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WIDECAST Sea Turtle Recovery Action Plan for the Netherlands Antilles

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 first in a series of Sea Turtle Recovery Action Plans prepared by the Wider Caribbean Sea Turtle Recovery Team and Conservation Network (WIDECAST), an organization comprised of a regional team of sea turtle experts, local Country Co-ordinators, and an extensive network of interested citizens. The objective of the recovery action plan series is to assist Caribbean governments in the discharge of their obligations under the SPAW Protocol, and to promote a regional capability to implement scientifically sound sea turtle conservation programs by developing a technical understanding of sea turtle biology and management among local individuals and institutions. Each recovery action plan summarizes the known distribution of sea turtles, discusses major causes of mortality, evaluates the effectiveness of existing conservation laws, and prioritizes implementing measures for stock recovery. WIDECAST was founded in 1981 by Monitor International, in response to a recommendation by the IUCN/CCA Meeting of Non-Governmental Caribbean Organizations on Living Resources

Conservation for Sustainable Development in the Wider Caribbean (Santo Domingo, 26-29 August 1981) that a "Wider Caribbean Sea Turtle Recovery Action Plan should be prepared ... consistent with the Action Plan for the Caribbean Environment Programme." WIDECAST is an autonomous NGO, partially supported by the Caribbean Environment Programme.

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[1] The WIDECAST regional Recovery Team provided impetus for this document and critiqued earlier drafts. These persons are the following: Lic. Ana Cecilia Chaves (Costa Rica), Dr. Karen Eckert (USA), Jacques Fretey (France), John Fuller (Antigua), Molly Gaskin (Trinidad), Dr. Julia Horrocks (Barbados), Maria Teresa Koberg (Costa Rica), Dr. Peter Pritchard (USA), Dr. James Richardson (USA), and Dr. Georgita Ruiz (Mexico). The IUCN/SSC Marine Turtle Specialist Group (Dr. Karen Bjorndal, Chair) also provided useful comments on an earlier draft. Major financial support for the international WIDECAST project has come from Monitor International, The Chelonia Institute, the UNEP Caribbean Environment Programme, and the U. S. National Marine Fisheries Service.

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ABSTRACT

The Netherlands Antilles consists of five Caribbean islands. The leeward islands are Curaçao and Bonaire, close to the mainland of Venezuela, while the windward islands are St. Maarten, St. Eustatius, and Saba, forming part of the Lesser Antilles archipelago. The sea turtles which are most abundant in the waters of the Netherlands Antilles are the green-back turtle, or *tortuga blanku* (Chelonia mydas) and the hawksbill, or *karet* (Eretmochelys imbricata). This is not surprising, since these species are generally found closely associated with Thalassia sea grass meadows and coral reefs, respectively, and these habitats are widespread in the Netherlands Antilles. The loggerhead, or *kawama* (Caretta caretta) is less common and often encountered further offshore, although it is also present in some of the inner bays, such as Lac Bay in Bonaire. The leatherback, or *driekiel* (sometimes spelled *drikil*) (Dermochelys coriacea) is rare, being present on a seasonal basis to nest. Information from all five islands indicates that sea turtles used to be far more abundant than they are today.

The sea turtle populations which remain in the Netherlands Antilles are stressed for many reasons. A major consideration is the destruction and/or modification of habitat. Almost all nesting beaches have disappeared or have been degraded because of sand mining or commercial and touristic development of the coast; further, beaches are altered or trampled for recreation. Light from nearshore buildings disorients hatchlings, confusing them so that they do not find the sea, while too many people scare the females away. Pollution from both land-based and marine sources (sewage, garbage, and oil) is an increasing problem throughout the Caribbean, and the Netherlands Antilles is no exception. Anchoring and careless diving behavior have degraded coral reef ecosystems and diseases (e.g., natural bleaching, black band disease) have also taken their toll. The extent to which these phenomena have reduced important turtle foraging grounds has not been quantified. Marine turtles are also vulnerable to a tumor disease known as fibro-papillomas which has affected our green turtles and is known to be fatal in other areas. Finally, there is the legacy of more than three centuries of uncontrolled harvest. While progress has been made toward protecting turtles in the Netherlands Antilles, particularly in Bonaire, regulatory mechanisms and enforcement remain inadequate on the whole.

The objective of this document is not only to summarize the status of sea turtles, including agents which may compromise their continued survival, but also to recommend solutions to contemporary stresses. First, it is clear that a more comprehensive knowledge of essential habitats is necessary. This will require systematic surveys of potential foraging and nesting areas. The best areas should be considered for protected status. Within these areas, activities which threaten sea turtles or the habitats upon which they depend should be controlled or prohibited. Specific management plans for important foraging and nesting areas need to be developed and implemented. This will require the involvement of local authorities who have the responsibility to draft regulatory guidelines and provide enforcement. It is of great importance that materials be developed to educate the public (residents, especially fishermen, and tourists) as to why all these measures for the protection of sea turtles are necessary. Such materials should emphasize national pride as well, noting that the Netherlands Antilles is taking its place in the community of Wider Caribbean nations in recognizing the depleted nature of sea turtle stocks, and in working to ensure that these animals do not disappear from our region.

An essential part of protecting sea turtles involves updating national and local laws and regulations. In the Netherlands Antilles, on the national as well as the island levels, much can be done to improve conservation legislation. Some of the islands, especially Bonaire, have good legislation in place to protect sea turtles. Intermediate legislation is in place in Saba; Curaçao, St. Maarten, and St. Eustatius have no legislation whatsoever to protect turtles. Comprehensive island legislation, including provisions for penalty and enforcement, is seen as a priority for the Netherlands Antilles. It is also recommended that relevant international and regional protective legislation (CITES, UNEP Cartagena Convention, and MARPOL) be implemented. Finally, suitable legislation strengthening enforcement is a necessity.

A Netherlands Antilles Sea Turtle Project is proposed with the primary goal of achieving a sustained recovery of depleted sea turtle stocks in the Netherlands Antilles and secondary goals of gathering more data on the local distribution of turtles (especially nesting activity) and promoting a public understanding of why the conservation and recovery of sea turtles in the Netherlands Antilles is necessary. To achieve these goals, complementary action is required at both the island and national levels. It is essential that each island of the Netherlands Antilles implement its own sea turtle project. Because each island has its own local government, non-government organizations (NGOs) and legislation, the implementation of sea turtle conservation and recovery actions will be most effective at the island level. In each case this will require a Lead Organization to support and execute the project, a timetable and budget, a realistic survey and monitoring program to gather data on sea turtle distribution and nesting, lobbying efforts on behalf of improved legislation and enforcement, and increased public awareness and involvement.

In concert with the island projects, action by the Central Government is needed to link the island programs together and to execute important national and international legislation. The government agency responsible for the environment is the Department of Public Health and Environment, which is currently being restructured to place greater emphasis on the environment. As part of an effort at national integration, the Department should (1) urge every island to design and implement a local sea turtle conservation project, (2) follow-up on the island projects and support local organizations, (3) adopt national legislation to protect sea turtles (ideally within the framework of holistic legislation protecting marine resources and the marine environment in general), (4) produce and distribute general information on regulations and the protection of sea turtles, (5) establish communication and information exchange among the islands by means of a newsletter or other mechanism, and (6) raise and allocate funds for local sea turtle conservation. Cooperative programs with neighboring nations should be initiated at the national level.

Using this decentralized approach, it is anticipated that several island programs will be implemented in a relatively short period of time, perhaps by 1995. Specific results and outputs are expected to include (1) comprehensive legislation for each island, as well as at the national level, that protects all sea turtles at all times and major parts of their environment (the latter may be achieved by the designation and support of Marine Parks or other conservation areas), (2) a better knowledge of the distribution and abundance of sea turtles, especially the nesting beaches

of these animals, (3) detailed recommendations to each island government regarding the protection and conservation of suitable nesting beaches (a balance between development and conservation must be sought in this regard), and (4) a better understanding on the part of the citizenry of why it is important to protect and conserve sea turtles for future generations.

SAMENVATTING

De Nederlandse Antillen bestaan uit vijf eilanden. De benedenwindse eilanden Curaçao en Bonaire liggen dicht bij Venezuela, terwijl de bovenwindse eilanden St. Maarten, St. Eustatius en Saba een deel uitmaken van de eilandenboog der Kleine Antillen. De meest voorkomende zeeschildpadden in de wateren van de Nederlandse Antillen zijn de soepschildpad, in het papiaments *tortuga blanku* (Chelonia mydas) en de *karetschildpad* (Eretmochelys imbricata). Dit is geen verrassing omdat deze soorten respectievelijk voorkomen in zeegrasvelden (Thalassia) en koraalriffen. Deze leefgemeenschappen komen algemeen voor in de Nederlandse Antillen. De dikkop, *kawama* in het papiaments (Caretta caretta), is minder algemeen en wordt vaker in open zee gezien, alhoewel hij ook wel in binnenbaaien zoals Lac te Bonaire voorkomt. De lederschildpad, of *driekiel* (soms *drikil*) in het papiaments (Dermochelys coriacea), is zeldzaam. Af en toe wordt deze waargenomen tijdens het nest seizoen. Uit informatie afkomstig van alle vijf eilanden kan worden afgeleid dat zeeschildpadden vroeger veel meer voorkwamen dan vandaag de dag.

