlike the loggerhead (section 2.1), the epipelagic years are not likely to involve trans-Atlantic movement.

Upon leaving the open sea existence that characterizes their earliest years, green turtles become herbivores and remain so for the rest of their lives (Bjorndal, 1985). In the Caribbean Sea, green turtles feed primarily on the sea grass Thalassia testudinum (Bjorndal, 1982), commonly referred to as "turtle grass". Field studies indicate that individual turtles maintain feeding "scars" by returning to the same area of sea grass meadow to forage each day (Ogden et al., 1980, 1983). These scars, or grazing plots, are maintained by regular cropping for several months and the more digestible newer growth (higher in protein, lower in lignin) is preferred (Bjorndal, 1980). When the cropped grasses show signs of stress (blade thinning, increased inter-nodal distance), the turtle apparently abandons the scar and moves on to form another. In Aruba, Thalassia is most common in Palm Beach Bay (Figure 3).

Green turtles travel extensively during the first decades of their lives and in the years preceding reproductive maturity take up temporary residence in many locations (Carr et al., 1978). They may travel thousands of kilometers throughout the region before the urge to reproduce impels them to migrate to mating and nesting grounds, the latter presumed to be their natal (=birth) beach. Caribbean green turtles reach sexual maturity at an estimated 18-36 years of age (reviewed by Frazer and Ladner, 1986). After reproducing, there is some evidence that turtles return to resident foraging grounds (=feeding areas). Therefore, the movements of adult

turtles are likely to be less extensive than those of juveniles, since adults move seasonally between relatively fixed feeding and breeding areas. Tagging and telemetry studies would be useful to determine residency and movement patterns in the waters of Aruba.

van Buurt (1984) did not report green turtle nesting, but an earlier reference (Rebel, 1974) cited personal communication from Dr. Ingvar Kristensen that "eggs are taken for local consumption from the three species that nest -- green, hawksbill, and loggerhead." If green turtles do nest in Aruba, such occurrences may be rare. Egg-laying has never been documented by LVV. Olinda van der Linden-Rasmijn watched a nesting female which she believes was a green turtle (olive-green color, very smooth shell, deep nesting pit) at Dos Playa on 9 May 1993; unfortunately, the eggs were subsequently lost to high seas. In general, green turtles prefer to nest on open beach platforms, as opposed to rocky or densely vegetated areas. Nests are characterized by a deep pit (1.5-2 m wide and 1 m deep) and a symmetrical crawl (1-1.2 m wide) leading to and from the ocean. Elsewhere in the Caribbean, 3-6 clutches of eggs are deposited per female per year. Adults are migratory, leaving the nesting grounds at the close of the breeding season and returning to repeat the ritual on multiple (2-3+) year intervals. Within season nestings are typically separated by 12-14 days and each clutch consists of about 120-150 eggs. Nesting is nocturnal. At the region's largest rookery (Tortuguero, Costa Rica), most nesting occurs between mid-June and mid-September (Bjorndal and Carr, 1989).

Green turtles are occasionally (and incidentally) netted, but the number of turtles taken is believed to be low (section 3.3). There is currently no export of green turtles; those not sold to local restaurants are sold to or shared with members of the community. Until recently, green turtles were quite frequently imported from Venezuela for restaurant sale (Rebel, 1974; J. Sybesma, 30 March 1987, in litt. to Groombridge and Luxmoore, 1989). The precise origin of the turtles brought into Aruba from Venezuela is not known, but many of them are captured off the east coast of the Peninsula de Paraguana (Guada and Vernet, 1988). Others are believed caught in the Gulf of Venezuela in the area of the Monkey Islands (R. de Kort, pers. comm.). The illegal trafficking is not nearly as common today as it was even a few years ago, yet it does continue on an irregular basis (section 3.3).

2.3 Dermochelys coriacea, Leatherback Sea Turtle

There are only rare reports of leatherbacks, known locally as *driekiel*. Leatherbacks are the largest of all sea turtles. Caribbean-nesting females typically weigh 300-500 kg (660-1100 lb). An adult male weighing a record 916 kg (2015 lb) stranded on the coast of Wales, U. K. in 1988 (Morgan, 1989). Leatherbacks lack a bony shell and the smooth black skin is spotted with white. The carapace is strongly tapered, typically measures 130-165 cm in straightline length, and is raised into seven prominent ridges (hence the name "driekiel", meaning "three ridges") (Figure 2). Powerful front flippers extend nearly the length of the body. Leatherbacks are excellent divers, having been recorded diving in excess of 1000 m offshore St. Croix, USVI (Eckert et al., 1989). Leatherbacks feed predominately on jellyfish and other soft-bodied prey (e.g., Hartog and van Nierop, 1984; Davenport and Balazs, 1991). Age at maturity is not known.

Leatherbacks are likely to be seasonal visitors, with observations largely confined to peak breeding months March-July. Caribbean island populations are relatively small (comprised of a

few dozen to a few hundred females), but Yalimapo-Les Hattes, French Guiana, supports an estimated 14,700-15,300 females (Fretey and Girondot, 1989). The turtles prefer to nest on beaches with deep, unobstructed access; contact with abrasive coral and rock is avoided (Eckert, 1987). Leatherbacks deposit an average of 5-6 clutches per year at 9-10 day intervals. Approximately 80-90 yolked eggs are laid in each nest, along with a variable number of smaller yolkless eggs. Tag returns from females tagged while nesting in the Guianas, Trinidad, and the U. S. Virgin Islands indicate that females return to north temperate waters after nesting. Corroborating evidence is available from studies of barnacle colonization on gravid females in St. Croix (Eckert and Eckert, 1988).

No nesting had been documented on Aruba at the time data were being assembled for the first Western Atlantic Turtle Symposium (van Buurt, 1984). However, in early April 1985, a leatherback with an estimated length of 1.5 m came ashore on Eagle Beach on the west coast of the island. An article in *La Prensa* (9 April 1985) reported that she was scared away by onlookers and had to return to the beach three times before her eggs were successfully laid. Three years later (2 April 1988), a female came ashore at Arashi beach (Figure 4). Nesting may occur regularly in this area but, since the beach is undeveloped, there are no security guards to observe and report nesting activity. In one case, 12 hatchlings from Arashi Beach were transferred to a mariculture facility on Bonaire (Marcultura Ltd.) where they were fed a diet of Cassiopeia jellyfish; they died 6-12 months later (Roberto Hensen, Marcultura, pers. comm.). Interviews and habitat surveys conducted for this Recovery Action Plan revealed additional evidence of nesting, but always along the western shore (Table 2).

In some parts of the Caribbean (e.g., French Guiana, Guyana, Trinidad, Grenada, St. Lucia, British Virgin Islands), gravid leatherbacks are killed for meat and/or oil whilst on the nesting beach. The shell and cartilage are boiled down for oil. The oil is often used for medicinal purposes, generally in cases of respiratory congestion (Cambers and Lima, 1990), and is sometimes believed to have aphrodisiac qualities. In addition to harvest, other threats include entanglement (longlines, shrimp trawls, pot lines, nets) and the ingestion of persistent ocean debris, notably plastic bags which are mistaken for jellyfish, the preferred prey item. A leatherback was brought in to the local abattoir in 1968, but subsequently released (section 3.3).

2.4 *Eretmochelys imbricata*, Hawksbill Sea Turtle

The hawksbill is known in Papiamento as *caret* and is recognized by the distinctly over-lapping scutes of the carapace, four pairs of lateral scutes, two pairs of scales between the eyes, and a narrow, pointed jaw (Figure 2). Adults rarely exceed 80 kg (175 lb) (Witzell, 1983) and a straight carapace length of about 90 cm; they are brightly patterned in yellow, gold, orange and brown. Hawksbills feed in coral reefs, where they appear to specialize on sponges. Ten sponge species accounted for 79.1% of the dry mass of all sponges identified in the stomachs of hawksbills from seven Caribbean countries, suggesting a degree of dietary selectivity (Meylan, 1988). Gravid females commonly nest on small, isolated beaches (often flanked by exposed coral and rock) that are difficult for biologists to survey on a consistent basis. When ashore for nesting, hawksbills typically retreat into the beach forest, leaving little evidence of the nest aside from a faint asymmetrical crawl (0.7-0.8 m wide) leading to and from the ocean. The asymmetry results because the fore flippers alternate with one anther during crawling.

In a report to the Western Atlantic Turtle Symposium, van Buurt (1984) speculated that hawksbills would be expected to nest on "various beaches on the north coast", but no specific records were available. He noted that there were several small sandy beaches on the north shore, including Boca Grandi, Boca Prins, Andicuri, and Druif (Figure 4). Most of these are surrounded by a limestone plateau; some have backbeach vegetation which includes Suriana maritima. We believe that the southeastern beaches, including Boca Grandi and Rodger's Beach, also offer favorable nesting habitat to hawksbills and recommend that future survey efforts include these sites. Very broad sandy beaches on the west and southwest shores are less likely to be suitable for hawksbill nesting; further, this habitat is compromised by intense tourist and industrial development. A few offshore islands such as De Palm Island may still have some nesting (none has been reported to date). Elsewhere in the Caribbean hawksbills nest throughout most of the year, but peak nesting activity is observed from July to November. Preliminary survey efforts in Aruba should be concentrated during this time.

Ongoing research on Long Island (Antigua, Eastern Caribbean) has shown that most hawksbills nest 4-6 times per year (averaging about 150 eggs per clutch), each nest separated by an interval of 14-15 days (range 13-18 days) (Corliss et al., 1989). Average clutch size in Mona Island, Puerto Rico, has ranged from 141.0 (1989) to 157.6 (1984); incubation lasts 47-63 days (Richardson, 1990). Females return to the nesting beach (thought to be their natal beach) at remigration intervals of 2-3 or more years and continue to breed throughout their adult lives. As is the case with other species, hatchling sex is largely determined by sand temperature during a 2-month incubation. Hatchlings emerge from their nests at night, scurry to the sea, and dwell in open ocean habitats for the first years of life. They return to coastal waters as young juveniles and may travel widely during the many years (20-30?) prior to sexual maturity (cf. green turtles, section 2.2).

Hawksbills are occasionally netted during nearshore fishing, but the number taken is believed to be low (section 3.3). The exquisite beauty of the shell scutes (known as "tortoiseshell") has long played a central role in jewelry and ornamentation in southeastern Asia (especially Japan) and, to a lesser degree, in the Caribbean. Harvest of hawksbills for their shells, while illegal in many nations, continues at a high rate in many parts of the world and is the single largest threat to the survival of the species in the Caribbean and elsewhere. In Aruba, two Oranjestad boutiques were found selling tortoiseshell in May 1993 and again in September 1993 (K. Eckert, pers. obs.) and in both cases the clerk noted that the items were fashioned locally. LVV is not aware of the identity of the supplier, but both stores will be investigated. In addition, Venezuelan suppliers illegally bring whole shells into Aruba whereupon they are sold to local buyers and ultimately to store owners (section 3.3).

2.5 Lepidochelys kempii, Kemp's Ridley Sea Turtle

There are no records of Kemp's ridleys in Aruba, nor would the species be expected to occur. The diminutive Kemp's ridley is gray in color as an immature and primarily olive-green as an adult (Pritchard et al., 1983). The carapace is round, often as wide as it is long, and carapace scutes do not overlap one another (cf. hawksbill sea turtle, section 2.4). According to Ross et al. (1989), adults weigh 60-90 lb (27-41 kg) and have a shell length of 23-30 inches (58-76 cm).The species is carnivorous and eats mostly crabs, but also preys on other crustaceans,

shellfish, jellyfish, sea urchins, starfish, and fish. With the exception of a single recapture from Caribbean Nicaragua of a "head-started" individual (Manzella et al., 1991), which may have displayed altered behavior due to having been held captive during its first year (Woody, 1991), Kemp's ridleys are confined to the Gulf of Mexico and temperate northern Atlantic. The total adult population is thought to number no more than 900 females and an unknown number of males (Ross et al., 1989), making it the world's most endangered sea turtle. The species nests almost exclusively in the state of Tamaulipas, Mexico.

2.6 Lepidochelys olivacea, Olive Ridley Sea Turtle

There are no records of this species in Aruba, although it may occur. A female was landed by a fisherman in Curaçao in July 1991 (Sybesma and Hoetjes, 1992). Olive ridleys are similar in appearance to Kemp's ridleys (section 2.5), having a nearly round carapace (the width about 90% of the length) and an adult color of olive green or brown dorsally and yellowish white ventrally. The turtle rarely exceeds 100 lb (45 kg) (Pritchard et al., 1983). Each front flipper bears a single claw, the horny beak may be finely serrated, and carapace scutes do not overlap one another. The lateral scutes (those to either side of the median on the shell) are divided into 5-9 pairs, considerably more than other sea turtles which typically have 4-5 pairs. The only significant nesting colony in the Western Atlantic is in Suriname, primarily at Eilanti Beach (Schulz, 1975). Olive ridleys nesting in Suriname have declined considerably in recent years, from about 3,000 nests per year in the late 1960's to fewer than 500 nests per year today (Reichart and Fretey, 1993). Diffuse nesting occurs in northwestern Guyana and in French Guiana (Reichart, 1989).

III. STRESSES ON SEA TURTLES IN ARUBA

3.1 Destruction or Modification of Habitat

Because many beaches suitable for egg-laying are also suitable for recreational tourism, much of the potential historical nesting habitat of sea turtles is now despoiled to a greater or lesser degree by large hotels or hotels under construction, by the activities of growing numbers of tourists and residents, and by a coastal boulevard that provides access to points once remote along the western shore.

Hotel development began with the construction of the Aruba Caribbean Hotel in 1959, followed by the Sheraton in the late 1960's. At the present time, virtually all nesting habitat along the west and southwest coasts has been developed in luxury, high rise hotels. Further north, at Arashi Beach, beachfront development consists of private residences. The capital of Oranjestad is also developed on what was once beachfront property. Vehicles have recently become commonplace on some beaches (e.g., Boca Prins, California Dunes, Eagle Beach) and this has caused noticeable damage (tire ruts, destruction of vegetation). Fortunately there is no history of commercial beach sand mining in Aruba, so this has not been a source of beach destruction. The widespread disposal of waste tar between Boca Grandi and Rincon by the LAGO Oil Company from 1926-1985 is not likely to have affected the beaches themselves; the deposits were cleaned away in 1991.

In some areas, foraging habitat (coral reefs and sea grass) has been adversely modified during the course of the twentieth century. Perhaps the most extreme example is San Nicolas Bay where long-term effects of chronic pollution (industrial harbor, chemical plant) include low coral cover, low coral recruitment, and modified reef species composition (section 4.143). Oil still finds its way into San Nicolas Bay as a result of the multifarious operations of the Coastal Oil refinery (which replaced the LAGO facility), and untreated sewage is also disposed of in the bay. In the past, dredging shoreward of the islands offshore Surfside did considerable damage to sea grass beds there. There is no indication that anchoring has damaged sea grass beds, but the story is different for coral reefs. Damage is particularly apparent at popular dive sites, where coral heads can be observed to be broken and/or overturned. For this reason, among others, most dive operators are keen in their support for the proposed Marine Park (section 4.12) and its system of moorings. Indiscriminate anchoring by fishing boats is also a problem. Some areas popular for skin diving and snorkeling, such as Palm Island on the south shore, receive large groups of tourists off visiting cruise ships and significant damage is visible to fragile shallow water reef formations.

The challenge in Aruba is to identify remaining habitat still important to sea turtles, and then to establish as a priority the safeguarding of this habitat in order to conserve our sea turtle resource. For new development sites, field surveys should be undertaken to assess usage of the site by sea turtles. Mitigation measures should then be required to minimize or eliminate negative effects of anchoring, dredging, sewage and garbage disposal, land reclamation, artificial beach lighting, and the construction of seawalls and jetties, etc. (see sections 4.13 and 4.14). For existing development sites, creative and comprehensive solutions must be explored to reduce current threats, including artificial lighting, vehicle traffic on the beach, the trampling of nests, etc. (see section 4.12).

3.2 Disease or Predation

There are no data on the extent to which disease affects sea turtles in Aruba. Fibropapilloma, a poorly understood tumor disease in green turtles, is debilitating and can be fatal (Jacobson et al., 1989; Ehrhart, 1991). In some cases the disease has resulted in blindness and starvation. In the southern regions of the Caribbean the disease has affected green turtles in Curaçao (Sybesma, 1989), Panama (Jacobson, 1990), Trinidad (Jacobson, 1991), Barbados (Horrocks, 1992), and Venezuela (Guada et al., 1991). It has not been reported in Aruba. Tumors appear as whitish or gray growths, similar to warts, which can be 10 cm or more in diameter.

Predation and other natural causes of mortality differ among life stages. Eggs are lost primarily to beach erosion and domestic animals (i.e., dogs). In general, hatchlings fall prey to dogs, crabs, ants, coastal/sea birds and, once offshore, to reef and pelagic fishes. Juveniles also face dangers from pelagic fishes, but, by the time adulthood is reached, the only non-human predators of any consequence are large sharks and killer whales. The remains of an approximately 28 kg hawksbill turtle were found in the stomach of a 4-meter tiger shark captured off St. Thomas (Boulon, 1984). A similar incident is reported from Nevis by Young (1992). Leatherback remains were found in the stomachs of three killer whales captured off St. Vincent (Caldwell and Caldwell, 1969). Natural levels of predation have not been determined in Aruba, but are assumed to be within tolerable limits.

3.3 Over-utilization

It is painfully difficult to quantify the historical abundance, harvest, and marketing of sea turtles in Aruba. With the exception of abattoir records (Table 3), there are no relevant data on this topic. Earlier reports have confessed facing similar obstacles (e.g., van Buurt, 1984). Sea turtles are certainly a rare sight today, especially on the nesting beaches where perhaps fewer than 30 nests are laid (all species combined) each year. It is difficult to believe that sea turtles have always been rare in Aruba (especially given the seemingly superb nesting habitat that characterizes the west coast; indeed, residents interviewed for this report contend that Eagle Beach was always a "popular" nesting area), but it is possible that they were never as common as we might think. It is significant that Aruban people claim no familiar folklore concerning sea turtles (e.g., locating a nesting female by signs in the night sky) and there have not been any turtle fishermen in recent memory. A broken piece of carapace is archived in the Archaeological Museum of Aruba, but there is no information as to where it was collected, the species or estimated age. Regarding eggs, the extent to which they are collected is unknown, but LVV is not aware of any physical evidence (open pits, probing sticks) of poached nests and eggs have not been seen for sale.

There is a long-standing tradition of importing sea turtles from Venezuela and, to a lesser extent, from Colombia. General knowledge holds that they were mostly adult greens, although hawksbills were also included. Guada and Vernet (1988) document the slaughter of green turtles captured along the east coast of the Peninsula de Paraguana (Venezuela) for black-market export to Aruba and Curaçao. The trade was lucrative; at that time a 30 cm green turtle shell sold for US$ 10 in Aruba, while in Venezuela the price was but a small fraction of that (Guada and Vernet, 1988). Import volume will never be known but, based on abattoir statistics, fewer than 10 turtles were legally processed in a typical year (1977-1986) (Table 3). Imports apparently diminished in the late 1980's, perhaps as a result of the 1987 legislation banning the take or possession of sea turtles in Aruba. The imported animals were often placed on tires on the ship's deck so as not to damage their shells. Prior to slaughter, turtles were kept in corrals made of loose rocks in front of the Government Building in Oranjestad. By law, they had to be slaughtered at the abattoir whether they were local-caught or imported. Restaurants and hotels bought much of the meat, which was more expensive than fish. A leatherback was brought into the abattoir in 1968, but Veterinary Service staff convinced the fishermen to release the animal. The abattoir stopped processing turtles in September 1986 with the advent of protected status.

In recent memory, turtles caught locally have been snared by nearshore seines (see section 4.27). The catch is opportunistic, and the meat is considered a delicacy. In April 1993, a local diver reported to LVV that he had encountered the shell of a freshly slaughtered turtle on the sea bottom at Blue Reef. Meat also still arrives on small boats that originate in Venezuela and transport fish to the floating market in Oranjestad Harbor. The volume of this trade is unknown and, as turtles are not regular fare on these boats, difficult to control. Restaurants purchase some if not most of the turtle meat. In early May 1993, Fisherman's House Restaurant in Savaneta advertised a Mother's Day Special Menu that included sea turtle meat. Several residents called LVV to report the advertisement and to request enforcement action. LVV officials immediately visited the restaurant and spoke with the proprietor. Ten kilos of green turtle meat had been purchased the day before from the floating market. The proprietor claimed

never to have purchased turtle meat before and only wanted to offer "something different" for Mother's Day. He willingly agreed to dispose of the meat and not to purchase it again. It is quite clear in cases such as this one that the law protecting turtles is an unfamiliar one, and that a concerted effort at public awareness is needed. Knowledge shared with the community at a LVV/ WIDECAST slide show at the Public Library at the same time that the restaurant was running the advertisement most likely led to informed residents alerting LVV to the incident. Following this incident, the Prime Minister sent a letter to all island restaurants reminding them that sea turtles are protected by law.

In addition to meat, sea turtle shells are also imported illegally from Venezuela. On 29 September 1993 a tourist reported to LVV that the gift shop at the Natural Bridge (a popular visitation site on the north coast) was selling whole polished shells of endangered sea turtles. LVV notified the Police and on 30 September, two uniformed officers visited the shop and informed the owner that sea turtles are protected in Aruba and the sale of their parts or products is forbidden. Later the same day Karen Eckert visited the shop to document the species involved. In all, 15 shells had been offered for sale to unsuspecting tourists at prices ranging from US$ 10-20. Two of the smallest shells (28-30 cm) were of the hawksbill; the other 13 (up to 65 cm) were of the green turtle. The shop clerk stated that they had not known of the law protecting the turtles and that all the shells had been purchased the previous week from a local importer who had obtained them from a Venezuelan vendor. The contraband was confiscated by the Police; a fine is not likely to be levied for a first offense. A letter from the Prime Minister to all gift shops reminding proprietors of the 1987 law prohibiting import, export, purchase, sale, etc. of sea turtles (including parts or products) would be very useful in curbing these offenses [N.B. a similar letter was mailed to island restaurants on 26 April 1993]. A diplomatic letter from the Government of Aruba to the Government of Venezuela protesting the illegal export (into Aruba) of endangered turtle meat and shell would also be appropriate.

A low level of illegal commerce in tortoiseshell jewelry also continues. In a survey of Oranjestad gift stores conducted by Karen Eckert on 6 May 1993, Potpourri (Sea Port Village Mall) had for sale four pairs of earrings at US$ 8.50 each. The clerk indicated that the items were locally made (not imported). When informed that sale of such items was illegal under Aruban law, the clerk displayed disbelief. When informed that turtles were protected internationally as 'endangered species' and thus any tourist attempting to return home with such items would risk prosecution, the clerk encouraged Eckert to pass them off as "plastic or goat horn". At the time of a follow-up survey on 30 September 1993, the store still carried six pairs of earrings at $8.50 each. On 6 May, Créatique Boutique (Harbor Town Mall, now Sea Port Village) had several pair of earrings for $3 each and "sometimes" had bracelets which sold for about $6. Again the clerk displayed disbelief when told that it was illegal to sell these items, and offered her assurances that "everyone eats them and there is certainly no law against it." On 30 September, this boutique displayed five rings at $3 each. On 6 May, in Anny's Flowershop (Harbor Town Mall), the shell of a small hawksbill (23 cm) hung on the wall. The clerk indicated that a friend had killed it "a year and a half ago" and that it was not for sale; the clerk believed that the owner would use it in a special flower arrangement.

The specific examples cited above do not encompass the whole of the problem in Aruba concerning the killing and sale of protected sea turtles but they illustrate adequately that the Gov-

ernment of Aruba is faced with a variety of challenges in this area and that enhanced public awareness of the status of sea turtles is sorely needed. Much of the sale appears to be aimed at tourists and the image of Aruba as a favorable tourist destination will surely be tarnished the first time an American or European visitor is heavily fined or jailed when attempting to return home with a sea turtle shell. It is noteworthy that 120 nations of the world, including Canada, the U. S., all of Mexico, Central and South America, and all of western Europe, belong to the CITES treaty which prohibits trafficking in sea turtle products across international borders. The maximum fine for attempting to enter the U. S. with a sea turtle shell is $20,000 and/or one year in prison.

3.4 Inadequate Regulatory Mechanisms

Specific legislation exists to protect sea turtles and their eggs (section 4.21), but penalties should be strengthened (section 4.25) and enforcement is problematic (section 4.22). We recommend that the public be made more aware of the laws protecting sea turtles and that citizens be encouraged to report violations. There is a history of importing (mostly green) turtles from Venezuela for sale in restaurants and markets (section 3.3), but this traffic appears to have declined in recent years. Ratification of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is imminent and will provide a much-needed regulatory tool to curtail trade in many species of internationally protected animals and plants (section 4.31). Ratification of the SPAW Protocol to the UNEP Cartagena Convention (see section 4.32) has not yet been approved, but would strengthen the legal framework for the conservation of sea turtles (and habitat) both domestically and throughout the Caribbean region. With regard to the protection of habitat, there is no explicit coastal zone management legislation but a "concept law" (Ruimtelijk Ordenings Plan Kustgebied) developed by a coalition of Government and private agencies was submitted to the Minister in March 1989. This framework sets the stage for comprehensive coastal zoning, land use and physical planning. Additional legislation (Landsverordening houdende regels ter bescherming van de natuur en de daarin voorkomende dier- en plantsoorten) to enable designation and maintenance of marine protected areas is before Parliament as this Recovery Action Plan goes to press (A. Curet, pers. comm.). The political will exists for conservation legislation, but the legislative process is tedious and slow.

3.5 Other Natural or Man-made Factors

Aruba is outside the hurricane belt, but severe erosion, especially of west coast beaches, occasionally results from forceful westerly storms. There are verbal reports of sea turtles struck by boats, 'jetskis', and windsurfers. Some incidents may result in debilitation or death to turtles, but there are no data to evaluate the extent to which this occurs. Natural debris (ocean borne, especially on north coast beaches) and man-made obstacles (especially on west and southwest coast hotel beaches) present a potential threat to the success of sea turtle nesting and hatching. We have not observed turtles ensnared at sea, such as in abandoned fishing gear, netting, or packaging material, but abandoned nets entangled around coral reefs are sometimes encountered by divers. Natural coral "bleaching" (a regional epidemic which continues to confound scientists) has been observed offshore Mangel Halto, but the condition is not widespread and the extent to which it has despoiled sea turtle foraging habitat is not known. Other factors reducing the survival prospects of sea turtles in Aruba have not been identified.

IV. SOLUTIONS TO STRESSES ON SEA TURTLES IN ARUBA

4.1 Manage and Protect Habitat

It is clear that conservation measures aimed at the protection of individual turtles are necessary but ultimately inadequate if the habitats upon which the turtles depend for food, refuge, and breeding are destroyed. Habitats necessary for the survival of endangered sea turtle species include unimpaired sea grass meadows, coral reefs, and sandy beaches. It is noteworthy that these ecosystems are important not only to sea turtles, but to the general productivity and health of Aruba's tourism and fisheries industries.

Sea grass meadows are very important to the ecology of coastal areas, in addition to providing essential foraging grounds for green sea turtles (section 2.2). Sea grass roots stabilize the sea bed and provide foraging habitat for fish, conch, sea urchins, sea stars and many other invertebrates. Sea grass serves as a critical developmental habitat for several commercially important species of fish and invertebrates. Much of the oxygen produced in nearshore water is generated in sea grass beds, and these areas also contribute to the clarity of littoral zones by absorbing animal wastes and stabilizing sediments (UNEP, 1984). Sea grasses are easily degraded by upland deforestation (resulting in nearshore sedimentation), coastal land reclamation, dredging, anchoring, and pollution from sewage and agricultural chemicals. To date we have not observed run-off and sedimentation in nearshore waters, nor, to any large degree, the uprooting of sea grass by indiscriminate anchoring. Past incidents of dredging, such as offshore Surfside, have resulted in only isolated damage. Any potential effects of chronic pollution on sea grasses, especially in the San Nicolas Bay area, have not been studied.

Coral reef communities are also important. Coral reefs provide shelter to sea turtles, as well as food (e.g., hawksbills consume reef-associated sponges, see section 2.4). In order to grow and flourish, coral reefs need clear, clean water and relatively high wave energy (Wilcox, 1989). In return, a healthy reef system protects economic investments along the coast by reducing incoming wave energy and providing a source of beach sand. Coral reefs are also critical habitat for the majority of bottom-dwelling or demersal fish living in nearshore areas of the Caribbean. As such, reefs are vital not only for sea turtles in Aruba, but also for a wide variety of commercially important fishes. More than 300 fish species are found on Eastern Caribbean cor-al reefs, and approximately 180 of these are used for human consumption (Goodwin et al., 1986). Reefs are easily damaged by indiscriminate anchoring, siltation, specimen collecting, and pollution. Anchoring is a serious concern in some areas and chronic pollution has degraded reefs in the San Nicolas Bay area. A Marine Park and associated mooring system are planned to ameliorate anchor damage, especially at popular dive sites.

In addition to essential marine habitat, sandy beaches are necessary for egg-laying. The protection of sandy beaches is an important component of any effort to conserve and perpetuate Aruban populations of sea turtles. Sea turtles return to the area where they were hatched when the time comes to lay their own eggs. Shoreline development (including beachfront construction, artificial lighting, and the removal of vegetation), coastal armoring, sand mining, and general activity at or proximal to a nesting beach can reduce or eliminate the capacity of the beach to support sea turtle nesting and the successful incubation of eggs. Sound management of

the beach resource is imperative; guidelines are provided in section 4.122 and expanded in section 4.13.

4.11 Identify essential habitat

Specific habitats essential to the survival of sea turtles in Aruba have yet to be identified. Nonetheless, it is obvious that habitat both on land (sandy beaches) and at sea (coral reefs, sea grass meadows) is important and should receive significant levels of conservation effort, both to encourage the survival of our sea turtles and to retain the integrity of our economy which depends on fisheries, tourism, and recreation in clean and pleasant surroundings. Surveys to identify specific habitats are recommended below. LVV should initiate this in coordination with local conservation groups such as StimAruba, FANAPA, Accion Ambiental, etc. Other government offices (e.g., VROM) and advisory groups (e.g., Commissie Marien Milieubeheer) are encouraged to participate in efforts to define essential sea turtle habitat.

4.111 Survey foraging areas

Recently, an offshore inventory of sand sources available for dredging was undertaken and the final report noted concentrations of sea grass offshore the Palm Beach area (Hulsbergen, 1987). The ECNAMP (1980) natural resource atlas for Aruba indicates that Palm Beach has the largest area of sea grass in Aruba and also indicates that sea grasses occur in the protected lagoons shoreward of the southern barrier islands. In addition, ECNAMP (1980) shows coral reef formations along virtually all of the north coast [N.B. the atlas errs in this regard, as true reef formations are found nowhere along the wave-tossed north coast], as well as significant areas of the west coast and offshore the southern barrier islands. A map summarizing existing knowledge of the distribution of sea grass and coral reefs was constructed specifically for this Recovery Action Plan (Figure 3).

Although some survey and biological data are available for the sea grass and reef communities of Aruba (Bak, 1975; Hulsbergen, 1987) there is no information related to the use of these environments by sea turtles. The only information that is available at the present time is anecdotal and fragmentary. For instance, foraging areas for loggerheads (*cawama*), hawksbills (*caret*), and green turtles (*tortuga blanco*) were reported by van Buurt (1984) on both the north and south coasts, but details were not provided. Foraging (presumably by green turtles) has been reported by divers at Rodger's Beach on the east side of the island. Buikhuizen (1993) mentions in his "Caribbean Story" that hawksbills are often seen in the coral reef area at the entrance of Oranjestad Harbor, and also at the entrance of Barcadera Harbor (in the latter case, the species was not mentioned).

It is a recommendation of this Recovery Action Plan that a program be initiated to assemble information on the distribution and health of potential foraging areas. The implementtation of this recommendation has already begun with the efforts of the WIDECAST Coordinator in Aruba to solicit information from the diving and fishing communities. Sander Vellinga (Atlantis Submarines) reports one particular hawksbill regularly seen on the submarine's route outside Barcadera Harbor. In order to seriously gather distribution data, we must work harder to build a sightings network to involve residents in reporting information concerning the distribu-

tion, abundance and activities of sea turtles. This might be done through a widely distributed brochure, radio announcements, or by personally soliciting the support of fishermen and divers at meetings convened for this purpose.

A Lead Organization (probably LVV) should initiate a data management system (this could be as simple as a file folder for notes and a large map where sightings can be indicated) so that all observations can be centrally compiled and readily accessible. Standard data/recording sheets are needed. Data should be shared with the CARMABI library in Curaçao.

4.112 Survey nesting habitat

A thorough survey of sea turtle nesting beaches has never been conducted in Aruba. van Buurt (1984) reported to the Western Atlantic Turtle Symposium in Costa Rica that turtles, probably hawksbills, nested on "various beaches on the north coast"; no information was available as to seasonality. He also reported that there was no nesting on the west coast, a conclusion which we now know to be false (see Table 2). It is a priority recommendation of this Recovery Action Plan that a nest survey be conducted. A preliminary survey was carried out by the WIDECAST Coordinator in Aruba and a small group of dedicated residents during the summer of 1993 to assess the feasibility of efforts on a larger scale. Eagle Beach was foot-patrolled daily (23 April to mid-August) from the Aruba Beach Club to Amsterdam Manor, usually between 2200-2400 hr and in the early morning. Selected north coast beaches (Dos Playa, Rincon, Quadiriquiri) were also monitored. Several hotels participated in a meaningful way, especially the Costa Linda which reported three nests and on two occasions collected and released to the sea hatchlings that were disoriented inland by hotel lights.