De zeeschildpaddenpopulatie die nog te vinden is in de Nederlandse Antillen, staat onder druk door verschillende oorzaken. Een van de belangrijkste aanslagen op zijn voortbestaan is de vernietiging en/of verandering van zijn leefomgeving. Bijna alle neststranden zijn verdwenen of in kwaliteit achteruit gegaan door het weghalen van zand voor constructie doeleinden en de commerciele en toeristische ontwikkeling van de kuststrook; ook worden zandstranden veranderd voor en vertrapt door rekreatie. Verlichting van gebouwen dichtbij de kust desorienteren pas geboren schildpadjes, zodat ze de zee niet meer kunnen vinden, terwijl teveel mensen op het strand de vrouwtjes die eieren willen leggen, wegjagen. Vervuiling, zowel vanaf het land als de zee (ongezuiverd rioolwater, afval en olie), is een toenemend probleem in het gehele Caraibische gebied, waarbij de Nederlandse Antillen geen uitzondering vormt. Ankeren en onvoorzich-tig duiken hebben koraalrif ecosystemen zichtbaar aangetast terwijl ziektes (bv. het verbleken van de koralen, black band disease) hun tol eisen. De reikwijdte van deze aantastingen, die belangrijke fourageergebieden voor de zeeschildpad verminderen, zijn echter niet goed genoeg on-derzocht en in cijfers uitgedrukt. Zeeschildpadden zijn ook gevoelig voor een tumorziekte bekend onder de naam fibropapillomas. Het heeft onze soepschildpad besmet en op andere plaatsen reeds tot sterfte geleid. Ten slotte is er de erfenis van drie eeuwen ongecontrolleerde vangst. Ondanks dat er er vooruitgang is geboekt in de wettelijke bescherming van zeeschildpadden in de Nederlandse Antillen, vooral in Bonaire, zijn de beschermende mechanismen en de uitvoering ervan over het algemeen nog onvoldoende.

Het doel van dit document is niet alleen een overzicht te geven van de zeeschildpadden status en de bedreigingen met betrekking tot hun voortbestaan in de Nederlandse Antillen, maar ook aanbevelingen te doen om de bedreigingen op te heffen. Ten eerste is het duidelijk dat een betere kennis van de belangrijkste leefgebieden van de schildpadden noodzakelijk is. Dit impliceert een systematisch onderzoek naar potentiele fourageer- en nestgebieden. De beste gebieden moeten vervolgens een beschermde status krijgen. In deze gebieden moeten alle handelingen die de schildpadden en hun leefomgeving bedreigen worden gereguleerd of verboden. Er moeten specifieke beheersplannen voor belangrijke fourageer- en nestgebieden worden ontwikkeld en uitgevoerd. Dit vraagt wel de actieve participatie van de lokale autoriteiten die de verantwoor

delijkheid hebben voor het opstellen van regelgeving en de uitvoer van controle. Het is van groot belang dat educatief materiaal wordt ontwikkeld voor het publiek (inwoners van de eilan-den, vissers in het bijzonder en toeristen) om hun de zin van deze maatregelen ter bescherming van zeeschilpadden uit te leggen. Het educatief materiaal moet nadruk leggen op nationale trots, waarin tot uiting komt dat de Nederlandse Antillen hun steentje bijdraagt binnen de Caraibische gemeenschap in het besef dat zeeschildpaddenpopulaties sterk zijn verminderd en dat er hard aan gewerkt wordt dat deze dieren niet voor altijd uit de regio verdwijnen.

Een belangrijk aspect betreffende de bescherming van zeeschildpadden is het updaten van nationale en lokale wetgeving. In de Nederlandse Antillen, zowel op nationaal als lokaal nivo, kan nog veel gedaan worden aan de verbetering van natuurbeschermende wetgeving. Sommige eilanden, in het bijzonder Bonaire, hebben goede bestaande wetgeving om zeeschildpadden te beschermen. Redelijke bescherming is te vinden op Saba. Curaçao, St. Maarten en St. Eustatius hebben echter helemaal geen beschermende wetgeving voor zeeschildpadden. Goede wetgeving, inclusief mogelijkheden tot controle en het geven van zware straffen, is een prioriteit voor de Nederlandse Antillen. Aan te bevelen is ook de uitvoering van relevante internationale en regionale beschermende wetgeving (CITES, UNEP Cartagena Conventie en MARPOL). Ten slotte, is het noodzakelijk dat de controle wordt versterkt. Milieu overtredingen moeten zwaar gestraft kunnen worden.

Dit document beveelt een zeeschildpaddenproject voor de gehele Nederlandse Antillen aan. Primair doel is het herstel van sterk verminderde zeeschildpaddenpopulaties in de Neder-landse Antillen. Secundaire doelen zijn het verzamelen van meer gegevens over de lokale ver-spreiding van deze dieren (vooral mbt het leggen van eieren) en het stimuleren van publiek begrip waarom de bescherming en het herstel van zeeschildpaddenpopulaties in de Nederlandse Antillen noodzakelijk is. Om deze doelstellingen te bereiken zullen zowel op eilandelijk nivo als nationaal nivo aktiviteiten moeten worden ontplooid. Het is belangrijk dat elk eiland van de Nederlandse Antillen zijn eigen zeeschildpaddenproject uitvoert. Omdat elk eiland zijn eigen overheid, eigen natuurinstellingen en eigen wetgeving heeft, zal de uitvoer van zeeschildpadden bescherming en herstel het meest effectief zijn op eilandelijk nivo. Dit heeft als consequentie dat er op elk eiland een voortrekkersorganisatie moet worden geidentificeerd die het eilandelijke schildpaddenproject opstelt, uitvoert en een tijdschema en budget vastgelegt. Het project moet bestaan uit een realistisch onderzoeks en monitorprogramma om gegevens te verzamelen over schildpaddenverspreiding en nestgedrag, lobby-activiteiten ter verbetering van wet- en regelge-ving, controle van bestaande wetgeving en educatie ter verbetering van de kennis en inzet van het publiek.

Samen met de eilandelijke projecten, zal actie van de centrale overheid noodzakelijk zijn om de diverse projecten aan elkaar te koppelen en om belangrijke nationale en internationale wetgeving uit te voeren. Binnen de centrale overheid is het departement van volksgezondheid en milieuhygiene (VOMIL) hiervoor verantwoordelijk. Dit department ondergaat momenteel een volledige reorganisatie waarbij meer nadruk gelegd wordt op het milieu. Het departement VOMIL moet pressie uitoefenen op elk eiland om een eigen project ter bescherming van de zee-schildpadden op te stellen en uit te voeren. Het zal follow up aan deze projecten moeten geven en daar waar nodig hulp bieden aan lokale organisaties op dit gebied. Tevens zal het nationale

wetgeving ter bescherming van zeeschildpadden moeten concipieren (ideaal zou zijn indien ditdeel uitmaakt van een algehele aanpak ter bescherming van mariene hulpbronnen en het mariene milieu). Ook moet een systeem van algemene informatie en communicatie tussen de eilanden worden opgezet door middel van bv. een zeeschildpaddennieuwsbrief of ander mechanisme. Het aanboren en verspreiden van fondsen voor lokale projecten ter bescherming van de schild-padden behoort oa. ook tot de taken van het departement VOMIL. Verder zal op nationaal nivo een samenwerkingsverband met omringende landen moeten worden gestart.

Deze gedecentraliseerde aanpak geeft de mogelijkheid dat sommige eilanden hun projec-ten binnen betrekkelijke korte tijd kunnen uitvoeren, bijvoorbeeld uiterlijk 1995. Verwachte specifieke resultaten zijn: (1) goede eilandelijke en nationale wetgeving die alle levensstadia van zeeschildpadden en de grootste delen van hun leefomgeving ten alle tijden beschermt (het laatste kan bv. worden bereikt door de instelling van onderwaterparken of beschermde mariene gebieden), (2) een betere kennis van de verspreiding en het voorkomen van zeeschildpadden (in het bijzonder met betrekking tot de stranden waar ze nesten), (3) gedetailleerde aanbevelingen naar alle eilandgebieden toe hoe de neststranden het beste beschermd en bewaard kunnen blijven (hierbij zal naar een evenwicht tussen ontwikkeling en bescherming moeten worden gezocht) en (4) een beter begrip vanuit de burgerij waarom het noodzakelijk is om zeeschildpadden te beschermen voor het nageslacht.

RESUMEN

Las Antillas Holandesas comprenden cinco islas del Caribe. Curaçao y Bonaire, ubicadas cerca de Venezuela continental, constituyen las Islas de Sotavento; San Martín, San Eustasio y Saba que forman parte del archipielago de las Antillas Menores constituyen las Islas de Barlovento. Las tortugas marinas que más abundan en el mar de las Antillas Holandesas son la tortuga de caparazón verde o *tortuga blanku* (Chelonia mydas) y la tortuga carey o *karet* (Eretmochelys imbricata). Esto no es sorprendente dado que estas especies normalmente se asocian con los prados de yerba marina Thalassia y los arrecifes coralinos respectivamente, y estos habitats son comunes en las Antillas Holandesas. La tortuga de mar o *kawama* (Caretta caretta) es menos común y a menudo se encuentra más lejos de la costa, aunque también aparece en algunas de las bahías interiores tales como Lac Bay en Bonaire. La tortuga barriguda o *driekel* (a veces escrita *drikil*) (Dermochelys coriacea) es poco común y sólo viene durante la estación de anidar. Según la información de las cinco islas, la población de tortugas marinas solía ser mucho mayor que la de hoy.

Las poblaciones de tortugas marinas que aún existen en las Antillas Holandesas sufren de muchas presiones de distintos índoles. Una consideración importante es la destrucción y/o modificación del habitat. Casi todas las playas que sirven de anideros han desaparecido o han sido degradadas a causa de la minación de la area o el desarrollo comercial y turístico de la costa. Además, las playas o son pisoteadas o transformadas para fines recreativos. Las luces de los edificios desorientan a los recién nacidos que se confunden y no logran ubicar el mar mientras que hay demasiadas personas que amedrentan a las hembras. La contaminación causada por fuentes tanto terestres como marinas (desechos, basura e hidrocarburos) representa un creciente problema para toda la región Caribeña sin excluir las Antillas Holandesas. El anclaje y el comportamiento desconsiderado de los buceadores han degradado los ecosistemas de arrecifes coralinos y las enfermedades (por ejemplo la descoloración natural o la banda negra) también han contribuido a este efecto. No se ha medido el grado hasta el cual estos fenómenos han reducido la extensión de terreno utilizada para el forraje. Las tortugas marinas también son vulnerables a una enfermedad tumorosa conocida como fibro-papillomas que ha afectado las tortugas verdes y ha sido fatal en otras áreas. Hay una tradición de más de tres siglos de cosecha vigilada. A la vez que ha habido progreso en los esfuerzos para proteger las tortugas en las Antillas Holandesas especialmente en Bonaire, por lo general los mecanismos reglamentarios y la aplicación de los mismos siguen siendo inadecuados.

El objetivo de este documento no sólo es resumir el estado de las tortugas marinas donde se incluirá a los agentes que puedan perjudicar su sobrevivencia continuada sino también recomendar soluciones para las tensiones contemporáneas. Primero, la necesidad de un conocimiento más comprensivo de los habitats esenciales es evidente. Para esto, se requieren encuestas sistemáticas tocante las posibles áreas de forraje y anidamiento de las cuales las mejores deberán considerarse para el estado de protegidas. Dentro de estas áreas, se deberá controlar o prohibir aquellas actividades que amenacen las tortugas marinas o los habitats de los cuales dependen. Hace falta diseñar e implementar planes específicos de forraje y anidamiento. Para esto se requiere la participación de las autoridades locales quienes tienen la responsabilidad de directrices reglamentarias y la aplicación de las mismas. Es de suma importancia diseñar

material para la educación del público (residentes, especialmente pescadores y turistas) con respecto a la necesidad de tantas medidas para la protección de las tortugas marinas. Tal material también debería destacar el orgullo nacional, señalando que las Antillas Holandesas están ocupando su debido lugar dentro de la comunidad de las naciones del Gran Caribe al reconocer la reducción en las existencias de tortugas marinas y al luchar para que estos animales no desaparezcan de la región.

La protección de las tortugas marinas involucra de modo esencial la actualización de las leyes y los reglamentos nacionales y locales. En las Antillas Holandesas, tanto a nivel nacional como insular mucho se puede hacer para mejorar la legislación en materia de la conservación. Algunas de las islas, particularmente Bonaire, tienen buena legislación para la protección de la tortuga marina. En Saba, hay legislación intermedia; en Curaçao, San Martín y San Eustasio no hay legislación ninguna para la protección de las tortugas. Las Antillas Holandesas tienen como prioridad, una legislación comprensiva para las islas, que incluye disposiciones para el castigo y su ejecución. También se recomienda la aplicación de la legislación regional e internacional pertinente a la protección (CITES, el Convenio de Cartagena de PNUMA y MARPOL). Finalmente, la aplicación apropiada de legislación consolidada es una necesidad. Las violaciones ambientales han de castigarse hasta cumplir con los límites de la ley.

Se propone un Proyecto de la Tortuga Marina de las Antillas Holandesas con el objetivo primordial de lograr la recuperación sostenida de las existencias reducidas de tortugas marinas en las Antillas Holandesas y el objetivo secundario de la recopilación de mayores datos sobre la distribución local de tortugas (el anidamiento en particular) y la promoción de la comprensión de parte del público de la necesidad de conservar y recuperar las tortugas marinas en las Antillas Holandesas. El logro de estos objetivos depende de la acción complementaria a nivel nacional y de cada isla. Es menester que cada isla de las Antillas Holandesas implemente su propio proyecto de tortuga marina. Dado que cada isla cuenta con su propio gobierno local, organizaciones no gubernamentales (ONG) y legislación, la ejecución de la conservación de la tortuga marina y las actividades de recuperación serán más eficaces a nivel insular. En cada caso, hará falta un Organismo Principal que apoyará y ejecutará el proyecto, un horario y presupuesto, una encuesta realista y un programa de supervisión para recopilar información sobre la distribución y aridamiento de la tortuga marina, acción de cabrildeo a favor de mayor legislación y ejecución y mayor conciencia y participación del público.

En concierto con los proyectos de las islas, es necesaria la acción de parte del Gobierno Central para enlazar todos los proyectos insulares y ejecutar legislación nacional e internacional de envergadura. La agencia gubernamental a cargo de asuntos ambientales es el Departamento de Salud Pública y Medioambiente que está en el proceso de reestructurarse para prestar mayor atención al medioambiente. Con motivo de la integración nacional, el Departamento debería (1) instar cada isla a diseñar y ejecutar un proyecto a nivel local para la conservación de la tortuga marina, (2) el seguimiento de los proyectos de las islas y el apoyo a las organizaciones locales dentro de lo posible, (3) adoptar legislación nacional para proteger las tortugas marinas (idóneamente dentro del marco de la legislación holista para la protección de los recursos marinos y el ambiente marino en general), (4) producir y distribuir información general sobre los reglamentos y la protección de las tortugas marinas, (5) establecer el intercambio de

comunicaciones e información entre las islas por medio de un boletín de noticias u otro mecanismo y (6) recaudar y distribuir fondos para los proyectos de conservación de las tortugas marinas locales. Además de eso, se debería iniciar programas cooperativos con los pueblos naciones vecinos a nivel nacional.

Con este enfoque decentralizado, se anticipa que varios programas insulares serán ejecutados dentro de muy poco, quizás para 1995. Entre los resultados y vendimientos específicos a esperarse, figuran (1) la legislación comprensiva tanto a nivel insular como nacional para la protección permanente de la población entera de tortugas marinas y áreas extensivas de su habitat (éste último se puede lograr con la designación y mantenimiento de Parques Marinos u otras áreas protegidas), (2) mayor conocimiento de la distribución y población de tortugas marinas, especialmente las playas donde anidan estos animales, (3) recomendaciones detalladas a todos los gobiernos de las islas tocante la protección y conservación de playas propicias para el anidamiento (debe buscarse el equilibrio entre el desarrollo y la conservación), y (4) mayor concientización de parte de los ciudadanos con respecto a la importancia de la protección y conservación de la población de tortugas marinas para las generaciones futuras.