The positive response to these preliminary efforts have encouraged the Coordinator to expand coverage in 1994. Full coverage will only be possible with the cooperation of a larger group of enthusiasts. Members of "StimAruba" (a local conservation group) have indicated their interest in making such an undertaking an official club project, with members agreeing to certain beaches and patrol times. Some FANAPA members have indicated a similar interest, and several non-members are also eager to participate. In all, it should not be difficult to assemble a team large enough to accomplish the task. The most important beaches to cover are indicated in Figure 4. Materials that will enable volunteers to distinguish sea turtle species on the basis of nesting crawls, nest sites, eggs, hatchlings, etc. should be developed with the assistance of WIDECAST. A Lead Organization (probably LVV) should implement a data management system so that all information can be centrally compiled and available for analysis. Standard data/ recording sheets are needed. Data should be shared with the CARMABI library in Curaçao.

4.12 Develop area-specific management plans

No specific protected area management plans (relevant to sea turtles) are in place in Aruba. Preliminary surveys conducted in 1993 (section 4.112) indicate that the most important nesting habitat may lie along the western shore. This area is heavily developed by high-rise hotels and the successful implementation of specific management schemes (see section 4.122) will depend heavily on the cooperation of hoteliers. It is a recommendation of this Recovery Action Plan that the Minister explore options within the context of current legislation to designnate the coast between the Bushiri Beach Hotel and Cudarebe (West Point) a "Sea Turtle

Refuge". A management plan for the Refuge should be drafted based on recommendations published in this Action Plan -- potentially damaging activities such as vehicles operating on the beach (which is already illegal in Aruba, see section 4.134), the construction of seawalls and jetties, and lights shining on the beach at night should be prohibited or closely evaluated in light of the ecological requirements of endangered turtles.

Offshore, efforts are underway to designate as a Marine Park the west and south shores between Cudarebe and Punta Basora (perhaps seaward to the 40 m contour, this has yet to be determined). Legislation to amend the existing Marien Milieuverordening Aruba (Marine Environment Ordinance) has already been submitted to Parliament to provide a legal basis for such a Park. A system of moorings is envisaged, as well as comprehensive protection to marine resources. This same legislation will also provide the legal basis to designate important nesting beaches as reserves, as recommended above.

4.121 Involve local coastal zone authorities

Management plans such as are called for in section 4.12 cannot be implemented without close involvement by regulatory agencies. The closest thing to a coastal zone management authority in Aruba is VROM within the Ministry of Public Works and Health. There is no comprehensive coastal zone legislation at the present time, but it is noteworthy that the draft Natuurbeschermingsverordening (Nature Conservation Ordinance) calls for an inter-agency Commission empowered to review and evaluate environmental decisions, including those affecting the coastal zone. VROM will be the Lead Agency. It is likely that this Commission will provide the administrative vehicle necessary to propose regulations and submit same to the Minister [N.B. Ministerial approval will be needed, but regulations will not need to be submitted to Parliament]. A more specific discussion follows in section 4.122.

4.122 Develop regulatory guidelines

It is a recommendation of this Recovery Action Plan that development proximal to important nesting beaches carry the requirement that beachfront lighting be designed in such a way as to prevent the disorientation of hatchlings or nesting adults. We recommend that such a requirement be inserted into the permit process for new developments. In the case of existing structures, the Minister should be notified by VROM about options available for mitigation of the most pressing problems, which appear to be beachfront lighting and vehicular traffic on the beach. Beach driving, already illegal, is an enforcement challenge. Options to reduce lighting, which can misdirect hatchlings inland to their deaths, should be evaluated with input from hoteliers. It may be that shielding the lights or extinguishing them during certain periods is more cost-effective than replacing existing fixtures with sodium vapor lights (see section 4.132). Similarly, important feeding areas should be safeguarded from man-induced degradation. Legislation currently before Parliament will provide the legal basis for designation of marine protected areas.

Standard guidelines for the conservation of sea turtle habitat are summarized below and are discussed in further detail in sections 4.13 and 4.14. Several of our recommendations are al-

ready included in national law, but oftentimes enforcement is less than adequate. A Division of Environmental Enforcement is highly recommended (see section 4.24).

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 stabilizing vegetation and exacerbates erosion. 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. Preferred extraction sites should be confined to well-studied offshore sites, ravines, and/or interior sites.

2) *Artificial lighting*: Sea turtles, especially hatchlings, are profoundly influenced by light. Baby 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. Window shading is recommended. 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 stabilization 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. Throughout the Caribbean region there are numerous examples of beaches lost, rather than secured, as a result of armoring; Aruba is no exception (section 4.133). Sandy beaches are naturally dynamic. The physical characteristics of the coastline should be taken into account prior to coastal construction so that adequate construction setbacks, rather than expensive and often counter-productive armoring, 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, construction 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. Setbacks of 30-40 m and 80-120 m from the line of permanent vegetation are reasonable guidelines for upland coast development and lowland beach coast development, respectively (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 motorized vehicles should be prohibited on sandy 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). Tire 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 minimize 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 pick up and 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 by hand or 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 stabilizes 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, including oil, sewage and landfill overflow, from land-based sources should be eliminated or centrally treated before its discharge into the sea. 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, especially tourists, should be thoroughly coached on diving etiquette so as to preclude 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 at all times and under all circumstances and should remain so. The destruction of coral reefs resulting from these practices can be irreversible in our lifetime.

4.123 Provide for enforcement of guidelines

Enforcement is important to the perpetuation of any management program. Ideally, regulations should be formulated with the needs of the community in mind to ensure a general acceptance on the part of the public toward the management framework. It is a recommendation of this Recovery Action Plan that civic groups, proximal residents (including hoteliers), and frequent commercial users (e.g., fishermen, divers) be made thoroughly familiar with the management program and be encouraged to report any observed violations. In this way, limited enforcement personnel will not have additional burdens placed upon them. This does not lessen the importance, however, of familiarizing enforcement officers with the new guidelines and regulations and making sure that all reports of violations (e.g., illegal dredging, anchoring, construction, beachfront lighting, waste disposal) are properly addressed by the appropriate enforcement authority. An enforcement subdivision devoted specifically to natural resources and environmental law would be highly desirable (section 4.24).

At the present time, the police corps' Beach Police is responsible for enforcing laws relating to beaches (e.g., pollution, dangerous situations) and nearshore waters (e.g., boating, sailing) adjacent to public and private beaches. In July 1991, Dr. Karen Eckert (Director, WIDECAST) gave a slide presentation to the officers of the Beach Police about the biology and conservation of sea turtles. Regulations enacted to protect sea turtles (and their eggs and hatchlings) whilst on the nesting beach would be the responsibility of the Beach Police, as well as private hotel security. It is noteworthy, however, that private security officials do not have powers of arrest. Within the proposed Marine Park, enabling legislation should provide for en-

forcement officials to be designated by the Minister. It is essential that Wardens have adequate transport to facilitate surveillance of Park waters. Ideally, mooring fees and other user fees will contribute substantially to financing Park enforcement activities.

4.124 Develop educational materials for each management area

It is a recommendation of this Recovery Action Plan that materials be developed for each management area to explain why it is an important ecological area. These can include signs or displays on site, fliers or posters placed in public areas (airports, hotels, government offices), books and pamphlets, guided tours or field trips to the area, regular media attention, public forum slide shows or interpretive programs. Revenue can often be generated by offering supervised access to protected areas and developing interpretive programming. Ideally, these efforts should be part of a larger national program to inform residents and tourists about nature conservation in general. A national campaign should be initiated by the Government of Aruba in cooperation with conservation and other interested civic groups for implementation in schools, hotels, etc.

4.13 Prevent or mitigate degradation of nesting beaches

4.131 Sand mining

The chronic mining of sand from nesting beaches accelerates erosion by removing sand and degrading or destroying stabilizing beach vegetation. In severe cases, entire beaches are lost, having been replaced by saline ponds in unsightly pits left by mining operations. Fortunately, beach sand mining is not and never has been practiced in Aruba. The Wetboek van Strafrecht (Penal Code) prohibits the taking of any sediment or rock from Aruba without a permit from Domeinbeheer (Land Management Office). A permit has never been given for white sand. Construction sand (road fill, foundations) is dredged from a designated offshore site (see section 4.147) and has to be purchased from Dienst Openbare Werken (Public Works Department). Concrete aggregate is available from ravine sand or finely crushed rock from interior sources.

4.132 Lights

Sea turtle hatchlings are sensitive to light and find the sea by orienting toward a bright, open horizon. In a natural situation, this horizon is the ocean. Beachfront development introduces artificial light that attracts hatchlings away from the sea. They may wander into streets and gardens where they are eaten by domestic animals, run over by cars, or die in the heat of the morning sun. The disorientation of hatchlings was reported several years ago at the Caribbean Hotel (now the Radisson Hotel, Palm Beach) and in 1993 at Costa Linda Hotel (Eagle Beach). Nesting females can also be disoriented by artificial light and sometimes travel inland after nesting rather than returning to the sea. It is important that developments near nesting areas take into consideration this fact and shield utility, security and decorative lighting from shining on the beach. Street lighting also disorients hatchlings. In 1991, two reports of hatchlings crossing the coastal boulevard at Eagle Beach were received by LVV. Many of the hatchlings (species not identified) were crushed. Virtually the entire beach west of Oranjestad is lit. The boulevard parallels the sea and hotels are usually constructed on the seaward side of the road.

Blair Witherington, examining the problem of artificial lighting on the beaches in Florida (USA) and Tortuguero (Costa Rica), found that the presence of mercury vapor lights all but eliminated nesting on affected beaches; nesting of green turtles and loggerheads on beaches so lit was 1/10 and 1/20 that observed on darkened beaches. With this in mind, some beachfront owners in Florida have switched to low pressure sodium (LPS) vapor lighting, which shines primarily in the 590 nm range and has little if any effect on nesting females. Unfortunately, low pressure sodium lights do not appear to constitute a complete answer to this difficult problem. While they are ignored by loggerhead hatchlings, they appear to mildly attract green turtle hatchlings (though to a much lesser extent than do mercury vapor lights; B. Witherington, Florida Department of Environmental Protection, pers. comm.).

It is a recommendation of this Recovery Action Plan that developers be required to construct lighting plans so as not to disturb sea turtles. Lights, even LPS lights, should be shielded from shining directly on the beach. A common and effective method for accomplishing this is to plant a vegetation buffer or hedge between the sea and shoreline developments. Alternatively, shields can be built into the lighting fixture. In some areas, the solution may be lie in extinguishing lights for specified evening hours (e.g., 1900-2400 hr) during the hatching season so as to reduce the effects of disorientation. This may be particularly relevant to high rise hotels, such as occur in Aruba, where ground-level shielding cannot solve the whole problem. In the U. S. Virgin Islands, background materials (e.g., Raymond, 1984) are issued to all developers seeking permits for projects which may have an effect on sea turtle orientation due to lighting. Many developers now include this information in their environmental impact assessments and are designing appropriate lighting systems (Ralf Boulon, USVI Division of Fish and Wildlife, pers. comm.).

Where problem lighting associated with existing hotels presents an insurmountable challenge, hotel staff should be required to be vigilant in their efforts to "rescue" hapless hatchlings. In 1992 and again in 1993, a letter was sent by the WIDECAST Coordinator in Aruba to all hotels requesting that evidence of sea turtle nesting or hatching be reported to LVV, and that misoriented hatchlings be collected and returned to the sea. In response, several hotels designnated their Chief Engineer to serve as a liaison to LVV in this matter. Twice in 1993 the Costa Linda Hotel reported leatherback hatchlings misdirected inland by hotel lights; in both cases, hotel staff carefully collected the hatchlings and returned them to the sea. Also in 1993, Bucuti Hotel staff collected misdirected loggerhead hatchlings and returned them to the sea.

4.133 Beach stabilization structures

Beach stabilization structures such as breakwaters, groynes, and solid jetties constructed perpendicular to the shoreline often exacerbate beach erosion and can lead to the loss of nesting habitat. A good example is the pier constructed by Shell Oil prior to WWII on the present site of the Divi Divi Hotel. The pier damaged down-current beaches, especially during periods of westward winds, by obstructing the natural longshore transport of sand along the coast. When the Tamaryn Hotel was constructed just east of this site, construction of a seawall was necessary to retain what was left of the beach. Today more than 200 m of potential nesting beach is fully obstructed to turtles for nesting. In another case, an unfinished jetty near the unfinished Ramada Inn has ruined nearshore water clarity and killed sea grasses because a large volume of fill dirt

was mixed with jetty boulders and the dirt subsequently washed away. Fortunately, a pier planned between the Holiday Hotel and the Beta Complex will be of piling construction. This pier will provide local fishermen with a central mooring area, security for their boats, and a landing area.

Beach stabilization structures constructed parallel to the shore can also provoke erosion, especially if they armor the zone of fore dunes. Furthermore, seawalls and riprap (unconsolidated rock and boulders) can prevent access by female sea turtles to the nesting beach. It is a recommendation of this Recovery Action Plan that holistic coastal zone regulations be developed that mandate responsible coastal zone development, including setback limits, so that the loss of sandy beach (and the need for stabilizing structures) is minimized. Nothing in existing legislation prohibits construction on the beach, although the general custom law states that 9 m above the high water line shall remain "unobstructed". Prior to construction, an environmental impact statement (EIS) should be required by a competent consultant and construction permits granted based on the results of the EIS. This is not now required, but in some cases it has been requested of the developer and in other cases the developer has offered it. At the present time the Government can put conditions on long-term leases (and these can include environment-related regulations), but requiring a comprehensive and mandatory EIS should become standard procedure. A related discussion on beach rebuilding is presented in section 4.135.

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

4.134 Beach cleaning equipment and vehicular use of beaches

Mechanized beach cleaning equipment can puncture or crush incubating sea turtle eggs. It is a recommendation of this Recovery Action Plan that the use of such equipment be avoided. At the present time, most beach cleaning is done by hand in Aruba and presents no threat to nesting sea turtles, their eggs or hatchlings. On the western shore, seaweed accumulates during periods of western swells. To accomplish clean-up, light agricultural tractors with wide tires are loaned by LVV to pull cleaning equipment which consists of drag screens to filter surface litter (e.g., cigarette butts). Tractor cleaning is done at most twice per year and is confined to the water line. The activity would not be expected to damage sea turtle eggs. Beach clean-up should never include the removal of live vegetation. Supralittoral trees and shrubbery provide hawksbills with nesting habitat (e.g., Ryder et al., 1989) and stabilize beach sediments. Even raking and removal of leaves and grasses above the high tide line can increase the probability of wind erosion and degrade nesting habitat.

The operation of motor vehicles on sandy beaches is of considerable concern. About half of all nests (five of nine, all leatherback) reported from Eagle Beach (Amsterdam Manor to Aruba Beach Club) in 1993 appear to have been destroyed/crushed by vehicles. Vehicles are operated by both tourists and residents for "joy-riding". Offenders are aware that Beach Police officers only patrol until 2100 hr; thus, most illegal activity occurs at night when the beaches are only periodically checked (using flood lights) by Road Patrol officers. In addition to the serious problem at Eagle Beach, nests laid in 1993 at Andicuri Beach on the north coast were damaged by vehicle traffic (Mr. Yarzagaray, pers. comm.) and driving is a long-standing problem in the sand dune ecosystems of Boca Prins and the California dunes. The WIDECAST Coordinator in Aruba has asked car rental agencies to alert tourists to the laws preventing driving on the beaches and has received a positive response from the agencies regarding sponsoring a bumper sticker to underscore the problem. In addition to public awareness initiatives, an arrest and conviction would be very useful. Article 25 of the 1987 Public Waters and Beaches Law (Landsbesluit Openbare Wateren en Stranden, AB 1987, No. 124) prohibits driving motor vehicles, bicycles, and horses on public beaches [N.B. all beaches are public in Aruba]. Maximum penalty is 60 days in prison or 3,000 Afls. No arrests have ever been made.

4.135 Beach rebuilding projects

There has not been a need for this type of project in Aruba. Wide sandy beaches are extensive and largely stable. To our knowledge, no rebuilding is planned. Should beach rebuilding (sometimes referred to as "beach renourishment") be contemplated in the future, it is a recommendation of this Recovery Action Plan that replacement sand have the same physical characteristics (e.g., organic content, grain size) as the original sand, or the beach can become hardened and unusable to nesting sea turtles. Any replacement of sand along the coast should be done outside of nesting and hatching seasons, preferably January-March. In this way, the probability of disturbing nesting females or incubating eggs is minimized. The Airport (Surf-side) beach is an artificial beach, but not by design. Dredged fill was brought up during field construction, and sand has blown and accumulated along the shore. At Barcadera, there is an artificial beach, again not by design, that was formed by the dredge fill from the harbor. On Sonesta Island, a small artificial beach was constructed by the owner for recreational purposes.

It is worth noting that there is an imbalance in the system somewhere when sand is lost from an otherwise predictable beach habitat and is not replaced by natural accretion processes. The underlying cause can be as direct as an up-current solid jetty or pier that is literally "starving" the down-current beaches by interrupting the longshore transport of sand (section 4.133). Or the impetus may be more subtle, as occurs with the removal of beach vegetation, or when nearshore pollution retards the productivity of calcareous (coralline) algae and other sand sources. If dunes are leveled, vegetation removed and/or jetties constructed, the likelihood of committing the owners to repetitive and increasingly expensive rebuilding is heightened.

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

There is no evidence that the dynamiting of coral reefs to stun fishes or to provide access for marine vessels is practiced in Aruba. The use of explosives in nearshore waters can result in extensive and permanent damage to important foraging and refuge areas. The use of explosives is prohibited by Article 1(f) of the General Fisheries Law (Visserijverordening (Visserijbesluit), AB No. 15, 1993). It is a recommendation of this Recovery Action Plan that all relevant legislation be strictly enforced.

4.142 Chemical fishing

There is no evidence that the dumping of chlorine or other chemicals on coral reefs for the purpose of extracting fishes or lobster is practiced in Aruba. This practice results in the death of a wide variety of reef organisms, can seriously degrade hawksbill sea turtle foraging habitat, and can poison important nursery areas for commercial fishes. The use of chlorine bleach and other chemicals for the purpose of catching fish is prohibited by Article 1(e) of the General Fisheries Law (Visserijverordening (Visserijbesluit), AB No. 15, 1993). It is a recommendation of this Recovery Action Plan that all relevant legislation be strictly enforced.

4.143 Industrial discharges

At the major ports of Oranjestad (the capital) and San Nicolas (the second largest urban area), the latter in particular, a history of industrial discharge is well known. Several reports have documented extensive damage to San Nicolas Bay from the oil refinery, chemical plant, and (now closed) rum distillery (e.g., Hoppe, 1985; Bak, 1986, 1987). The disposal of untreated sewage is also a well-known problem in this bay (section 4.146). The response, especially to oil, has been a deterioration of the spatial structure of the offshore reef, comparatively low coral cover (when compared to reefs upcurrent of the refinery), and low coral recruitment in front of and downcurrent of the refinery. According to Bak (1987), "the results of chronic oil pollution are, after 60 years, clearly discernible over a distance of 10 to 15 km along the reef." It is a recommendation of this Recovery Action Plan that offshore monitoring of pollutants be initiated in Aruba, and especially in high risk areas such as San Nicolas Bay, in order to secure the health of residents and natural systems alike. In addition, the practice of allowing garbage and residue from the land fill (Parkieten Bos) to be discharged into Barcadera Bay should cease. Under VROM supervision, the landfill has been pushed back from the edge of the bay and dikes are under construction to contain landfill spillage. As the bulging landfill reaches capacity, there is a clear need not only to use landfill space more efficiently, but to practice waste reduction and recycling.

4.144 At-sea dumping of garbage

Garbage and other substances dumped at sea contaminate the environment and threaten sea turtles. Worldwide, death to marine organisms as a result of ingestion or entanglement is a serious problem (e.g., O'Hara et al., 1986; Laist, 1987; CEE, 1987). Mrosovsky (1981) has sum-

marized data showing that 44% of adult non-breeding leatherbacks may have plastic in their stomachs (plastic bags are mistaken for jellyfish and consumed). Styrofoam and other soft plastics also present a significant health hazard to sea turtles (Balazs, 1985). Debris discarded from cruise ships and merchant ships ultimately washes ashore on windward coasts throughout the Caribbean. This is the case in Aruba where the windward (north) coast, including potentially important nesting areas at Rincon and Boca Grandi (Figure 4), is littered with plastics and other debris. Cruise ship waste was collected from north coast beaches during a recent beach clean-up campaign. In contrast, the wide, sheltered beaches of the west coast receive a smaller volume of debris and a greater proportion of it is shore-based in origin. Hotel personnel make a concerted effort to keep these beaches clean.

Article 30 of the 1987 Public Waters and Beaches Law (Landsbesluit Openbare Wateren en Stranden, AB 1987, No. 124) prohibits littering the beaches and public waters with bottles, packaging materials and other solids [N.B. all beaches are public in Aruba]. Maximum penalty is 1,000 Afls. The disposal of waste at sea (waste generated by ships) is prohibited by the 1993 Prevention of Pollution by Ships Ordinance (Landsverordening ter Voorkoming Verontreiniging Door Schepen, AB 1993), which was only recently approved by Parliament. Penalties include two years in prison and/or 100,000 Afls. Despite legislation, dumping violations by the boating community are difficult to monitor and require a concentrated effort at public education, coupled with convenient places to safely dispose of refuse on shore and sure convictions for offenders. It is a recommendation of this Recovery Action Plan that an active public awareness campaign be initiated by the Government of Aruba, beachfront hoteliers, and the professional diving community. Penalties for fouling the sea should be well advertised and offenders should be reported to the Police.

It is noteworthy that Aruba joined for the first time in 1993 the International Coastal Clean-up Program sponsored by the Center for Marine Conservation in Washington D. C. On 18 September, *all* Aruba's beaches and bays were cleaned! Roeland de Kort (representing VROM, the Lead Organization for the clean-up in Aruba) served as program coordinator. The work was performed on a voluntary basis mainly by students. This event was of "utmost importance", since it was not only for the protection of marine wildlife and the promotion of public awareness about litter (especially persistent marine debris), but also for the tourism industry which is the foundation of the local economy (R. de Kort, pers. comm.). Beachfront hotels showed their support for the clean-up by participating in their areas. Other businesses donated collection bags, gloves, transportation, and refreshments. The island was divided into 58 zones (Figure 5), of which 18 were hotel sites, and each zone had a Zone Captain responsible for guiding the volunteers and assembling data. Eight main categories of trash were recorded: plastic, foamed plastic, glass, rubber, metal, paper, wood, and cloth. More than 12,000 kg of trash were collected on 22 km of coastline (and 2 km in the water) by 1200 volunteers.

4.145 Oil exploration, production, refining, transport

An oil-contaminated environment can be lethal to sea turtles and incubating eggs. Behavioral experiments indicate that green and loggerhead turtles possess limited ability to avoid oil slicks. Physiological experiments show that the respiration, skin, some aspects of blood chemistry and composition, and salt gland function of 15-18 month old loggerheads are signifi-

cantly affected by exposure to crude oil preweathered for 48 hours (Vargo et al., 1986). There is some evidence to suggest that hawksbills are also vulnerable to oil pollution. Hawksbills (predominantly juveniles), were only 2.2% (34/1551) of the total sea turtle strandings in Florida between 1980-1984, yet comprised 28.0% of petroleum-related strandings. Oil and tar fouling was both external and internal. Chemical analysis of internal organs provided clear evidence that crude oil from tanker discharge had been ingested (Vargo et al., 1986). Carr (1987b) reported juvenile hawksbills (to 20 cm) "stranded [in Florida] with tar smeared sargassum"; some individuals had ingested tar.

Because Aruba is on the continental shelf of the mainland of Venezuela, and it is close to the lake of Maracaibo, one of the major oil fields of Venezuela, oil exploration has been initiated at various sites. The results indicate that reserves are not substantial enough to warrant extraction. The refining and transport of oil have caused considerable environmental damage to Aruba. The LAGO (ESSO) refinery was closed in 1986 and reopened by Coastal Oil Company in 1991. The destruction of marine habitat between the refinery and Pos Chiquito that has taken place since prior to WWII will be seen for some time. The pitch (tar) field on land was recently cleaned up, but chronic pollution is quite dramatic in San Nicolas Bay (see section 4.135). Oil is sometimes reported on north coast beaches, including Boca Grandi; the source is assumed to tank cleaning, but spills outside of Aruba's waters may also contribute. Most evidence of oil spills and slicks is reported by local airline pilots.

An Oil Spill Contingency Plan has been drafted by a Dutch government agency, but the Plan has yet to be finalized and adopted. The lead technical organizations are VROM and the Fire Department, but the Government lacks the personnel and equipment to deal with major incidents. As much as practicable, responsibility (both prevention and clean-up) should be placed with the companies themselves and not with the Government of Aruba. The draft Plan articulates the responsibilities of the various parties, public and private. To cope with low level accidents, higher risk areas (e.g., harbors, WEB) should have basic equipment on hand at all times. In addition to national planning efforts, a bilateral agreement between the Kingdom of the Netherlands and Venezuela is in the final stages. The Kingdom of the Netherlands ratified the Cartagena Convention (section 4.32), including the Protocol Concerning Co-operation in Combating Oil Spills in the Wider Caribbean Region, on 16 April 1984, and for Aruba on 1 January 1986. Article 3 of the Protocol states:

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

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

4.146 Agricultural run-off and sewage

Because of the arid climate of the island, natural runoff occurs only during the wet season. Pollution of nearshore waters by agricultural chemicals is not considered a problem. In contrast, since island-wide sewage treatment is not available, untreated or under-treated sewage is discharged directly into the sea at a number of sites. Perhaps the most notable are St. Nicolas Bay and the Simeon Antonio area, both on the south coast. Until recently, some residents of Savaneta discharged sewage directly into the sea, but the Department of Public Works has mandated the installation of cesspits in this area (A. Curet, pers. comm.). A sewage treatment plant at Bubali serves the hotel community and most of Oranjestad as far as the airport. There are plans to connect the San Nicolas area, as well as a commitment on the part of the government to seek funding to connect all other communities along the south coast road. Inland communities are still served by cesspits and septic tanks.

4.147 Anchoring and dredging

The full extent of anchor damage to coral reefs and sea grass has not been quantified. There is some west coast (Palm Beach Bay) damage to patch reefs a few kilometers offshore, mostly from tankers seeking sheltered anchorage in calm waters. Popular dive sites are heavily affected by anchoring. Arashi is perhaps the worst example, where the once-beautiful reef is now dead. In addition to anchor impact, considerable damage is caused by the anchor chain. All reef areas show damage to some extent, some worse than others, from fisherman's anchors. The persistent, cumulative damage may not always be dramatic, but is clearly visible in mutilated, broken, and sometimes dying coral (T. Duncan and J. Wardlaw, pers. comm.). Permanent anchorages on the southwest and west coastlines are in place for charter yachts. Moorings are planned for the proposed south coast Marine Park.

In the absence of secure moorings, the demolition of coral reefs and the uprooting of sea grasses by anchors will be quick and can be permanent (e.g., Rogers, 1985; Rogers et al., 1988). Therefore, it is a recommendation of this Recovery Action Plan that a national system of moorings be installed to minimize anchor damage to coral reefs and sea grass. Halas (1985) has designed an inexpensive mooring system (US$ 100-200/mooring) which is adequate for holding yachts and live-aboard dive boats <100 feet in length. A demonstration of this technology is available upon request to John Halas, Key Largo National Marine Sanctuary, P. O. Box 1083, Key Largo, Florida 33037; Tel: (305) 451-1644. It is noteworthy that Bonaire, Curaçao, and Saba Marine Parks have installed mooring buoy systems that work well. Mooring fees and other user fees in Park waters should be earmarked for Park activities, including maintenance, enforcement, and interpretation. Cruise ships (>200 feet in length) are presently restricted to the Oranjestad Harbor Pier.

Oranjestad Harbor is periodically dredged with barge and crane and the spoils dumped at sea; there is no observed damage to potential sea turtle habitat. Similarly, deep water dredging for construction sand off the west coast has not resulted in significant damage to potential sea turtle feeding areas. In contrast, Bucuti Island seaward of Surfside was severely eroded (at least half the beach disappeared) in the early 1980's as a direct result of dredging undertaken for the construction of the airport and the stockpiling of seabed sand for road building and other con-

struction. Other examples of dredging (e.g., Barcadera, Lago Bay) in years past probably did effect serious damage to nearshore sea grasses and other ecosystems perhaps once important to sea turtles. Destruction of sea grass and coral as a result of dredging in San Nicolas Bay (=Lago Bay) is described briefly by Hoppe (1985).

4.2 Manage and Protect all Life Stages

If sea turtles are to survive in the waters of Aruba, it is necessary to protect them from harassment and killing. The previous section (section 4.1) concerned itself with the conservation and stewardship of habitat, namely sandy beaches and marine areas important to sea turtles either for food or for refugia. The following discussion will focus on the laws that protect sea turtles themselves and how they can be more fully enforced.

4.21 Review existing local laws and regulations

All sea turtles and their eggs are protected by Marien Milieuverordening Aruba (Marine Environment Ordinance) AB 1980, No. 18. Article IV states that it is prohibited to disturb sea turtle nests, or to remove, destroy, possess, deliver, transport, buy or sell sea turtle eggs. Article V states that it is prohibited to kill animals and/or plants from the waters of Aruba if such animals and/or plants are so listed by subsequent decree. In addition, it is prohibited to sell, purchase, work (as in fashioning earrings from tortoiseshell), deliver, import, export, or possess such animals and/or their parts or products (living or dead). All Atlantic/Caribbean species of sea turtle were listed by Decree No. 51 in 1987. These species are: Caretta caretta, Chelonia mydas, Dermochelys coriacea, Eretmochelys imbricata, Lepidochelys olivacea, and Lepidochelys kempii. The law is understood to include protection for turtles at sea, as well as gravid females on the nesting beach. The maximum penalty described for violation of these Articles is one month in prison and/or a fine of 2500 Afls. Equipment used in an offense may be confiscated. A repeat offense within a year doubles the penalty due.

4.22 Evaluate the effectiveness of law enforcement

In the absence of Fisheries or other conservation/natural resource enforcement personnel, sea turtle protection statutes are enforced by the Police. In reality, however, the Police Department is over-extended and under-staffed and crimes against wildlife are not viewed as priorities. There has never been an arrest for possession or sale of sea turtles or their products, even though it is common knowledge that the meat is sold illegally from the floating market in Oranjestad and selected boutiques carry tortoiseshell crafts. In September 1993, police officers investigated a tip received that the gift shop at the Natural Bridge (a popular visitation site on the north coast) was selling whole carapaces. The officers confiscated 15 carapaces on display; no fines were levied (see section 3.3). We applaud this action on the part of the Police Department and hope that media coverage of the case will publicize the protected status of turtles in Aruba.

4.23 Propose new regulations where needed

Sea turtles and their eggs have been protected in Aruba since 1987 and 1980, respectively (section 4.21). There is no need for additional legislation, only more vigilant enforcement of ex-

isting statutes. In contrast, several deficiencies exist in the regulatory framework with regard to habitat protection (see section 3.4).

4.24 Augment existing law enforcement efforts

Recognizing that environmental law is becoming increasingly important and increasingly technical in Aruba, it is a recommendation of this Recovery Action Plan that a Division of Environmental Enforcement be inaugurated within the appropriate Department, most likely within VROM. Similar proposals have been made in the past, and the idea has the support of Police administrators. A minimum of two officers should be hired (or designated from within the Police Department) to oversee compliance with environmental legislation. These officers should be trained in environmental law and enforcement procedures, 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., and have the flexibility to work irregular hours. A Workshop should be convened jointly by the Ministry, the Police, including PB1 (Marine Patrol) and the Beach Police, and Customs/Immigration to better inform all officers of conservation regulations and the urgent need to consistently enforce domestic and international laws protecting sea turtles and other depleted species. A Manual of existing environmental legislation should be developed for public distribution.

Clear and public support from senior Government officials is a prerequisite for effective enforcement of environmental statutes. This would foster a greater sense of confidence among arresting officers that offenders would be prosecuted. The media and the conservation community also have important roles to play in encouraging a national consensus that conservation laws are important. Public participation in law enforcement is crucial. Violations should be reported. Complaints should be aired by the national media when reports of violations are ignored. Divers and fishermen are in unique positions to monitor offshore damage to habitat, report illegal landings, and exert peer pressure to reduce violations. The owners of residential and commercial beachfront property should be enlisted to report turtles caught or eggs collected, and to monitor nesting beaches for poaching and other disturbances. No arrest has ever been made for the harvest of endangered turtles or their eggs, even though such harvest is known to occur. Precedent cases are needed so that news of a "new attitude" toward offenders will spread.