RESUME

Les Antilles néerlandaises se composent de cinq îles des Caraïbes. D'une part, les îles sous-le-vent sont Curaçao et Bonaire, qui sont près du Venezuela sur le continent, et d'autre part, les îles du-vent qui sont St. Maarten, St. Eustatius et Saba, et qui font toutes partie de l'Archipel dont se composent les petites Antilles. Les tortues de mer qui abondent dans les eaux baignant les Antillees néerlandaises sont les tortues vertes ou *tortuga blanku* (Chelonia mydas) et les tortues à écaille ou *karet* (Eretmochelys imbricata). Ceci est tout à fait normal puisque ces deux espèces se trouvent souvent dans les eaux où poussent les champs d'herbes marines Thalassia et des coraux respectivement, et en effet, les Antilles néerlandaises favorisent une prolifération de tels habitats. On rencontre moins fréquemment, les caouans, ou *kawama* (Caretta caretta), qui se trouvent plutôt au large des côtes quoiqu'on les trouve aussi dans les eaux des baies intérieures, telles que le Lac Bay à Bonaire. On trouve plus rarement les tortues à cuir, ou *driekiel* (qui s'écrit aussi *drikil*) (Dermochelys coriacea), qui viennent, seulement pondre leurs oeufs de manière saisonnière. Les informations recueillies de toutes les cinq îles indiquent que les tortues de mer étaient jadis beaucoup plus abondantes qu'elles ne le sont aujourd'hui.

Les populations de tortues de mer qui existent encore dans les Antilles néerlandaises subissent des pressions à cause de diverses raisons. Une cause majeure est la destruction et/ou la modification de leurs habitats. La plupart des plages à nicher ont disparu ou bien elles ont été détruites à la suite de l'exploitation des mines de sable et des activités de développement liées au commerce et au tourisme dans les zones côtières. En outre, les plages subissent des modifications du fait de la mise en place des installations de récréation, et de l'épuisement des terrains, suite à une forte présence de promeneurs. La lumière émanant des bâtiment construits près de la côte désoriente les nouveaux-nés en les empêchant de trouver le chemin qui mène à la mer, et parallèlement, un très grand nombre de promeneurs effrayent les femelles. La pollution émanant de l'intérieur des îles aussi bien que celle d'origine marine (telles que les boues d'égoût, les ordures et le pétrole) accentuent le problème dans toute la Caraïbe; à ceci les Antilles néerlandaises ne font pas exception. La pratique consistant à jeter l'ancre et à plonger d'une manière fort insouciante entraîne la dégradation des ecosystèmes des ris de coraux. En plus, les maladies (telles que l'amiante nature, et la maladie au ruban noir) ont aussi fait des dégâts. On n'a pas encore quantifié à quel point ces phénomènes ont contribué à beaucoup diminuer les terrains d'alimentation des tortues. Les tortues de mer se trouvent aussi fort susceptibles d'attraper une tumeur, connue sous le nom de fibro - papillomas, laquelle a frappé nos tortues vertes et s'avère mortelle dans d'autres régions. Et enfin, on doit aussi tenir compte d'un héritage de plus de trois cents ans de la chasse aux tortues incontrôlée. Alors que des progrès ont été réalisés dans le domaine de la protection des tortues aux Antilles néerlandaises, et surtout à Bonaire, les mécanismes régulatoires et la mise en oeuvre restent en général insuffisants.

Ce document n'a pas pour but unique de résumer le statut des tortues de mer, y compris les agents qui sont susceptibles de compromettre la survie continue de celles-ci; il préconise aussi des solutions pour combattre les pressions actuelles. D'abord, il est clair qu'il faut une connaissance plus exhaustive des habitats et ceci nécessitera des enquêtes systématiques des terrains potentiels d'alimentation et de nichage. Il faudrait envisager la possibilité d'accorder un statut de protection aux meilleures zones et à l'intérieur de celles-ci; il faudrait contrôler ou

interdire toute activité susceptible de menacer les tortues de mer ou les habitats dans lesquels elles s'alimentent. Des projets spécifiques de gestion. Relatifs aux zones d'alimentation et de nichage de grande importance doivent être développés et exécutés. Ceci nécessitera la participation d'autorités locales qui devront formuler des principles régulatoires et être chargées de leur mise en oeuvre. Il importe que des programmes de sensibilisation du public (c.à d. les résidents, en particulier, les pêcheurs et les touristes) soient mis en place pour leur expliquer la nécessité des mésures qui visent à protéger les tortues de mer. De tels programmes doivent aussi mettre l'accent sur la fierté nationale, et doivent souligner le fait que les Antilles néerlandaises sont en train de prendre leur place au sein de la Communauté des nations de la région des Caraïbes et de reconnaître que les populations des tortues de mer s'épuisent et d'oeuvrer pour assurer que ces animaux ne disparaissent pas complètement de la région. Un volet important de la protection des tortues de mer comporte la mise à jour des lois et des réglements tant à l'échelle nationale que régionale. Aux Antilles néerlandaises insulaires, il reste beaucoup à faire en ce qui concerne l'amélioration de la législation en matière de conservation. Quelques-unes des îles, en particulier, Bonaire, ont d'excellentes lois en place qui servent à protéger les tortues de mer. Une législation intermédiaire est en place à Saba; mais à Curaçao, Saint Maarten et Saint Eustatius, il n'existe aucune législation pour protéger les tortues. On reconnaît qu'une législation complète des îles y compris les dispositions relatives à mise en vigueur et aux sanctions s'avère prioritaire pour les Antilles néerlandaises. On recommande aussi que soient mises en oeuvre des lois appropriés en matière de protection régionale et internationale (CITES, et la Convention de Carthagène du PNUE et MARPOL). Et enfin, une législation adéquate capable de renforcer la mise en application est une nécessité. Les atteintes portées à l'environnement doivent être punies avec toute la force du droit.

Une recommendation a été formulée en ce qui concerne la mise en place d'un projet des Antilles néerlandaises relatif aux tortues de mer; elle aurait pour but principal de réaliser la récupération soutenue des populations de tortues de mer épuisées, avec, pour but secondaire, de recueillir davantage d'informations sur la distribution locale des tortues. (surtout concernant les activités de nichage) et de promouvoir à l'intention du public les raisons pour lesquelles la conservation et la récupération des tortues de mer s'avèrent nécessaires aux Antilles néerlandaise. Pour atteindre ces buts, une action complémentaires s'impose aux niveaux tant insulaire que national. Il faut que chacune des îles qui constituent les Antilles néerlandaise mettre en place son propre projet en ce qui concerne les tortues de mer. Puisque chaque île est dotée de son gouvernement local, de ses organisations non2Dgouvernementales (les ONGs) et de sa législation, c'est à ce niveau-ci que des actions qui visent à la conservation des tortues de mer et à la récupération de celles-ci seront les plus efficaces. Dans chaque cas, ceci nécessitera une Organisation Motrice afin de fournir l'assistance et d'exécuter le projet, de dresser un emploi du temps et un budget, et de réaliser une enquête réaliste et un programme de surveillance afin de recueillir les informations relatives à la distribution et aux pratiques de nichage des tortues de mer. Il faut aussi des initiatives au niveau des groupes de pression pour obtenir une amélioration en matière de législation et d'exécution et pout mieux sensibiliser et faire participer le public.

Parallèlement aux projets relatifs aux îles, une action de la part du gouvernement central est nécessaire afin de coordoner tous les programmes concernant les îles et de mettre en application une législation importante tant à l'échelle nationale qu'internationale. L'organe gouvernemental

chargé de l'environnement est le Department de la Santé Publique et de l'Environnement. Ce department est en train d'être restructuré, afin de mettre l'environnement plus en valeur. Dans le cadre des efforts déployés en matière d'intégration nationale, le department doit: (1) encourager chaque île à mettre en application un projet local de conservation des tortues de mer, (2) assurer le suivi des projets relatifs aux îles et dans la mesure du possible, apporter un appui aux organisations locales, (3) adopter une législation à l'échelon national afin de protéger les tortues de mer (le mieux serait de le faire dans le cadre de la législation holis-tique qui sert à protéger d'une facon générale les resources marines et l'environnement marin), (4) produire et disséminer des informations générales sur les règlements et la protection des tortues de mer, (5) etablir la communication et l'échange d'informations entre les îles, grâces à un bulletin ou à un autre moyen, (6) se procurer des fonds et les allouer pour le financement des projets locaux de conservation des tortues marines. En outre, des programmes de coopération avec les nations voisines doivent être initiés au niveau national.

En utilisant cette approche de décentralisation, on anticipe que plusieurs programmes seront mis en place dans les îles dans un d'élai relativement court, d'ici à 1995 peut-être. On s'attend à ce que des résultats et des actions spécifiques comportent: (1) une législation exhaustive pour chaque île, aussi bien qu'à l'échelon national, visant à protéger toutes les tortues de mer à tout moment ainsi que la majeure parties de leur environnement (ceci peut être réalisé en désignant et en appuyant les Parcs Marins ou d'autres zones de conservation), (2) une meilleure connaissance de la distribution et de l'abondance des tortues de mer, en particulier les plages à nichage de celles-ci, (3) des recommendations détaillées à l'intention des gouvernements de chaque île en matière de protection et de conservation des plages de nichage appropriées (un équilibre entre développement et conservation doit être recherché à cet égard) et, (4) une connaissance plus profonde de la part des citoyens en ce qui concerne l'importance de la protection et de la conservation des tortues de mer pour les générations futures.