4.25 Make fines commensurate with product value

Existing penalties include fines, incarceration, and the confiscation of equipment (section 4.21). The maximum fine should be increased in order to substantially exceed product value. It is a recommendation of this Recovery Action Plan that penalties in the proposed Nature Conservation Ordinance (Natuurbeschermingsverordening) be adopted as soon as practicable. These include one year in prison and/or a fine of 100,000 Afls. for killing an animal, such as a marine turtle, protected by law.

4.26 Investigate alternative livelihoods for turtle fishermen

Alternative livelihoods for turtle fishermen are not necessary to contemplate at this time because there are no turtle fishermen in Aruba (and this has been the case throughout recent

memory). Local fishermen participate in a multi-species fishery. No one depends on sea turtles for their livelihood. The turtle catch is wholly opportunistic and impossible to estimate. Turtles are occasionally brought ashore after being ensnared in seines (*reda*) drawn in shallow nearshore waters. The use of *redas* is prohibited along the south shore and thus this activity is largely restricted to Palm Beach Bay (West Point to Pelican Rocks, see Figure 4). The catch is clandestine and fishermen will not discuss it with LVV officials. A comprehensive Sea Turtle Fishery Frame Survey is not likely to be feasible in Aruba, but it is a recommendation of this Recovery Action Plan that the Fisheries Officer take every opportunity to solicit information about the extent to which illegal take occurs. As appropriate, the following points should be made in discussions with fishermen:

1. Sea turtles are long-lived, reaching sexual maturity in 20-35 years.
2. Mortality is high in young juvenile stages, but extremely low for fully armored large juveniles and adults.
3. Adult females average five clutches of eggs per year and nest every 2-5 years; under natural conditions females live for many years and lay thousands of eggs in order that populations remain stable.
4. Unfortunately, large turtles have historically been targeted because they provide the most meat; Fisheries laws usually protect only small turtles.
5. Egg-bearing adult females are taken in disproportionate numbers because they are easily obtained from the nesting beach.
6. Over-harvesting large turtles, especially gravid females, is a sure way to invite population collapse (this has been observed at rookeries throughout the world and is easily shown mathematically).
7. Sea turtle populations *cannot sustain* the persistent harvest of large juvenile and adult animals.
8. Nesting populations have been greatly reduced or exterminated all over the Caribbean, including Aruba, because adults are not surviving long enough to produce the next generation (the widespread harvest of eggs 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. Adult females return to Aruba at regular intervals to lay their eggs and then leave at the end of the nesting season to return to feeding areas most likely located in distant countries.
12. All nations must work together if this shared resource is to survive.

4.27 Determine incidental catch and promote the use of TEDs

No shrimp trawling occurs in the waters of Aruba, and thus there is no need for use of Turtle Excluder Devices (TEDs) to mitigate the incidental catch of sea turtles in trawl nets. Venezuelan trawlers used to come into Aruban waters, but this ended with the enactment of 1993 General Fisheries Ordinance (Algemene Visserij Verordening, 1993, No. 15).

With the exception of cast nets (bait nets) thrown from shore, net-fishing is prohibited on the south coast from Seroe Colorado to Punta Brabo by the Towing of Fish Nets Ordinance (Verordening op Het Slepen Met Visnetten, 1992, GT No. 17). The penalty is low, however, for offenders (14 days in prison or 100 Afls.). Seines and gill nets are permitted in all other areas, but fishing is largely restricted to the west coast since the north coast is rough. There are about six nets (about 30 m each) active on a regular basis off the west coast. The nets are set offshore when fish schooling is observed, especially in the northern reaches of Palm Beach Bay and Malmok. Nets are set during daylight hours for about an hour. Turtles are sometimes caught, but not usually drowned. The senior author has witnessed three small hawksbills (*caret*) (±40 cm shell length) brought ashore in recent years; the last observation was in 1990. In each case the turtle was released, but this may have been because of the presence of LVV personnel. Turtles are not likely to become ensnared by trap buoy lines in Aruba because most traps do not use a buoy line. Traps are relocated by means of a piece of metal can which is secured to the trap and glints in the sunlight. In general, traps are placed in sandy areas near coral reefs and do not seriously damage reefs.

A potentially expanding longline industry may create an incidental catch problem. Until recently, foreign longline vessels (e.g., Italy, Taiwan, USA, Russia, Cuba) fished for tuna in Aruba from January to March. LVV is not aware of any turtle bycatch by these vessels. The activity of foreign vessels has ceased for the time being because new legislation disallows permits for foreign vessels until a stock assessment has been done and the Government has confirmed that local vessels cannot reach the established quota [N.B. there may still be some foreign fishing in local waters because one police boat cannot possibly undertake the necessary surveillance]. A UNDP project is currently undertaking a feasibility study to determine fish populations, economic viability, and the fisheries zone for a new domestic longlining industry. Current fisheries legislation allows longlining with a 200 hook limit, but preliminary results from the UNDP study indicate that longlining may not be profitable in Aruba.

The capture of leatherbacks by longlines has been documented in the northeastern Caribbean (Cambers and Lima, 1990; Tobias, 1991), the southeastern U. S. (Witzell, 1984), and the Gulf of Mexico (Hildebrand, 1987). Leatherbacks (*driekiel*) and loggerheads (*cawama*) are captured in Antigua (Fuller et al., 1992). Fisheries personnel should be aware that the longlining industry has the potential to accidentally catch and kill sea turtles during normal operations. It is a recommendation of this Recovery Action Plan that all cases of sea turtle capture, as well as the fate of the animal, be reported to the Fisheries Officer (LVV). Mitigating measures should be imposed should incidental capture be reported.

4.28 Supplement reduced populations using management techniques

Stringent enforcement of existing regulations banning the harvest of sea turtles and their eggs (section 4.21), enhanced public awareness of the protected status of sea turtles (section 4.41), identification of important foraging and nesting areas (section 4.11), national application of guidelines for the conservation of foraging grounds and nesting beaches (section 4.122), and implementing specific, hands-on management initiatives are considered by this Recovery Action Plan to be the highest national management priorities. In light of the near complete commercial development of nesting beaches, one useful management option is sure to be the translocation of

eggs threatened by erosion, predation, or human interference to more secure habitat. A training session on the subject of relocating sea turtle eggs was provided by WIDECAST for LVV staff in May 1993. Should the adoption of more elaborate strategies, such as tagging programs or the maintenance of an egg hatchery, be deemed desirable, methodology should follow that described in the Manual of Sea Turtle Research and Conservation Techniques (Pritchard et al., 1983). Advice and training is also available from WIDECAST.

The decision to move eggs 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. Thus, beaches should be surveyed for nesting activity on a daily, early morning basis (section 4.291). Sometimes a compromise has to be made. If, for example, eggs are exposed 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 utmost care and reburied on a natural beach, preferably the one where the female made the original nest. In the case that it is not possible to move eggs to a safe location on the original beach, a nursery beach should be selected with the assistance of WIDECAST personnel that exhibits all the necessary conditions for successful incubation. The new nest should be dug to the same depth and diameter as the original nest and in the same type of habitat (open beach, beach forest, etc.) so that the temperature of incubation is not altered.

Nest sites should not be marked. To enable researchers to find the nest two months hence and monitor hatch success, the site should be triangulated from predetermined landmarks. Hatchlings should always be allowed to emerge from the nest naturally and traverse the beach unaided as soon as they emerge. Each hatchling is very important and contributes to the probability that enough turtles will mature to perpetuate the population. Those that survive the 20-30 years to maturity will return to the beaches of Aruba to lay the eggs of the next generation. Fenced 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. A small, fenced hatchery, if absolutely necessary, might be advantageously placed on the beach of a sympathetic hotel. In this way, financial and security support for the hatchery could be solicited from the sponsoring hotel and the hatchery could serve to educate residents and visitors about sea turtles.

4.29 Monitor stocks

Without adequate stock monitoring, it is not possible to evaluate whether conservation and management programs are having the desired effect; that is, whether these programs are successfully recovering depleted sea turtle populations. It is relatively easier to document trends on the nesting beaches, but it is also important to evaluate trends, positive or negative, at local feeding grounds. Techniques and recommendations are explained in the sections that follow.

4.291 Nests

Leatherbacks (*driekiel*), green turtles (*tortuga blanco*), hawksbills (*caret*), and loggerheads (*cawama*) are all known or suspected to nest in Aruba (section II). Leatherback nest-

ing is likely to commence in March or April, followed by loggerheads in May, green turtles in June, and hawksbills in July. Elsewhere in the Caribbean, leatherbacks terminate nesting by mid-July, but the other three species may continue to nest into the winter season, with hawksbills potentially active through December or later. Monitoring the deposition of eggs on the beaches of Aruba will provide a wealth of useful information, including the distribution and timing of breeding effort, the species involved, the location of the most important breeding habitats, and the fate (i.e., success or failure) of nests laid. Shifts in habitat use can be monitored, as well as trends in population status. Positive results of nest and habitat protection efforts may not be seen right away, however, since eggs protected today will not mature into breeding adults for two decades or more.

In support of the development of this Recovery Action Plan, a preliminary program to monitor nesting beaches was initiated in May 1993 by the WIDECAST Coordinator in Aruba. Ongoing beach patrol is essential in order to record anticipated increases in nest numbers following concerted efforts to protect habitat and turtles from harm. The number of crawls will be the basis of comparison among beaches and among years because the verification of eggs can be problematic. Discriminating between successful egg-laying (a nesting crawl) and unsuccessful egg-laying (a "false crawl") may require monitoring hatching activity. Whether or not eggs are deposited will depend on obstacles (erosion bluffs, fallen trees, beach lagoons) encountered by the female during the course of her time on the beach, level of disturbance (human activity, dogs, lighting), physical condition of the site chosen (she may encounter impenetrable roots, buried glass, water; the sand may be too dry to hold a nest cavity), and whether the turtle is injured (e.g., a missing flipper can prevent her from successfully excavating a nest chamber).

With experience, some field workers are able to discern a nest from a false crawl and thus calculate the nest:false crawl ratio needed to convert activities reported to actual nests. Sometimes it will be obvious that a turtle landed on the beach and returned to the sea without ever attempting to dig. This is a "false crawl". However, when signs of digging are apparent, the observer needs to have some experience watching sea turtles at night in order to distinguish a true nest from a false nest. Gently probing for the eggs with a sharp stick will sometimes confirm the presence of a nest, but the subsequent bacterial invasion attacking the broken egg(s) may destroy the entire nest. In the case of hawksbills, even finding a site suitable for probing among dense vegetation can be difficult. Thus it is recommended that crawls, rather than nests, be the basis of reporting. Of course crawls that are quite obviously "false" (e.g., a turtle encounters a tree or bluff and retreats without any sign of nest excavation) or, alternatively, quite obviously successful (e.g., a dog or crab has exposed the eggs) should be noted as such. When a crawl has been counted, it should be disguised with a palm frond or a gentle sweeping motion of hands or feet in order to dissuade possible poachers from finding the site and also to prevent the crawl from being counted twice.

Identifying a crawl as to species is readily accomplished in most 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 both front flippers. 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 two meters in width. Green turtles also leave a symmetrical crawl, but it is narrower (1.0-1.2 m wide) and the nest site is often character-

ized by a deep, solitary pit a meter or so in depth and breadth. Hawksbills and loggerheads leave an asymmetrical crawl, the hawksbill about 0.7 m in width and the loggerhead about 1.2 m in width. The hawksbill crawl is often very faint, however, since the animal averages a mere 54 kg (Caribbean Nicaragua: Nietschmann, 1972 *in* Witzell, 1983). Loggerheads are typically twice as massive, averaging about 116 kg in Florida (Ehrhart and Yoder, 1978 *in* Dodd, 1988). In addition, hawksbills will often make their nests deep within the shelter of Coccoloba or other beach vegetation.

Having identified the most important breeding beaches, it would be very useful to implement a nocturnal project on a selected beach (or beaches) whereby biologists or other trained persons patrolled the area at night to tag nesters, observe the ratio of successful nests, count the number of eggs laid, etc.

4.292 Hatchlings

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

Hatchling emergence at the beach surface usually occurs at dusk, and thus, if the timing is accurately predicted, it can be witnessed with relative ease. Predators, disorientation, and/or entanglement at the time of emergence should be noted. If the emergence was missed, it is easy enough to know when the majority of little turtles have escaped to the sea when dozens of tracks are observed at the site. The nest can be excavated at this time and the number of hatchlings can be roughly estimated from the remains of broken egg shells. In addition, unhatched eggs can be opened to determine the proportion of eggs which did not produce hatchlings. If a particular problem recurs, such as nest flooding and the subsequent drowning of embryos, then a conservation program to move eggs either at oviposition or early the next morning to higher ground should be considered. An in-depth analysis of hatch success should be undertaken on an index beach as soon as resources permit.

4.293 Immature and adult turtles

The monitoring of juvenile and adult turtles at sea requires special preparation and is more difficult than counting nests or evaluating hatchling mortality. In order to monitor foraging populations, systematic surveys to specific foraging grounds must be undertaken. If such survey work is undertaken in conjunction with a tagging program it is possible to evaluate not only for-

aging behavior, but also the movements of individuals since a tagged turtle may turn up at some point distant from where it was tagged. It is not necessary, however, to tag individuals and valuable information can be garnered by repeated observation of foraging areas and reporting the number of turtles seen. The support of professional divers and other relevant personnel should be solicited for at-sea surveys.

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 member nations worldwide, the most recent being Korea, 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. The Netherlands ratified the Convention on International Trade in Endangered Species of Flora and Fauna (CITES) on 18 July 1984, but Aruba is not yet a signatory.

In the interim before CITES is formally signed by Aruba, parts of the provisions of the treaty are executed by the Import and Export of Animals and Plants Decree (Landsbesluit in- en Uitvoerverbod Bedreigde Dieren en Planten, AB 1991, No. 102). As this Recovery Action Plan goes to press, legislation to fully implement CITES has been submitted to the National Advisory Council, the final administrative step before approval. Aruba (represented by Alexander Koolman, Customs Officer; Sylvester Vrolijk, LVV; and Theo Wools, Veterinary Service) attended the Caribbean CITES Implementation Training Seminar held in Trinidad, 14-18 September 1992. This comprehensive seminar, hosted by the Government of Trinidad and Tobago and the CITES Secretariat, was convened to familiarize Eastern Caribbean governments, especially non-CITES parties, with the Convention. It is a recommendation of this Recovery Action Plan that Customs officials and other relevant parties be fully supported at all levels of Government in their important and difficult task of implementing the provisions of the CITES treaty.

4.32 Regional treaties

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

In March, 1983, a Conference of Plenipotentiaries met in Cartagena, Colombia to negotiate the Convention. Representatives from 16 States participated, including the Netherlands. The Conference adopted both the Convention and a Protocol concerning cooperation in combating oil spills in the region. The Convention describes the responsibilities of Contracting Parties to "prevent, reduce and control" pollution from a variety of sources (i.e., pollution from ships, from at-sea dumping of waste, from land-based sources, from sea-bed activities, and from airborne sources). Article 10 is of special interest, urging Contracting Parties to "individually or jointly, take all appropriate measures to protect and preserve rare or fragile ecosystems, as well as the habitat of depleted, threatened or endangered species, in the Convention area." The Netherlands ratified the Convention on 16 April 1984.

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

On 11 June 1991, Plenipotentiaries again met in Kingston, Jamaica, to formally adopt the Annexes. The Conference voted unanimously to include all six species of sea turtle inhabiting the Wider Caribbean (i.e., Caretta caretta, Chelonia mydas, Eretmochelys imbricata, Dermochelys coriacea, Lepidochelys kempii, and L. olivacea) in Annex II (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 strong recommendation of this Recovery Action Plan that the Kingdom of the Netherlands, for Aruba and the Netherlands Antilles, ratify the SPAW Protocol and its annexes, and that the Government of Aruba adopt enabling legislation to implement the provisions of the treaty at the earliest possible opportunity.

Another international treaty important to the survival of sea turtles in regional waters is MARPOL 1973 (with Protocol 1978). 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 in place the facilities to receive garbage on shore. The 1993 Prevention of Pollution by Ships Ordinance (Landsverordening ter Voorkoming Verontreiniging Door Schepen, AB 1993) implements MARPOL, but an effective date cannot be established until shore-based reception facilities are put in place.

4.33 Subregional sea turtle management

Sea turtle stocks in Bonaire and Curaçao (Netherlands Antilles), as well as in Venezuela and Colombia, are surely shared with those in Aruba. Compatible legal protection should be encouraged in order to prevent illegal trade between nations and burdensome enforcement problems which arise when proximal nations disagree on how best to manage migrating species. In addition, it does not make good long-term management sense to protect sea turtles in the waters of one nation if they continue to be exploited in the waters or on the beaches of another nation. Conformity with regard to the protection of sea turtles will eventually be achieved with the ratification by nations throughout the region of the SPAW Protocol (section 4.32). Joint marine sanctuaries might be proposed to safeguard not only shared turtle resources, but also common marine resources in general. It is a recommendation of this Recovery Action Plan that full advantage be taken of the existing quad-lateral committee ("Consultative Mechanism: Working Group on the Environment") currently working on mechanisms for cooperation between the Kingdom of the Netherlands, the Netherlands Antilles, Aruba and Venezuela in implementing CITES and other regional marine environmental legislation.

4.4 Develop Public Education

4.41 Residents

It is a recommendation of this Recovery Action Plan that concerted efforts be made on the part of both government agencies (such as LVV) and established conservation groups (such as FANAPA and StimAruba) to provide schools and other audiences with conservation material. This would certainly include information on locally important or depleted species such as sea turtles. Some noteworthy individuals, such as Olinda van der Linden-Rasmijn, have made a personal commitment to responding to requests by schools for presentations about the conservation of sea turtles. It is clear that citizen knowledge of sea turtles is very slight, but with our involvement in the WIDECAST project we have access to slides, posters, and other materials which have made the task easier. We believe that the school program is especially important as this may be the most direct way to reach parents.

"Bumper stickers" are popular and may be particularly appropriate for messages pertaining to not driving on Aruba's beaches (see section 4.134). StimAruba and Accion Ambiental have newsletters, and these should carry sea turtle articles. A public library exhibition (Oranjestad, San Nicolas) is planned and will make use of photos, confiscated turtle shells (see section 3.3), and other material. Regular radio coverage of pertinent issues should be encouraged. The support of the office of the Prime Minister in sending letters to island establishments informing them that sea turtles are protected by law (see section 3.3) is deeply appreciated.

4.42 Fishermen

The best way to communicate with fishermen is through the Fisheries Officer, although indirect methods, such as educating school children, will surely have an effect as well. Education of fishermen should focus on ways to prevent the incidental catch of turtles in *redas* (seines drawn in shallow waters) and other commonly used gear. Information regarding the safe

release of turtles from nets and proper resuscitation techniques would be useful. Fishermen should be encouraged to report incidents of sea turtle injury, stranding, or nesting.

4.43 Tourists

The sale of turtle shell and tortoiseshell items is aimed at tourists. In addition, the negative effects of activities generally associated with high density tourism (irresponsible/ inexperienced divers, indiscriminate anchoring, beach and nearshore litter, joy-riding on the beaches, noise and lights on nesting beaches, etc.) may be lessened if tourists were more aware of the implications of their actions. Therefore, we plan to solicit the support of beachfront hotels in establishing information displays in the hotels, as well as designing an "Endangered Sea Turtles of Aruba" exhibit at the airport. Brochures and posters available at dive shops and other relevant locales would also be useful.

4.44 Non-consumptive activities that generate revenue

Tourism is appreciated and understood as a primary source of revenue. SCUBA dive clubs could perhaps be rewarded with free promotional help if they feature non-consumptive experiences with sea turtles, such as photography. It should be stressed whenever possible that the value of accessible, visible sea turtles on natural coral reefs is a good investment! Hotels might also consider providing room and board, or other support, to a local biologist in return for leading natural history expeditions to the beach at night to witness sea turtle nesting. While this type of nature-tourism has been very successful in other Caribbean islands, such as Antigua, it cannot be over-emphasized that the project must be supervised by trained personnel and the welfare of the turtles must be considered paramount. Sea turtles are easily frightened and insensitive activity will further erode already depleted populations.

4.5 Increase Information Exchange

4.51 Marine Turtle Newsletter

The Marine Turtle Newsletter (MTN) is currently received by Tom Barmes, LVV, VROM, Colegio Arubano (high school), Biblioteca Nacional (national library), and interested residents. All interested persons are encouraged to subscribe by writing to the Editors (Karen and Scott Eckert), Hubbs-Sea World Research Institute, 1700 South Shores Road, San Diego, California 92109 USA. The MTN is published quarterly, distributed free of charge in English and Spanish to readers in more than 100 countries around the world, and is one of the best ways to keep informed about sea turtle conservation and research. In addition to features, each issue includes a list of recently published scientific articles and reports.

4.52 Western Atlantic Turtle Symposium (WATS)

Aruba was represented by the Netherlands Antilles National Representative at WATS I (Costa Rica, 1983), but not at WATS II (Puerto Rico, 1987). In 1983, the National Report for the Netherlands Antilles included the island of Aruba, and was prepared by Gerald van Buurt, Department of Agriculture and Fisheries (LVV) in Curaçao. In 1987, the Netherlands Antilles

National Report was prepared by Jeffrey Sybesma, Caribbean Marine Biological Institute (CARMABI) in Curaçao. Because of changes in Aruba's status, pending independence from the Kingdom of the Netherlands, Aruba was not included in Sybesma's 1987 report. Aruba is encouraged to remain informed about this important regional data base and to have representation at upcoming Symposia.

4.53 WIDECAST

The Wider Caribbean Sea Turtle Recovery Team and Conservation Network, known by the acronym "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 Aruba, in the Wider Caribbean. Each STRAP is tailored specifically to local circumstances and provides the following information:

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

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

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

Beyond supporting the local and national efforts of governments and non-governmental organizations, WIDECAST works to integrate these efforts into a collective regional response to

a common problem, the disappearance of sea turtles. WIDECAST is supported by the Caribbean Trust Fund of the UNEP Caribbean Environment Programme, as well as by government (e.g., U. S. National Marine Fisheries Service) and non-government (e.g., The Chelonia Insti-tute) agencies and groups. Government and non-government entities, biologists, fishermen, educators, developers, and other interested persons are encouraged to join in WIDECAST's efforts. The WIDECAST Country Coordinator in Aruba is Tom Barmes, Assistant Director, LVV, Piedra Plat 114-A, Aruba.

4.54 IUCN/SSC Marine Turtle Specialist Group

The Marine Turtle Specialist Group (Dr. Karen A. 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 a valuable source of information about sea turtles and technical advice on conservation projects. For further information, contact Dr. Karen Bjorndal, Archie Carr Center for Sea Turtle Research, Department of Zoology, University of Florida, Gainesville, Florida 32611 USA.

4.55 Workshops on research and management

Prior to the implementation of field surveys or other sea turtle conservation projects, participants should be educated concerning basic sea turtle ecology. This training would logically include the identification of sea turtle species, whether the evidence available was a live turtle, a hatchling, an egg, or a crawl on the beach. Additional detail, provided as needed, could include proper methods to conduct surveys of nesting beaches (section 4.291), transect surveys of foraging areas (section 4.293), the movement of eggs, aerial surveys, etc. Informal local workshops can be arranged upon request by WIDECAST. More formal training has in the past been available from the Caribbean Conservation Corporation (P. O. Box 2866, Gainesville, Florida 32602) at their Sea Turtle Short Course in Tortuguero, Costa Rica. The WATS Manual of Sea Turtle Research and Conservation Techniques (Pritchard et al., 1983) provides instruction and background for many sea turtle research and management techniques. Program managers are encouraged to follow it to the fullest extent when research and conservation projects are designed and implemented.

4.56 Exchange of information among local groups

It is very desirable to have local groups coordinating efforts toward sea turtle research and conservation, in order that personnel and other resources are most efficiently used and data are compatible. StimAruba has been the most involved in issues of sea turtle conservation (monitoring beaches, sponsoring public lectures) to date, but the island's other two conservation groups (FANAPA, Accion Ambiental) have indicated a strong interest in becoming more deeply involved in 1994 and beyond. It is very encouraging to see this enthusiastic response -- there is no question but that there is much to be done! In addition to ongoing efforts (coordinated by Tom Barmes) to monitor nesting beaches, the efforts of conservation groups to promote public awareness and to report violations are sorely needed.

4.6 Implement a National Sea Turtle Conservation Project

4.61 Rationale

It is clear from the information provided in this Recovery Action Plan that Aruba provides foraging habitat to at least two species of sea turtle (green, *tortuga blanco* and hawksbill, *caret*) and hosts a small number of nesting females each year, perhaps fewer than ten (mostly the leatherback, *driekiel* and loggerhead, *cawama*). Sea turtles and their eggs are fully protected in Aruba by Landsverordening, Marien Milieuverordening Aruba (Marine Environment Ordinance) (AB 1980, No. 18) and penalties for convicted violators include both fines and jail sentences. Nevertheless, enforcement is problematic and an unquantified (but probably low) level of harvest continues on the part of local fishermen and meat and shells are also imported from Venezuela in contravention of both national and international laws. The sale of meat in restaurants and trinkets in tourist-oriented boutiques continues at a persistent but, again, probably relatively low level.

The clandestine harvest and marketing of sea turtles, while not as dramatic in volume as it is in some other countries in the region, is a source of grave concern in Aruba because we have only a handful of turtles remaining in the wild. The take of a single gravid female, for instance, may represent 50% or more of the total nesting population in some years. And our reputation as a favorable tourist destination is certainly tarnished by the blatant sale of species which are recognized around the world to be threatened with extinction. Finally, we have reason to be quite concerned about the integrity of habitats important to the survival of our sea turtles. Most potentially important nesting beaches are heavily developed in high rise hotels, and the tourist industry brings other threats, including beachfront lighting, vehicles joy-riding on the beaches, litter, and increased pressure on reefs by divers.

There is ample rationale for a national commitment to sea turtle conservation, and with the support of WIDECAST and the excellent framework provided by this Recovery Action Plan we are for the first time in a position to move forward with this important agenda.

4.62 Goals and objectives

Restoring living and nesting habitat will only be possible where no permanent changes have been made. The west coast from Bushiri Beach Hotel to Cudarebe (West Point) is the most attractive beach because of its sand structure and the rather calm sea. Its once pristine state, however, has been lost forever to the coastal boulevard and several high-rise hotels. This is not possible to undo, and thus it is necessary to instruct hotel personnel on how to handle the situation when gravid turtles come ashore to lay their eggs and hatchlings subsequently emerge from the sand. We have already solicited the support of hotel staff in collecting and releasing to the sea hatchlings which travel inland after becoming disoriented by beachfront lighting. In light of the particular situation in Aruba, our primary goals will be to (i) safeguard all nests laid and (ii) bring to a halt *all* harvest and commerce in sea turtles and their products, as mandated by national law. In order to accomplish these goals, we are committed to the following objectives:

1. Monitor nesting beaches and maximize hatchling production.
2. Enhance public awareness of and participation in sea turtle conservation.
3. Promote improvements in legislation and law enforcement.

4.63 Activities

In order to meet the above objectives, the WIDECAST Coordinator in Aruba proposes to undertake the following activities. LVV will be the Lead Organization for the National Sea Turtle Conservation Project, with active support from other government agencies (e.g., VROM, Police), local conservation and interest groups (e.g., StimAruba, FANAPA, dive operators, hoteliers), and international organizations (e.g., WIDECAST).

1. Assemble and maintain sightings and nesting data bases. Design and distribute standard record sheets.
2. Monitor potential nesting beaches on a daily basis throughout the annual nesting season (April-August, and through November if confirmation of hawksbill nesting is obtained).
3. Determine primary threats on the nesting beaches and design (and implement) specific mitigating measures. For instance, work collaboratively with beachfront hoteliers to modify lighting and clear the beaches of recreational equipment (e.g., beach chairs, sailboats) at night.
4. Maintain a small hatchery facility as a last resort if necessary to safeguard eggs laid in high risk (heavy traffic) zones. Gain hotel sponsorship for this.
5. Instruct hotel personnel on how to monitor their beaches for sea turtle hatching activity and how to "rescue" hatchlings misoriented inland by hotel lights.
6. Encourage people to report offenses against sea turtle conservation legislation, and encourage prosecution of convicted offenders.
7. Make personal contact with owners of boutiques selling tortoiseshell and restaurants selling meat, alerting them to the consequences of such commerce.
8. Design and distribute public awareness materials, including but not limited to brochures, posters, bumper stickers, and informative displays in restaurants, hotel lobbies, boutiques, and libraries.
9. Offer training opportunities, such as workshops, to habitat survey participants and persons volunteering to provide presentations to schools. Request training materials and/or instructors as needed from WIDECAST.
10. Lobby for habitat protection, including Marine Park status for the south coast and Sea Turtle Refuge designation for west coast beaches.
11. Involve the media more consistently in coverage of sea turtle conservation issues.

4.64 Budget

We are a small island with relatively few sea turtles, perhaps fewer than 30 nests laid per year. We do not anticipate that large-scale fund-raising will be necessary to implement a national conservation program. We feel that quite possibly the private sector in Aruba will agree to covering costs incurred by activities outlined in section 4.63. Hotels have already shown admirable interest in protecting sea turtles on their beaches, it is simply a question of organizing

and focusing this interest. We will emphasize that protecting nests is not only good ecology, but can potentially serve as a tourist attraction if carefully and thoughtfully executed. With regard to educational materials, WIDECAST has provided us with slides, leaflets, and brochures and will soon have posters available. In addition, a variety of educational materials can be sponsored locally, such as bumper stickers by car rental agencies. Restaurants are likely to be amenable to exhibit plaques or stickers that explain to patrons that sea turtle meat is not offered in deference to the endangered status of these animals. Further, a good deal of information can be disseminated by word of mouth, such as by dive operators and other tour personnel. With regard to monitoring beaches, local volunteers are available and willing to participate in this task. LVV staff will compile and archive relevant data.

V. LITERATURE CITED

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.

Bak, R. P. M. 1975. Ecological aspects of the distribution of reef corals in the Netherlands Antilles. Bijdragen tot de dierkunde, 45(2):181-190.

Bak, R. P. M. 1986. The status of Aruban reefs and their relation with the refinery's location. CARMABI Consultancy Report for Grontmij Netherlands. 36 p. (translated from Dutch)

Bak, R. P. M. 1987. Effects of chronic oil pollution on a Caribbean coral reef. Mar. Poll. Bull. 18(10):534-539.

Bjorndal, K. A. 1980. Nutrition and grazing behavior of the green turtle, Chelonia mydas. Marine Biology 56:147-154.

Bjorndal, K. A. 1982. 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. 1985. Nutritional ecology of sea turtles. Copeia 1985:736-751.

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. 1984. National Report for the U. S. Virgin Islands, p.489-499. *In*: Proc. Western Atlantic Turtle Symposium, San José, Costa Rica, 1983 (P. Bacon et al., Editors). Volume 3, Appendix 7. University of Miami Press, Miami. 40 p.

Brongersma, L. D. 1972. European Atlantic turtles. Zool. Verh. (Leiden) No. 121.

Buikhuizen, H. 1993. Caribbean Story. 9 p. Mimeo.

Buurt, G. van 1984. National Report for the Netherlands Antilles (Aruba, Curaçao, Bonaire), p. 329-333. *In*: Proc. Western Atlantic Turtle Symposium, San José, Costa Rica, 1983 (P. Bacon et al., Editors). Volume 3, Appendix 7. University of Miami Press, Florida.

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 H. Lima. 1990. Leatherback turtles disappearing from the BVI. Marine Turtle Newsletter 49:4-7.

Carr, A. 1987a. New perspectives on the pelagic stage of sea turtle development. Cons. Biol. 1(2):103-121.

Carr, A. 1987b. Impact of nondegradable marine debris on the ecology and survival outlook of sea turtles. Mar. Pollut. Bull. 18(6 PartB):352-356.

Carr, A., M. H. Carr, and A. B. Meylan. 1978. The ecology and migrations of sea turtles, 7. The west Caribbean green turtle colony. Bull. Am. Mus. Nat. Hist. 162(1):1-46.

Corliss, L. A., J. I. Richardson, C. Ryder, and R. Bell. 1989. The hawksbills of Jumby Bay, Antigua, West Indies, p.33-35. *In*: Proceedings of the Ninth Annual Workshop on Sea Turtle Conservation and Biology (S. A. Eckert, K. L. Eckert, and T. H. Richardson, Compilers). NOAA Tech. Memo. NMFS-SEFC-232. U. S. Dept. Commerce.

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. 1988. Synopsis of the biological data on the loggerhead sea turtle, Caretta caretta (Linnaeus 1758). U. S. Fish Wildl. Serv., Biol. Rept. 88(14):1-110.

Eckert, K. L. 1987. Environmental unpredictability and leatherback sea turtle (Dermochelys coriacea) nest loss. Herpetologica 43(3):315-323.

Eckert, K. L. 1991. Caribbean nations vote to protect sea turtles. Mar. Turtle Newsl. 54:3-4.

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, S. A., K. L. Eckert, P. Ponganis, and G. L. Kooyman. 1989. Diving and foraging behavior by leatherback sea turtles (Dermochelys coriacea). Can. J. Zool. 67:2834-2840.

ECNAMP. 1980. Aruba: Preliminary Data Atlas. Prepared by the Eastern Caribbean Natural Areas Management Programme.