I. INTRODUCTION

1.1 General Description of the Netherlands Antilles

The Netherlands Antilles consists of five islands 1/ (Figure 1) which are inhabited by approximately 200,000 people. Curaçao and Bonaire are known as the Leeward Islands, described in the WATS I [First Western Atlantic Turtle Symposium] Proceedings (Van Buurt, 1984) as "Netherlands Antilles South". In contrast, St. Maarten, St. Eustatius and Saba are the Windward Islands of the Netherlands Antilles, or "Netherlands Antilles North".

Curaçao (12°10'N, 68°18'W), the largest island in the Netherlands Antilles, has a land area of 444 km^2 (Figure 2). It is the most populated with 150,000 people. It is the center of the Central Government and generates income through oil refining, harbor activities (container movements, drydock facilities), offshore banking and finance, and tourism. The coastal zone consists of a steep rocky north coast with rough water and a quieter south coast, also consisting of rocky shores but intersected by natural harbors and both rubble and sandy beaches. The entire coast supports healthy fringing reefs that are best developed along the south coast. Ten kilometers to the southeast of the east point of Curaçao lies a small island called Klein Curaçao. It is uninhabited with a long sandy beach and is infrequently visited by fishermen.

Bonaire (12°12'N, 68°77'W) has a land area of 288 km^2 (Figure 3) and a population of 10,500 inhabitants. The island is very similar to Curaçao, both physically and culturally. As in Curaçao, the language is Papiamentu. Bonaire has a small oil terminal for transshipment, the International Salt Company (AKZO), and a well developed diving tourism industry. In 1990, some 15,000 divers made 150,000 dives (source: Bonaire Tourist Office). The coral reefs are among the best developed in the Caribbean Sea. The island has several sandy beaches.

The Dutch part of St. Maarten (18°05'N, 63°03'W) consists of 34 km^2 of land (Figure 4) and 30,000 inhabitants. The other half of the island, St. Martin, is French. The island has developed in recent years into a thriving tourist destination; the beaches on the southern coast are among the most commercially developed in the Eastern Caribbean. At the present time, stay-over tourists number about 400,000 per year (Central Bureau of Statistics, 1989). The is-land has several sheltered sandy beaches. Offshore, the substrate is sandy with turtle sea grass (Thalassia testudinum). In certain places there are well developed coral reef patches.

St. Eustatius (17°30'N, 63°00'W) has a land area of 21 km^2 (Figure 5) and is inhabited by only 1,500 persons. Its cultural history can easily be traced through the artifacts found all over the island and in offshore areas. The island has some sandy beaches. The southwest coast has well-developed coral reef ridges, interspersed with sandy channels. Some shallow coral patches can be found at Jenkins Bay and Kay Bay. On the Atlantic side there is some coral development on steep slopes near shore; in deeper water, coral patches and ridges occur in a mixed coral, sponge and algae community.

1/ Aruba was formerly a part of the Netherlands Antilles. However, as of 1 January 1986, Aruba acquired a "Status Aparte" within the Kingdom of Holland. A separate WIDECAST Sea Turtle Recovery Action Plan will address the situation of sea turtles in Aruba.

Saba (17°38'N, 63°14'W), the smallest island, has 13 km^2 of land area (Figure 6) and a

population of about 1,100. Saba is a steep, dormant volcano. The island is surrounded by well developed fringing reefs and has two seasonal beaches (from about April to October), Wells Bay and Cave of Rum Bay. Both the islands of Saba and St. Eustatius are in proximity to the Saba Bank. This shallow underwater bank has some well developed coral reefs and algae fields. According to Saba fishermen, both habitats (reef and algae) serve as feeding grounds for green turtles and hawksbills.

1.2 Historical Overview of Sea Turtles

Sea turtles have never been described as abundant in the Netherlands Antilles, nonetheless they provided an important source of protein in the form of meat and eggs for many generations. In a report describing animal remains from Indian sites on Aruba, Hooijer (1960) stated that "these remains relate for the most part to marine turtles (Chelonia mydas L. and Caretta caretta L.), indistinguishable from the recent forms today living in the Caribbean Sea, but they do include also a small number of bones of mammals." The use of sea turtles for food continued after European colonists arrived. Hermans (1961) remarked that while sea turtle populations around Curaçao were not large, there were sufficient numbers of turtles brought ashore for slaughter that on 8 October 1737 the Governor declared it illegal to kill them in the streets, further requiring that the slaughter take place outside the city. The decree was in response to complaints from wealthy residents that the stench was unbearable. Two and a half centuries later, the legacy of persistent exploitation is the fact that there are many places where turtles could once be found, but today they are either absent or rare. Indeed, Hermans (1961) concedes it is rather miraculous they have survived at all.

By the middle of the twentieth century, turtles were considerably harder to find than they had been in the past. According to Hermans (1961), most were by then being harvested from the waters of Venezuela, probably from Islas los Roques. Obtaining turtles from Venezuela was not new to the people of the Netherlands Antilles. In early 1643, the Director of the West Indian Company (Island Administrator) noted that there was not much to eat on Curaçao and he sent a company of men to Klein Curaçao to obtain a few turtles. Soon thereafter, on 14 April 1643, he ordered vessels sent to Isla Aves and Islas los Roques to see whether any turtles could be obtained, for he had heard that the turtles were "fairly abundant during the months May and June." Again on 19 May men were deployed to Islas Aves and Islas los Roques to find food.

Turtles brought home from Isla Aves in the seventeenth and eighteenth centuries were likely to be breeding animals, but it appears that by the mid 1900's the catch was primarily composed of juveniles and subadults. Hermans (1961) reported that the average shell length and width for green turtles brought to the Curaçao slaughterhouse was 83.50 cm and 66.75 cm, respectively. According to a local veterinarian, the sample from which this mean size was derived was composed of turtles a little larger than normally seen at the facility. Hermans also calculated, using data obtained from three turtles (55, 79, 98 kg) examined at the slaughterhouse, that green sea turtles were composed, on average, of 61.7% edible components. Numbers of turtles killed per annum during the mid-1950's are provided in Table 1. Of course these data represent only a fraction of the total number of turtles harvested throughout the Netherlands Antilles during these years, as Table 1 pertains only to Curaçao.

Table 1. Number of sea turtles killed at the Curaçao slaughterhouse, 1955-1959.

The ratio of green to hawksbill turtles was not provided, but it is assumed that most were green turtles. Mean weight of the turtles was 75 kg (from Hermans, 1961).

Year	Turtles killed
1955	116
1956	105
1957	104
1958	100
1959	105

Green turtles were generally preferred for consumption, though young hawksbills were considered better eating in some areas (e.g., Banda Abau, Curaçao) and in Willemstad the meat of both species was available in the market with no distinction made between them (Hermans, 1961). With the decline of wild stocks, meat became more expensive and was no longer predictably available in the markets. Turtles were sometimes seen languishing alive in market ponds, awaiting purchase and slaughter, perhaps because the price was out of reach for most consumers. Significant efforts were eventually made to rear sea turtles in captivity. According to a colonial report (1915, cited but unreferenced *in* Hermans, 1961), part of Spaanse Bay in Curaçao was closed off to retain captive green turtles for experimental breeding purposes. The animals were, however, subsequently released when they ran out of food.

The local government of Curaçao had a genuine interest in the possible cultivation of sea turtles during the middle of this century. Therefore, CARMABI did some preliminary research on sea turtles when it was established in 1955. However, this work never developed beyond the initial phase (Kristensen, 1980). Similarly, there were efforts in Bonaire to cultivate sea turtles. According to Hermans (1961), about 100 turtles were confined to an inner bay with the intent of rearing them for food. He did not provide dates for this venture, but he did note that Bonaire had so depleted its turtle supply that the demand for meat and eggs gave impetus to serious attempts at captive breeding. All such attempts failed, however, and today there are no plans to engage in what are characteristically expensive and low yield propagation schemes with turtles.