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. 1991. Fibropapillomas in green turtles of the Indian River Lagoon, Florida: distribution over time and area, p.59-61. *In*: Research Plan for Marine Turtle Fibropapilloma (G. Balazs and S. Pooley, Editors). NOAA Tech. Memo. NMFS-SWFSC-156. 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. and L. M. Ehrhart. 1985. Preliminary growth models for green, Chelonia mydas, and loggerhead, Caretta caretta, turtles in the wild. Copeia 1985:73-79.

Frazer, N. B. and R. C. Ladner. 1986. A growth curve for green sea turtles, Chelonia mydas, in the U. S. Virgin Islands, 1913-14. Copeia 1986:798-802.

Frazier, J. 1984. Las tortugas marinas en el Oceano Atlantico Sur Occidental. Asoc. Herpetol. Argentina 2:2-21.

Fretey, J. and M. Girondot. 1989. L'activité de ponte de la tortue luth, Dermochelys coriacea (Vandelli 1761), pendant la saison 1988 en Guyane Française. Rev. Ecol. (Terre Vie) 44: 261-274.

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. 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, Suisse. 601p.

Guada, H. J. and P. Vernet P. 1988. Informe del proyecto situación actual de las tortugas marinas en la costa Caribeña de Venezuela. Estado Falcón: Costa Oeste y Peninsula de Paraguaná. Informe Interno de FUDENA. 25 p.

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. 5th Intl. Coral Reef Congress (C. Gabrie and B. Salvat, Editors). Volume 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.

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.

Hoppe, W. 1985. Orienterend onderzoek naar de invloed van vervuiling op de kust bij de Lago raffinaderij. CARMABI, Curaçao. Mimeo. 10 p.

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. 61 p.

Hulsbergen, C. H. 1987. Zandinventarisatie Aruba. Prepared by Waterloopkundig laboratorium for the Government of Aruba. 49 p. + figs.

Jacobson, E. R. 1990. An update on green turtle fibropapilloma. Marine Turtle Newsl. 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.

Jacobson, E. R. et al. 1989. Cutaneous fibropapillomas of green turtles (Chelonia mydas). J. Comp. Path. 101:39-52.

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.

Manzella, S., K. Bjorndal, and C. Lagueux. 1991. Head-started Kemp's ridley recaptured in the Caribbean. Marine Turtle Newsletter 54:13-14.

Meylan, A. 1988. Spongivory in hawksbill turtles: a diet of glass. Science 239:393-395.

Morgan, P. J. 1989. Occurrence of leatherback turtles (Dermochelys coriacea) in the British Islands in 1988 with reference to a record specimen, p.119-120. *In*: Proc. Ninth Annual Workshop on Sea Turtle Conservation and Biology (S. A. Eckert, K. L. Eckert, and T. H. Richardson, Compilers). NOAA Tech. Memo. NMFS-SEFC-232.

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.

Mrosovksy, N. 1981. Plastic jellyfish. Marine Turtle Newsletter 17:5-7.

Mrosovsky, N., S. R. Hopkins-Murphy, and J. I. Richardson. 1984. Sex ratio of sea turtles: seasonal changes. Science 225:739-741.

Nietschmann, G. 1972. The exploitation and conservation of hawksbill sea turtles, eastern Nicaragua. Report to the Department of Geography, Univ. Michigan. 15 p. (Unpubl.)

Ogden, J. C., S. Tighe and S. Miller. 1980. Grazing of sea grasses by large herbivores in the Caribbean. American Zoologist 20:949 (abstract).

Ogden, J. C., 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. Márquez M., L. Ogren, W. Pringle, Jr., H. Reichart and R. Witham. 1983. Manual of sea turtle research and conservation techniques, second edition (K. A Bjorndal and G. H. Balazs, Editors). Ctr for Environmental Education, Washington D. C. 125 p.

Raymond, P. W. 1984. Sea turtle hatchling disorientation and artificial beachfront lighting. The Ctr for Environmental Education, Washington D. C. 72 p.

Rebel, T. P. 1974. Sea Turtles and the Turtle Industry of the West Indies, Florida, and the Gulf of Mexico. University of Miami Press, Coral Gables, Florida. 250 p.

Reichart, H. A. 1989. Status report on the olive ridley turtle (Lepidochelys olivacea), p.175-188. *In*: Proc. Second Western Atlantic Turtle Symposium (Larry 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. 65 p.

Richardson, J. I. 1990. Estimation of sea turtle abundance and nesting success on Mona Island, Puerto Rico. Final Report, Fish Wildl. Serv., Unit Coop. Agreement #14-16-0009-1551, Work Order #10. 42 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.

Rogers, C. S. 1985. Degradation of Caribbean and Western Atlantic coral reefs and decline of associated fisheries, p.491-496. In: Proceedings of the 5th International Coral Reef Congress. Volume 6.

Rogers, C. S., L. McLain, and E. S. Zullo. 1988. Recreational uses of marine resources in the Virgin Islands National Park and Biosphere Reserve: trends and consequences. Biosphere Reserve Research Report No. 24. VIRMC/NPS. U. S. National Park Service. 30 p.

Ross, J. P., S. Beavers, D. Mundell, and M. Airth-Kindree. 1989. The Status of Kemp's Ridley. Ctr for Marine Conservation, Washington D. C. 51 p.

Schulz, J. P. 1975. Sea Turtles Nesting in Suriname. Zool. Verh. (Leiden) No. 143. The Netherlands.

Squires, H. J. 1954. Records of marine turtles in the Newfoundland area. Copeia 1954:68.

Sybesma, J. 1987. National Report for the Netherlands Antilles, Western Atlantic Turtle Symposium (WATS II), Mayagüez, Puerto Rico, 1987. 29 p. (Unpubl.)

Sybesma, J. 1989. Sick sea turtle. Curaçao Underwater Park Progress Report April-June 1989. CARMABI, Netherlands Antilles.

Sybesma, J. and P. C. Hoetjes. 1992. First record of the olive ridley and of nesting by the loggerhead turtle in Curaçao. Carib. J. Sci. 28(1-2):103-104.

Tobias, W. 1991. Turtles caught in Caribbean swordfish fishery. Mar. Turtle Newsl. 53:10-12.

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.

UNEP. 1984. The State of Marine Pollution in the Wider Caribbean Region. United Nations Environment Programme, Regional Seas Reports and Studies No. 36. 45 p.

Vargo, S., P. Lutz, D. Odell, E. Van Vleet, and G. Bossart. 1986. Effects of oil on marine turtles. Final Report, Vol. 2-Technical Report. Prepared for Minerals Management Service, U. S. Dept. Interior. OCS Study MMS 86-0070.

Wilcox, E. 1989. Marine Resources Management Plan. In: The Southeast Peninsula Project in St. Kitts, Volume I: Resource Management Plans. Prepared for the U. S. Agency for International Development, contract #DHR 5438-C-00-6054-00. 40 p.

Witherington, B. 1990. Photopollution on sea turtle nesting beaches: problems and next-best solutions, p.43-45. In: Proc. 10th 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 Fisheries Synopsis No. 137. Rome. 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. Mar. Fish. Rev. 46(3):56-58.

Woody, J. B. 1991. Guest Editorial: It's time to stop head-starting Kemp's ridley. Marine Turtle Newsletter 55:7-8.

Young, R. 1992. Tiger shark consumes young sea turtle. Marine Turtle Newsletter 59:14.

Table 1. Stay-over arrivals in Aruba. Source: Curaçao Tourist Bureau (1980-1986), Aruba Tourist Bureau (1987-1992).

Year	Arrivals
1980	188,900
1981	221,300
1982	220,200
1983	195,200
1984	210,200
1985	206,000
1986	181,211
1987	231,582
1988	277,573
1989	344,336
1990	432,762
1991	501,324
1992	541,714

Table 2. Documented records of sea turtles nesting in Aruba, 1993 (data courtesy LVV). Prior to 1993, no reliable field surveys had been undertaken, although some anecdotal data are available (see section 4.112 of this Recovery Action Plan). Four species may nest; they are the green turtle or *tortuga blanco* (Chelonia mydas), hawksbill or *caret* (Eretmochelys imbricata), loggerhead or *cawama* (Caretta caretta), and leatherback or *driekiel* (Dermochelys coriacea) (see Figure 2). Leatherback nesting is reported the most often, perhaps because the large tracks of this species are the easiest for laymen to identify and west coast beaches were the most thoroughly surveyed (hawksbill and green turtle nesting is likely to be more common along the east and southeast coasts).

Date	Species	Beach	Comments
April 23	Leatherback	Druif Beach (south coast)	Confirmed crawl, but no hatchlings seen
May 4	Loggerhead	Pirate's Nest, Bucuti Beach Hotel (Manchebo Beach)	Hatched 25 June, released ±50 hatchlings, nest excavation revealed 20 unhatched eggs
May 9	Green (?)	Dos Playa Beach	Resident observed nesting, but eggs subsequently washed away
May 13	Leatherback	Swiss Chalet, Eagle Beach	Confirmed crawl, but no hatchlings seen
May 21	Leatherback	Sandra's Restaurant, Eagle Beach	Confirmed crawl, but no hatchlings seen
June 1	Leatherback	Arashi Beach	Hatched 31 July; 70 live hatchlings, 30 unhatched eggs
June 10	Hawksbill (?)	Aruba Beach Club, Druif Beach (south coast)	Security personnel observed nesting; no hatchlings seen
July 10	Leatherback	Arashi Beach	±20 hatchlings released to the sea
July 26	Leatherback	Costa Linda Hotel, Eagle Beach	±150 hatchlings released to the sea *
August 17	Loggerhead	Arashi Beach	5 hatchlings found dead
August 24	Leatherback	Costa Linda Hotel, Eagle Beach	±100 hatchlings released to the sea *
undated	Leatherback (?)	Andicuri Beach	Plantation owner reported that 200 or more hatchlings were killed on the beach by 4-wheel drive vehicles

* these hatchlings (disoriented inland by beachfront lighting) were "rescued" by hotel security staff

Table 3. Number of sea turtles killed at the Aruba abattoir, 1977-1986. Unfortunately, data are not available prior to 1977, and no information is available concerning species, size or weight, or sex.

Year	Turtles processed
1977	31
1978	8
1979	--
1980	6
1981	6
1982	10
1983	4
1984 1/	--
1985 1/	--
1986	32

_____

1/ the unusually high value given for 1986 may represent a cumulative total, 1984-1986

Table 4. Aruba coastal clean-up zones and zone areas, September 1993 (see Figure 5). Zone length is measured in meters. Asterisk (*) indicates hotel area and zone area average; double asterisk (**) indicates SCUBA operation area and zone area estimate (source: R. de Kort, VROM).

Clean-up zone		Zone length	Clean-up zone		Zone length
1.	Basiruti	750	30.	San Nicolas Bay Cays (# 4 & 3)	1275
2.	Hadicurari	1000			
3.	Malmok	625	31.	Wickland Beach	300
4.	Boca Catalina	500	32.	Master	200
5.	Arashi	650	33.	Santo Largo	200
6.	Cudarebe	375	34.	Mangel Halto	250
7.	California Dunes	750	35.	Barcadera	500
8.	Druif	250	36.	Surfside	300
9.	Urirama	200	37.	Harbour Town*	100
10.	Boca Grandi (west)	125	38.	Waf	100
11.	Boca Curá	100	39.	Bushiri Beach Hotel*	150
12.	Boca di Pos di Noord	325	40.	Tamarijn Beach Hotel*	250
13.	Boca Chikitu	100	41.	Divi Divi Beach Hotel*	250
14.	Wariruri	300	42.	Casa Del Mar*	250
15.	Budui	275	43.	Aruba Beach Club*	250
16.	Natural Bridge	275	44.	Manchebo Beach Hotel*	250
17.	Andicuri	150	45.	Bucuti Beach Hotel*	250
18.	Noordkaap	225	46.	Costa Linda Beach Resort*	250
19.	Daimari	200	47.	Eagle Beach	750
20.	Boca Ketu	250	48.	La Cabana Beach Resort*	150
21.	Conchi	100	49.	Amsterdam Manor*	150
22.	Suplado	125	50.	Ramada Renaissance*	250
23.	Dos Playa	300	51.	Aruba Concord Hotel*	250
24.	Boca Druif	150	52.	Aruba Palm Beach Hotel*	250
25.	Boca Prins	300	53.	Radisson Hotel*	250
26.	Rincon	275	54.	Americana Hotel*	250
27.	Boca Grandi (east)	1900	55.	Hyatt Regency Hotel*	250
28.	Punta Basora (incl. Baby Beach)	2250	56.	Playa Linda Beach Hotel*	250
			57.	Holiday Inn Beach Hotel*	250
29.	Nanki	1000	58.	W Coast, underwater area**	2000

Total Rural Areas	17,700 m
Total Hotel Areas	4,300 m
Total Underwater Area	2,000 m
TOTAL AREA	24,000 m = 24 km

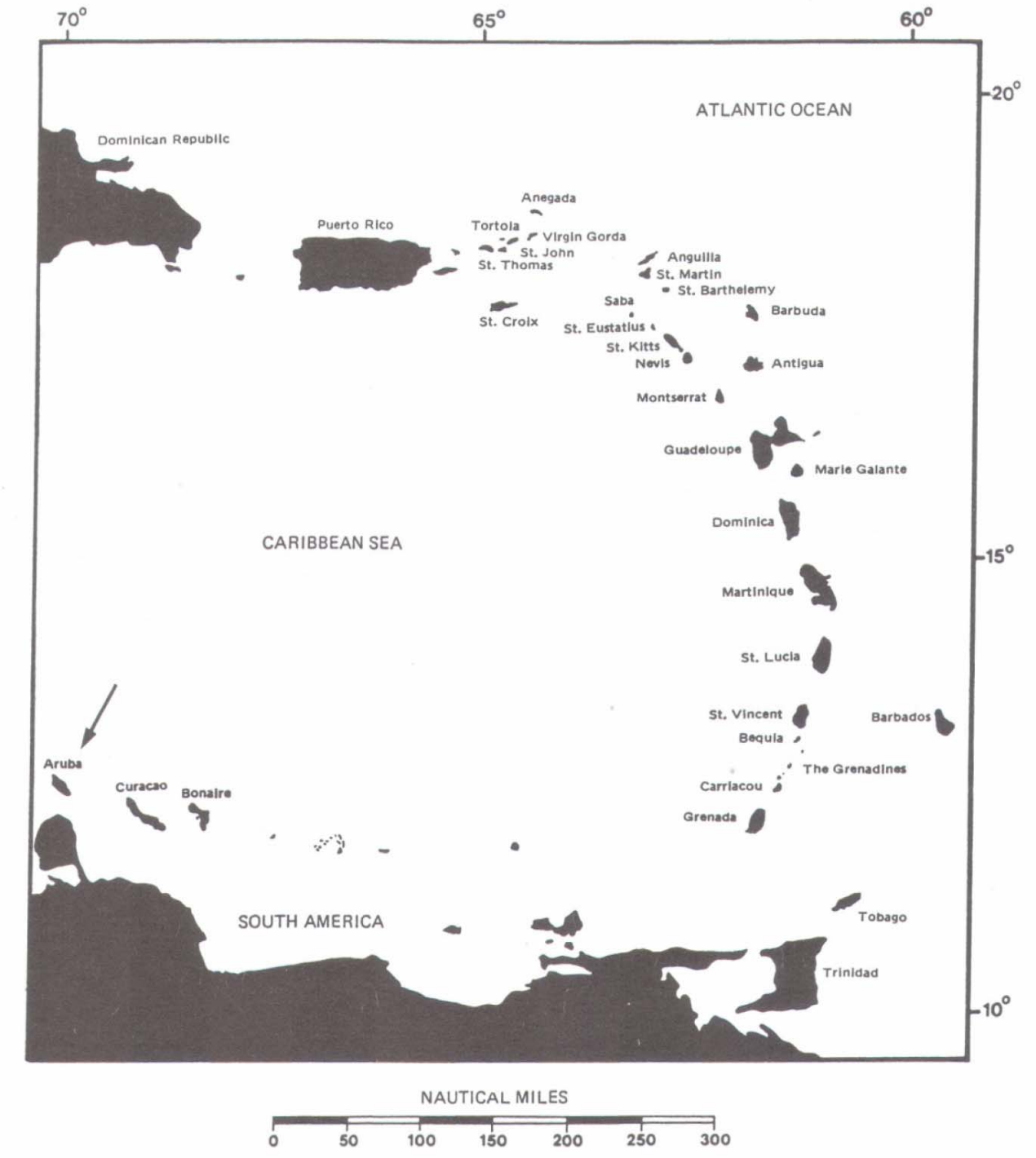


Figure 1. Aruba (12°30'N, 70°W) is located 32 km (19 miles) north of Venezuela and 67 km (42 miles) west of Curaçao, Netherlands Antilles (source: ECNAMP, 1980).