The slaughterhouse in Curaçao is active to the present day, but only occasionally are sea turtles processed there. The latest data available as to the number of turtles killed at the facility are from Van Buurt (1984), who presented records from the late 1970's to the Western Atlantic Turtle Symposium held in Costa Rica in 1983 (Table 2). Today the catch is difficult to estimate because turtles are obtained largely opportunistically and there is no mechanism for record-keeping. Turtles are netted, speared (though this is illegal), and sometimes grabbed by hand by fishermen fishing with hand lines. Nets are confined mostly to sheltered, inner bays since the currents are strong in open water and there is a great risk of damage to the nets from increasing boat traffic around the islands (Van Buurt, pers. comm., 1991). Gill nets of 12-15 cm mesh are used in Lac Bay, Bonaire, and target both fishes and turtles. Turtles which are brought ashore bring as much as NAf. 500 for a large animal. For a summary of what is known of the present level of harvest, see section 3.3.

Table 2. Number of sea turtles killed at the Curaçao slaughterhouse, 1977-1981.

Green turtles, hawksbills, and loggerheads are included (from Van Buurt, 1984).

Year	Turtles killed
1977	16
1978	31
1979	13
1980	14
1981	7

1.3 Contemporary Efforts on Behalf of Sea Turtles

For the First Western Atlantic Turtle Symposium (WATS I), held in Costa Rica in 1983, Gerard Van Buurt, Netherlands Antilles national fisheries officer, sent in 1981 an *ad hoc* report based on his knowledge of the sea turtle situation in all the Netherlands Antilles islands (Van Buurt, 1984). Soon thereafter, Anne Meylan published a paper entitled "Marine Turtles of the Leeward Islands, Lesser Antilles" (Meylan, 1983) which summarized information on sea turtles in St. Maarten, St. Eustatius, and Saba.

In 1985, the first formal contacts were established between CARMABI (formerly the Caribbean Marine Biological Institute; now an ecological institute pursuing both terrestrial and marine research on behalf of nature conservation and management) and WIDECAST (the Wider Caribbean Sea Turtle Recovery Team and Conservation Network). CARMABI agreed to join the regional WIDECAST project, and to formulate a Sea Turtle Recovery Action Plan for the Netherlands Antilles. Because at that time no one was actively engaged in sea turtle research and available data were out-dated and scarce, CARMABI began collecting basic data on all the islands through a volunteer WIDECAST network. Jeffrey Sybesma, marine biologist and Manager of the Curaçao Underwater Park, was selected to be the Executive Coordinator of WIDECAST in the Netherlands Antilles.

In 1986, with the assistance of Quirino Richardson (Netherlands Antilles representative of IOCARIBE), CARMABI received a grant from the Secretary of the Second Western Atlantic Turtle Symposium (WATS II) to collect recent data on the different sea turtles and their situation in the Netherlands Antilles. The results were later presented at the WATS II meeting in Mayagüez, Puerto Rico, in early October 1987 (Sybesma, 1987). CARMABI assigned Jeffrey Sybesma to act as Coordinator of the Netherlands Antilles Sea Turtle Project. The new network of sea turtle volunteers on each major island continued to regularly collect sea turtle data and to draw public attention to sea turtles. Additional and valuable information was gathered from carefully designed interviews with fishermen. By visiting marketplaces, sea food restaurants and souvenir shops, further knowledge was compiled. Dive operators were asked to stimulate all divers to record sightings of turtles and local dive clubs were encouraged to inform the net-work about their encounters with sea turtles. The media (radio, television, newspapers) was also used to motivate the public to send in turtle information.

After providing network participants on all major islands with information on sea turtle identification and behavior, the Project Coordinator distributed questionnaires according to the WATS I Manual (Pritchard et al., 1983) and asked participants to gather all available data. In

Saba, Bonaire, and Curaçao, data on sea turtle sightings were also collected. The period of data collection was August 1986 to September 1987. From 10-17 March 1987, the Coordinator visited the islands of St. Maarten, St. Eustatius, and Saba. He met with all network members and personally verified the information he received. Saba, in particular, was carefully examined by organizing several dives around the island, a visit with local fishermen to the Saba Bank, and extensive talks with dive operators and Marine Park personnel. From 12-13 March 1987, the Coordinator visited Bonaire and met with network members, fishermen, park personnel, and dive operators. Data from Curaçao were gathered by the Coordinator himself during the course of the year. Island visits were made possible through a WATS II grant.

In July 1988 and in June 1991, CARMABI sponsored visits to Curaçao by Dr. Karen Eckert of WIDECAST. The 1991 visit also included travel to Bonaire, at which time very useful information was received from government and non-government personnel about the status of sea turtles on that island. During these visits, the draft Sea Turtle Recovery Action Plan was critiqued, expanded, and improved. Now, in final form, the Action Plan includes the most up-to-date information on the distribution and status of sea turtles in the Netherlands Antilles, a discussion of the threats to their survival, recommendations for their conservation, and a summary of the national and international legal responsibilities of the government toward sea turtles. While there are still several gaps in our knowledge, it is hoped that this document will provide information and impetus to those in the Netherlands Antilles who are interested in improving the plight of sea turtles in our waters and throughout our region.

II. STATUS AND DISTRIBUTION OF SEA TURTLES

Zoogeographically, the Leeward Islands are grouped with the Guianas, Venezuela, Colombia, and all the other islands near the mainland of northeastern South America. In contrast, the Windward islands are grouped with the northeastern islands of the Lesser Antilles. Because of the distance between the Leeward and the Windward Netherlands Antilles islands, it is likely that, in most cases, the sea turtles associated with these two groups of islands are from different and distinct populations. Four sea turtle species nest in the Netherlands Antilles (Figure 7) and a fifth, the olive ridley turtle (section 2.6), has been sighted on rare occasions. The Kemp's ridley turtle (section 2.5) has never been documented in the Netherlands Antilles.

2.1 Caretta caretta, Loggerhead Sea Turtle

This sea turtle species is referred to as "Kawama" in Papiamentu, the local language of Bonaire, Curaçao, and Aruba. It is recognized by its large head, thick and somewhat tapered carapace (=top shell), and often heavy encrustation of invertebrate epifauna, especially barnacles. The large head and strong jaws, for which the species was named, are necessary adaptations to a diet of mollusks and hard-shelled crabs; tunicates, fishes, and plants are also eaten. Pritchard et al. (1983) report that adults attain a straight-line carapace length of 120 cm (nuchal notch to posterior tip) and weigh up to 200 kg. No detailed size or weight data are available from the Netherlands Antilles.

In the Atlantic Ocean, loggerhead turtles have been sighted as far north as Newfoundland (Squires, 1954) and the waters of northern Europe (Brongersma, 1972) and as far south as Argentina (Frazier, 1984). Nesting grounds are often located in temperate latitudes, with the greatest numbers of nesting females recorded along the Atlantic coast of Florida (USA) and on

Masirah Island (Oman). Nesting is also reported from the Caribbean coasts of Mexico and Central America, the Atlantic coast of South America from Venezuela to Brazil, and in low density on several West Indian islands (summarized by Dodd, 1988). The most significant source of mortality to loggerheads from the large nesting colonies in the USA is incidental capture and drowning in shrimp trawls (U. S. National Research Council, 1990).

Loggerheads are considerably rarer in the Netherlands Antilles than either the green or the hawksbill sea turtles. Some historical data are available. For example, Euwens (1907 *in* Hermans, 1961) reported the nesting season in Curaçao to be May-August. On Klein Curaçao, the season is said to have been July-December, during which time females laid some three nests per year on intervals of 14 days. Eggs were routinely located using a sharp stick and eaten, but for those which escaped detection, incubation was "about nine weeks" (Winterdaal, pers. comm. *in* Hermans, 1961). A low level of nesting still occurs on Curaçao, as evidenced by a successful hatch on Boca Manzaliña (north coast) on 30 June 1991. At 1700 hrs, 80-100 loggerhead hatchlings emerged from this nest; photodocumentation is on file at STINAPA, the Netherlands Antilles National Parks Foundation. Van Buurt (1984) reported possible nesting by loggerheads on the north side of Curaçao at East Point Bay.

In Bonaire, large juvenile loggerheads are occasionally seen in Lac Bay, but there are no recent reports of nesting. Nesting may have occurred in the past, however, as evidenced by the comments of Heitkönig that he collected a clutch of eggs laid on Bonaire and hatched them in a bucket (pers. comm. *in* Hermans, 1961). Data collected for WATS I indicate possible nesting on a number of Bonaire beaches, including Washikemba (Washikemoa, or Lagoen beach), Playa Grandi, Saliña, and Sorobon (Van Buurt, 1984). Systematic study is needed to verify the extent to which loggerheads still nest on the island of Bonaire. In the case of our northern islands, loggerheads are "present but rarely encountered" in St. Maarten, a loggerhead was captured on the Saba Bank, and the species "has not been recorded" in St. Eustatius (Meylan, 1983).

To my knowledge, loggerhead turtles are rarely observed offshore. There are no data to specify what age/size classes are present. Preferred foraging areas have not been delimited.

2.2 Chelonia mydas, Green Sea Turtle

This species is the most commonly encountered sea turtle in the Netherlands Antilles. It is referred to as "Tortuga blanku" in the Leeward Islands and "Green-back" in the Windward Islands. It is recognized by a round, blunt beak with serrated cutting edges, one pair of enlarged prefrontal scales between the eyes, and smooth carapace plates (=scutes) that do not overlap one another (cf. hawksbill, section 2.4). The carapace is generally devoid of barnacles. The carapace color is light to dark brown, sometimes shaded with olive, with radiating wavy or mot-tled markings of darker color or with large blotches of dark brown. The plastron (=bottom shell) is whitish to light yellow. West Indian green turtles attain weights of 230 kg (Pritchard et al., 1983). Adults generally measure 95-120 cm in straight-line carapace length (nuchal notch to posterior tip); a mean of 100.2 cm (n=2107) is reported from the Tortuguero nesting beach in Costa Rica (Bjorndal and Carr, 1989). Individuals of varying sizes are present throughout the year in the Netherlands Antilles.

Green turtles are herbivorous and in the Caribbean they feed primarily on the sea grass Thalassia

testudinum (Bjorndal, 1982). Field studies indicate that individual turtles maintain feeding "scars" by returning to the same area of sea grass meadow to forage everyday (Ogden et al., 1983). These scars, or grazing plots, are maintained by regular cropping for several months and the more digestible newer growth (higher in protein, lower in lignin) is preferred (Bjorndal, 1980). When the cropped grasses show signs of stress (blade thinning, increased inter-nodal distance), the turtle apparently abandons the scar and moves on to form another. Green turtles travel widely during their juvenile years. Individuals are long-lived and require 25-35 years to reach sexual maturity in the Caribbean (Frazer and Ladner, 1986). The age structure of populations foraging in local waters has not been studied.

Sea grass meadows are rare around Saba and Curaçao, but green turtles can be found in areas where isolated grass beds occur; for example, green turtles have been reported foraging in East Point Bay, Curaçao (Van Buurt, 1984). In contrast, sea grass is extensive off the north-western coast of St. Maarten and foraging is reported throughout this area (Meylan, 1983). Green turtles have also been observed feeding in northeastern Saba Bank (R. Hassel, pers. comm. *in* Van Buurt, 1984) and in the lush grass beds of Lac Bay, Bonaire (Van Buurt, 1984; Roberto Hensen, Fundashon Marcultura, pers. comm., 1991). In areas where grass is scarce, green turtles may feed on fleshy algae (see section 4.111); algae diets have been reported from some areas of the Pacific (e.g., Hawaii: Balazs, 1980). Green turtles can be seen surfacing in the harbor at Oranjestad in St. Eustatius, but, since the harbor lacks sea grass, it may serve as an area of refuge rather than forage. In Meylan (1983), one fisherman related his view that small green turtles sleep near the pier in this harbor and then move offshore each day to feed; 20 years ago, the harbor was a favored netting location.

The green turtle is occasionally found nesting on some of the least disturbed beaches on the islands. No nesting activity has been reported in recent years on Curaçao. However, on 24 August 1991, a day before the full moon, a green turtle came ashore to lay eggs on the small island of Klein Curaçao. She was flipped onto her back, left overnight, transported the next day to Curaçao, and offered for sale to the Curaçao Seaquarium. A price of NAf. 3000 (US$ 1650) was asked, but the Seaquarium offered only NAf. 750 (US$ 420). The fishermen refused and butchered the turtle. The estimated income from the meat does not exceed NAf. 400 (US$ 220). Nothing could be done about this incident, because Curaçao lacks any relevant legislation (see section 4.21). The killing was covered in several local newspapers, showing at least some public outcry against these continuing practices.

On Bonaire, "two to three" nests per year are reported, mostly from Sorobon and Cai beaches at Lac Bay and from Pink Beach on the southwest shore, as evidenced by the distinctive nesting pits left behind (Roberto Hensen, pers. comm., 1991). Meylan (1983) reported a very low level of nesting at Guana Bay and Oyster Pond on the windward coast of St. Maarten, at Long Bay on the southwestern tip of that island, and on Flat Island; copulating has been observed in the Oyster Pond area. On Saba, despite the fact that there are no permanent beaches, residents insisted to Meylan that hawksbill and green turtles nested on rare occasions at Cave of Rum Bay, Wells Bay, and Fort Bay. Nesting may still occur on beaches on the Atlantic side of St. Eustatius; Van Buurt (1984) reports nesting in Concordia Bay during July and August.

The precise distribution, seasonality, and frequency of egg-laying are not known. According to

early reports, nesting occurred on Curaçao between May and August (Euwens, 1907). Mating has been observed at Klein Curaçao (Winterdaal, pers. comm. *in* Hermans, 1961). Mating is observed off Bonaire in late summer, mostly in August (Roberto Hensen, pers. comm., 1991). On the basis of information available from other areas, 2-6 nests are probably laid per female every 2-3 years. Nesting is nocturnal and clutches of 125-150 eggs are typically laid 12-14 days apart. In 1990, two green sea turtle hatchlings were found in the water intake of Marcultura, a Bonaire mariculture operation, and another in an intake canal of the International Salt Company. Most likely these had hatched on the beach at Sorobon. Green turtles are harvested locally for meat (section 3.3).

2.3 Dermochelys coriacea, Leatherback Sea Turtle

The leatherback, called "Driekiel" (or "Drikil") in the Leeward Islands, is rarely seen in the waters of the Netherlands Antilles, though there are reports from all islands that the species is occasionally captured. The leatherback is the largest and most pelagic of all of the sea turtles. Adult females weigh 250-500 kg and males sometimes exceed 900 kg (Morgan, 1989). Leatherbacks lack a bony shell and cornified epidermal scales; the smooth, black skin is spotted with white. The carapace is strongly tapered, generally measures 130-165 cm in straight-line length, and is raised into seven prominent ridges. Powerful front flippers extend nearly the length of the body. Leatherbacks are seasonal visitors, migrating from temperate foraging grounds in order to lay their eggs. Recent studies using time-depth recorders on gravid (=egg-bearing) females have shown that individuals nesting in the U. S. Virgin Islands spend their 10-day inter-nesting intervals diving to an average depth of about 60 m, and have attained maximum depths exceeding 1000 m (Eckert et al., 1989). Leatherbacks feed predominately on jellyfish and other soft-bodied prey. They may dive to feed, or perhaps to escape predators.

Hermans (1961) recounts that on 17 April 1947 a gravid leatherback was detained on a St. Maarten beach by means of ropes; she subsequently escaped, became entangled at sea, and drowned. The reason for her detention was not made clear; Hermans noted that the meat was not considered edible. Nesting records on Bonaire include a July 1988 incident at Lagoen on the east coast. In this case a gravid female attempted to nest in mid-afternoon, but was flipped over before egg-laying could occur. She was subsequently released and returned to nest about three nights later (Eric Newton, pers. comm., 1991). Elsewhere on Bonaire, high energy sandy beaches at Playa Chiquito and Lac Bay (Sorobon, Cai) might possibly be suitable habitat for leatherbacks (Roberto Hensen, pers. comm., 1991).

According to Meylan (1983), leatherbacks have nested in the "recent past" at Long Bay and Simpson Bay, St. Maarten, "a few nesting records" exist for the Atlantic shore of St. Eustatius, and, on Saba, one octogenarian recalled the nesting of a leatherback at Fort Bay "many years ago". Van Buurt (1984) noted for WATS I that a leatherback was "once observed" at Corre Corre Bay, St. Eustatius. There are no documented nestings on Curaçao. The nesting season is assumed to be April-July, based on data from the West Indies (Bacon, 1970; Eckert and Eckert, 1988; d'Auvergne et al., 1989). Long-term studies of this species in the northeastern Caribbean have shown that gravid females produce an average of 5-7 clutches per season and typically return to the same nesting beach every 2-3+ years. Clutch size averages 80-90 yolked eggs; a variable number of smaller yolkless "eggs" are laid as well (Basford et al., 1990; Tucker and Frazer, 1991).

2.4 Eretmochelys imbricata, Hawksbill Sea Turtle

The hawksbill turtle, called "Karet" in the Leeward Islands, is the second most common turtle in the Netherlands Antilles. Many records of sightings, catch and, in the past, nesting, refer to this species. Because of the well developed coral reefs off Bonaire, Curaçao, Saba and, to some extent, St. Maarten, numerous sightings are recounted by SCUBA divers who have seen this species foraging on the reefs. In addition, fishermen report foraging hawksbills in the waters of St. Eustatius, specifically in Tumble Down Dick and Jenkins Bays (Van Buurt, 1984). During a 1992 marine area survey of St. Eustatius by Tom Van't Hof and Jeff Sybesma, small to medium-sized hawksbill turtles were regularly encountered. In some cases the turtles were quite tame and could be touched by hand by SCUBA divers, especially off the southwestern coast of the island which is characterized by well-developed coral reefs (White Wall).