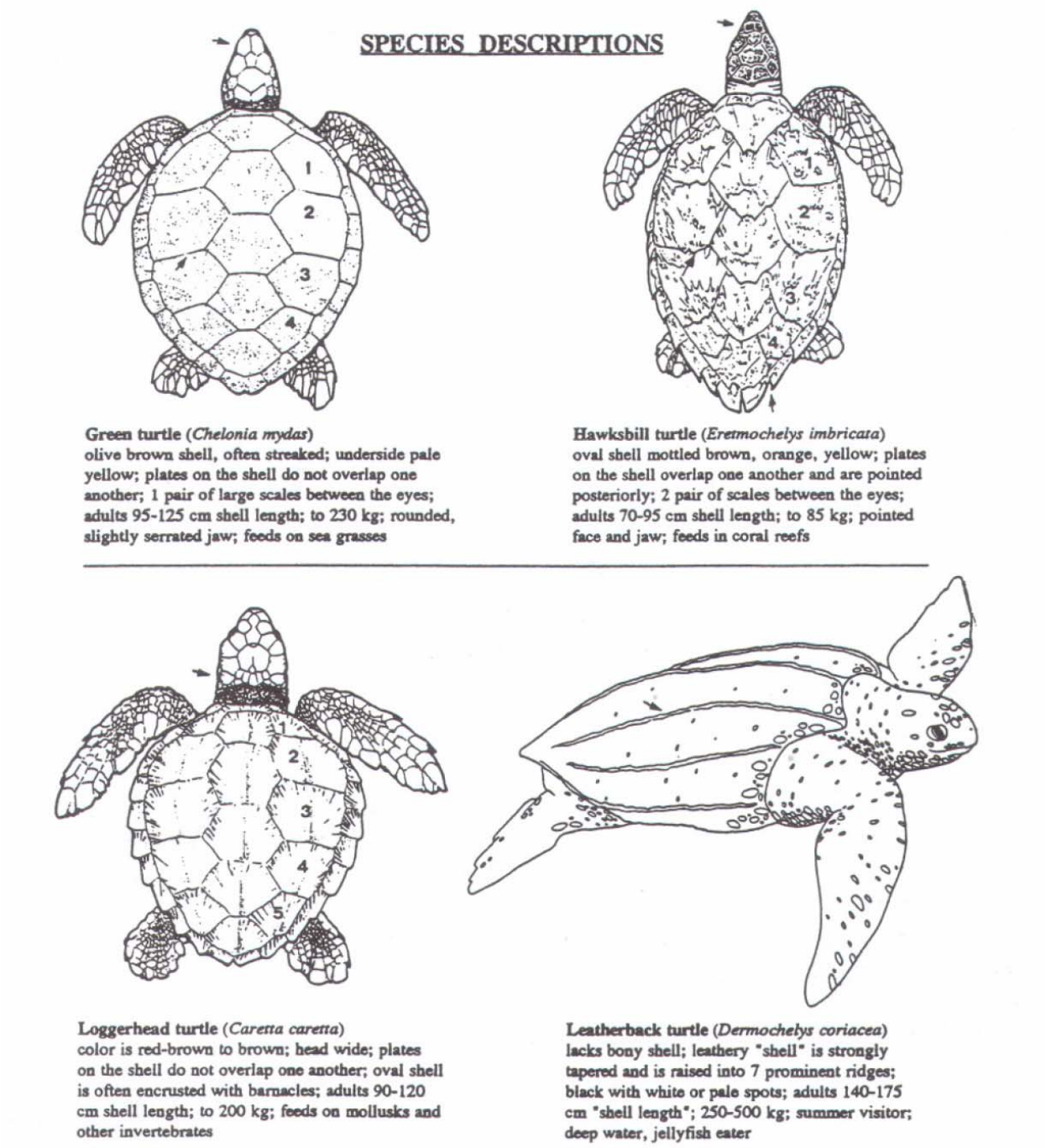


Figure 2. Four species of sea turtle reportedly nest in Aruba: the green turtle or *tortuga blanco* (Chelonia mydas), the hawksbill or *caret* (Eretmochelys imbricata), the loggerhead or *cawama* (Caretta caretta), and the leatherback or *driekiel* (Dermochelys coriacea).

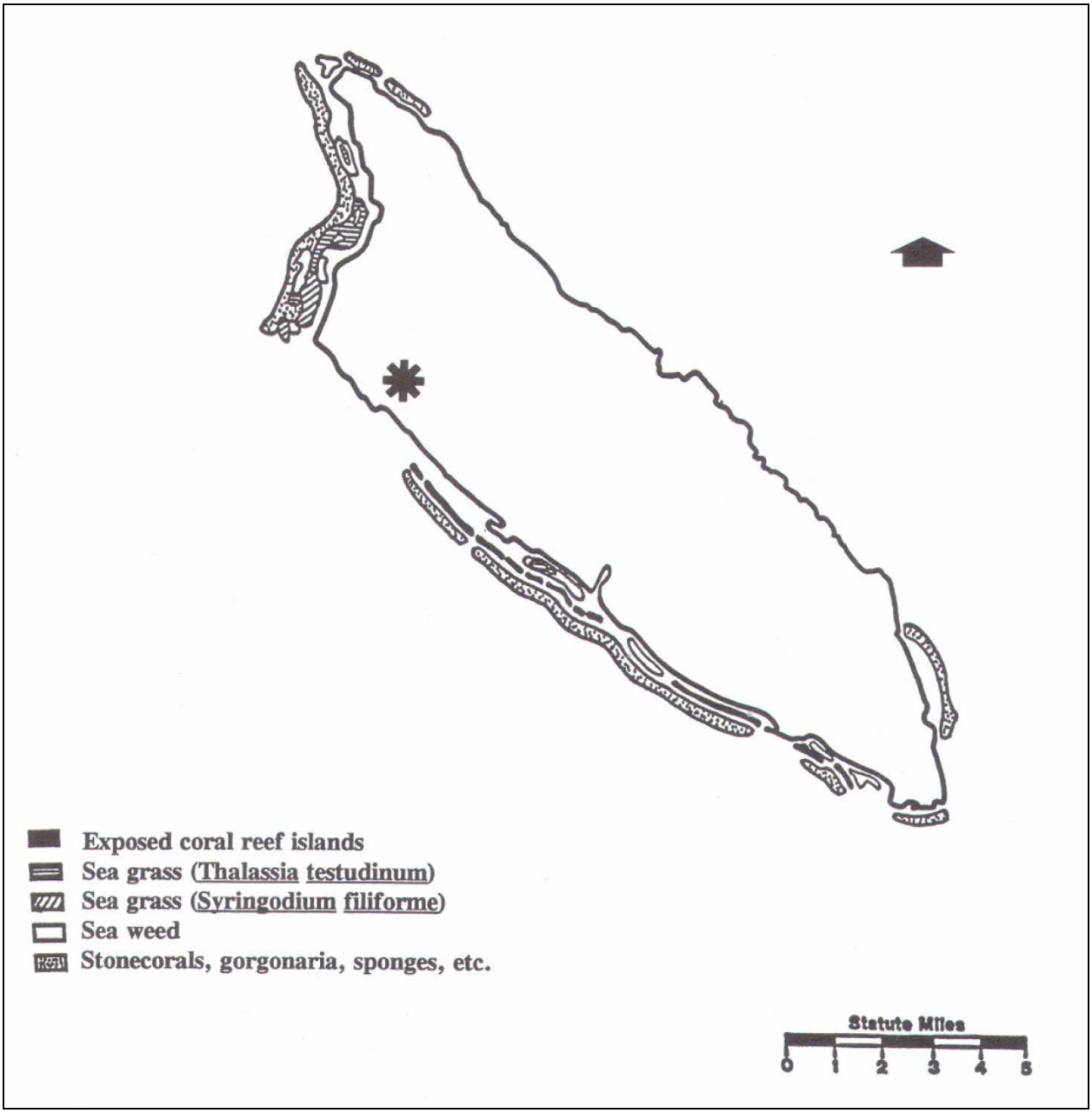


Figure 3. Sea grass and coral reef formations around Aruba. Source: R. de Kort (VROM).

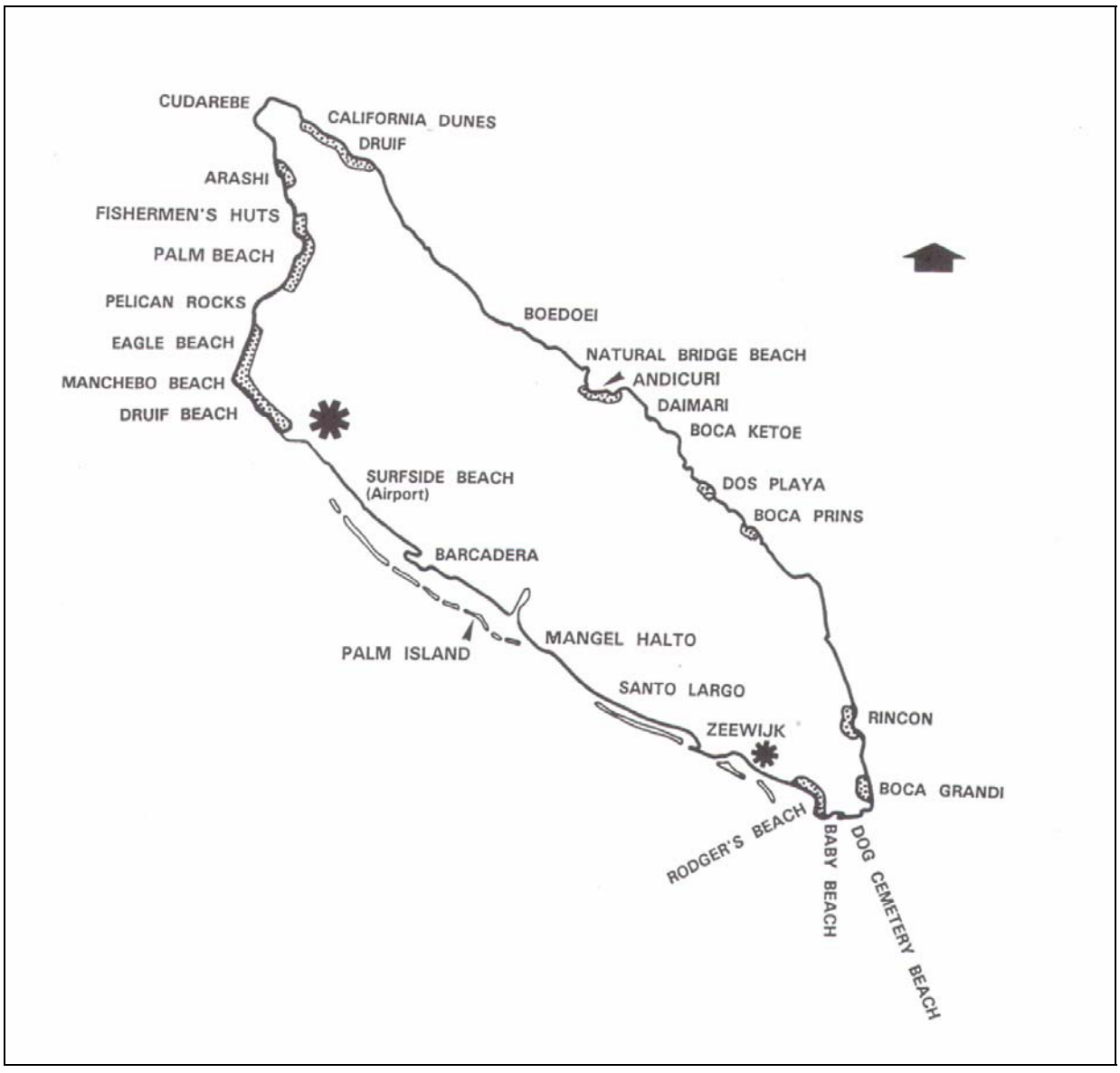


Figure 4. Prominent sandy beaches known or suspected to serve as nesting habitat for endangered marine turtles are indicated by stippling. Aruba's two major population centers, Oranjestad and San Nicolas, are shown as large and small stars, respectively.

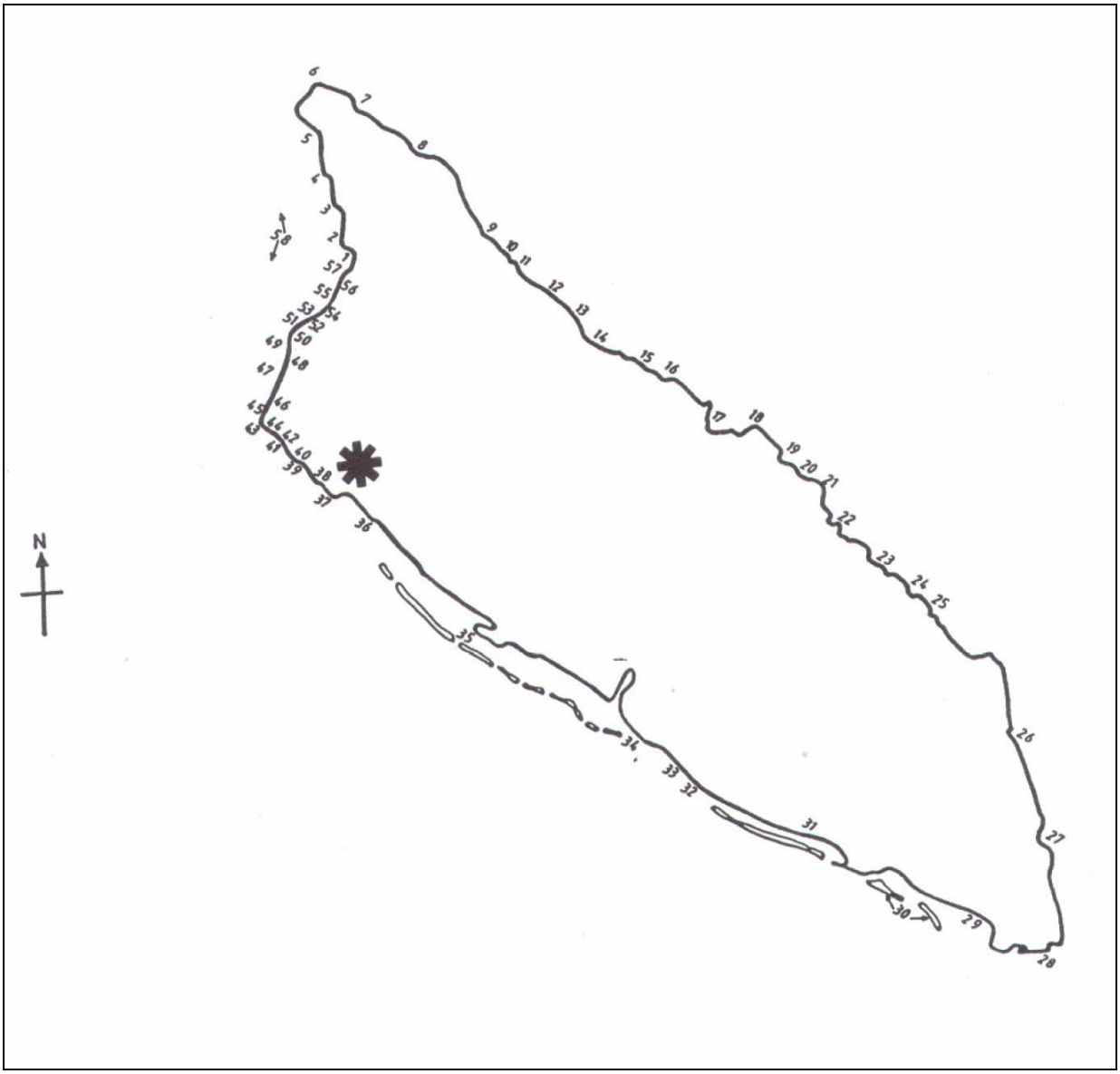
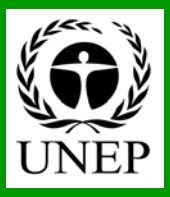


Figure 5. Aruba coastal clean-up zones, September 1993. Zone numbers correspond to locations provided in Table 4. Source: R. de Kort (VROM).

Issued and printed by:



Caribbean Environment Programme

United Nations Environment Programme

Additional copies of this and other publications issued by UNEP's

Caribbean Environment Programme can be obtained from:

Regional Co-ordinating Unit

Caribbean Environment Programme

United Nations Environment Programme

14-20 Port Royal Street

Kingston

Jamaica

Telephone: (1-809) 922-9267 to 9

Telex: 3672 UNEPCAR JA

Telefax: (1-809) 922-9292

Electronic Mail: UNIENET: UNX040 & ENVIRONET: UNE091 & ECONET: UNEPRCUJA

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

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

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

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

*

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

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