Hawksbill sea turtles can be distinguished from other sea turtles by two pairs of prefrontal scales (the scales between the eyes), carapace scutes that overlap one another like shingles on a roof, and a relatively narrow, pointed head and beak. The carapace is typically serrated along the posterior margin (becoming less so with age) and is "tortoiseshell" in color and pattern, showing radiating streaks of brown, black, orange, and gold. Carapace color is geographically variable and may also change with age (see Witzell 1983 for review). The scales of the head are dark brown with pale yellow margins. Both adults and hatchlings have a "normal tetrapod gait" while on land, with alternating movements of opposing flippers (Pritchard 1979). Adults rarely exceed 80 kg and a straight-line carapace length of about 90 cm (nuchal notch to posterior tip). The diet consists of sponges and other marine invertebrates.

Hermans (1961) described the nesting season in Curaçao as July through November. He witnessed an attempted nesting (the female was killed) in November 1960 on an unnamed beach in Curaçao. He emphasized how little was known about this species and offered his opinion that the females nest 2-3 times per year at 14-16 day intervals. A nesting hawksbill was later caught (date unknown) at Knip Bay beach, a busy bathing beach, in the western part of Curaçao (Van Buurt, 1984). In a 29 December 1982 letter to Fred Berry (U. S. National Marine Fisheries Service), Van Buurt noted that at Wacawa, an inner bay on the north coast of Curaçao, "more than 30 hawksbills were caught [a few years ago] using a beach seine". Two were taken and the others were released. No documented records of nesting are available for the past decade, although a low level of nesting surely continues in Curaçao.

In Bonaire, nesting peaks in September; some activity is also observed during August and October (Roberto Hensen, pers. comm., 1991). According to Silvo ('Chibo') Domacassé, a life-long resident of Bonaire, nesting used to take place on pocket beaches distributed along the coast of Bonaire from Playa Lechi south almost to Punt Vierkant. Recent coastal development, including the international airport, has eliminated much of this habitat. A recent condominium development has been built at Punt Vierkant where 3-4 nests are laid each year, as identified by the tracks in the sand. Data collected for WATS I indicates that hawksbill nesting also occurs, or occurred in the past, at Washikemba (Lagoen), Sorobon, Saliña, and Playa Grandi (Van Buurt, 1984). In the latter case, the beach has been virtually eliminated due to sand mining (section 4.131). Nests are occasionally found hidden in the vegetation of Klein Bonaire, generally on the white sandy beaches of the northeast coast; these are most likely hawksbill nests (Roberto

Hensen, pers. comm., 1991). Van Buurt (1984) confirmed nesting by hawksbills at Klein Bonaire and reported the season to be June to September.

Meylan (1983) reported that "a few hawksbills" nested at Guana Bay and Oyster Pond on the windward coast of St. Maarten, at Long Bay on the southwestern tip of the island, and on Flat Island; copulating had been observed in the Oyster Pond area. Despite the fact that Saba has no permanent beaches, rare nesting is reported by residents at Cave of Rum Bay, Wells Bay, and Fort Bay; mating has been observed in surrounding waters (Meylan, 1983; Susan Walker, pers. comm., 1991). Van Buurt (1984) also specified Cave of Rum Bay, a dark volcanic sand beach with rocks and pebbles, as a nesting beach for hawksbill turtles. Few data exist for St. Eustatius. Green and hawksbill turtles apparently nest on rare occasions, most likely on the Atlantic shore. Zeelandia, in Concordia Bay, is frequently cited by residents as a turtle nesting area (Van Buurt, 1984). Small beaches at Nap, Corre Corre Bay, Kay Bay and Crook Bay may be used (Meylan, 1983). No nesting has been reported from Oranjestad, the second-largest beach on St. Eustatius.

Hawksbills have proven difficult turtles to study, both in the Netherlands Antilles and elsewhere. Based on data that have recently become available from Antigua, we may conclude that gravid females which come ashore on our beaches are likely to lay, over the course of the nesting season (July to November?), four or five clutches of typically 150 eggs each at intervals of 13-18 days (cf. Corliss et al., 1989). The female often lays her eggs deep in the shelter of beach vegetation. Little evidence of the visit exists aside from a faint asymmetrical (flippers alternating) crawl about 0.7 m wide leading to and from the ocean. Local fishermen reported to Hermans (1961) that eggs incubated for 49 days. Data from elsewhere suggest a range of incubation periods averaging, in the Western Atlantic, from 60 to 75 days (Witzell, 1983).

The potential foraging habitat available to hawksbill turtles in the Netherlands Antilles is extensive. Hawksbills feed almost exclusively on sponges in the Caribbean. Their diet is taxonomically narrow, apparently highly uniform geographically, and includes sponges that are toxic to other vertebrates. In a study of the gut contents of hawksbills from Panama, the Dominican Republic, and the Lesser Antilles, the ten most commonly ingested sponge species were Geodia sp., Ancorina sp., Ecionemia sp., Myriastra sp., Chondrosia sp., Chondrilla nucula, Tethya cf. actinia, Aaptos sp., Suberites sp., and Placospongia sp. (Meylan, 1988). While there has been some effort to quantify marine sponges in the Netherlands Antilles (e.g., Van Soest, 1978, 1980, 1984), detailed research is needed to assess the distribution of sponges suitable as forage for hawksbill sea turtles.

In summary, individuals of various sizes are present in waters of the Netherlands Antilles year around. Preferred foraging areas have not been documented and nesting is rare. From all accounts, hawksbills appear to much depleted from their former numbers; present population estimates are not available. One of the most prominent threats to the continued survival of the hawksbill is the international market for their shell ('tortoise-shell'). In 1980, one tortoise-shell dealer in St. Maarten was buying shell from several islands in the northern Leewards and exporting it to Holland. Despite the high price he offered, US$ 100/kg, he was able to purchase less than half as much shell as formerly, presumably because local hawksbill populations had been so badly depleted (Meylan, 1983). While there is no evidence that turtle shell has been exported to Japan from the Netherlands Antilles, there has been extensive export from other

Caribbean countries (see Mack et al., 1982; Milliken and Tokunaga, 1987; Canin, 1989, 1991), which could affect stocks in our waters.

2.5 Lepidochelys kempi, Kemp's Ridley Sea Turtle

There are no records of Kemp's ridleys in the Netherlands Antilles, nor would the species be expected to occur here. With the exception of a single recapture from Caribbean Nicaragua of a headstarted 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 northern Atlantic (Ross et al., 1989). Unarguably the most endangered sea turtle in the world, the total adult population is thought to number no more than 900 females and an unknown number of males (Ross et al., 1989). Some 42,000 females were observed nesting in a single day at the primary rookery at Rancho Nuevo in 1947, whereas 200-400 females nest annually today. The species nests almost exclusively in the state of Tamaulipas, Mexico.

2.6 Lepidochelys olivacea, Olive Ridley Sea Turtle

Periodic reports by fishermen suggest that turtles are sometimes caught which are "different" from the species normally seen or caught. These may represent rare catches of the olive ridley (see also Hermans, 1961). Nevertheless, with only one exception there are no documented records of this species from the Netherlands Antilles. On 26 July 1991, a Curaçao fisherman landed a female olive ridley weighing 30 kg (62 cm straight-line carapace length). The turtle was caught by a hand line on the wave-exposed north coast of the island; the hook was baited with fish. The turtle was slightly injured upon retrieval and later donated to the Curaçao Seaquarium where it is doing well (Sybesma and Hoetjes, 1992). The only significant nesting colony in the Western Atlantic is in Suriname, primarily at Eilanti Beach (Schulz, 1975). Olive rid-leys nesting in Suriname have declined considerably in recent years, from about 3,000 nests per year in the late 1960's to fewer than 500 nests per year today (Fretey, 1990). Diffuse nesting occurs in northwestern Guyana and in French Guiana (Reichart, 1989).

III. STRESSES ON SEA TURTLES

3.1 Destruction or Modification of Habitat

All the beaches once known as turtle nesting beaches are, to the best of our knowledge, either no longer visited by gravid turtles or are visited only rarely. The major reasons for this appear to be local exploitation, as well as the increasingly heavy use of beaches for recreation and tourism. There has been a rapid increase in the recreational use of all beaches by the local population, especially on Curaçao, Klein Curaçao, and St. Maarten. Extensive beachfront hotel development has brought lights (section 4.132) and activity that may discourage sea turtles from nesting. Nearly a decade ago Meylan (1983) concluded, "commercial exploitation and the loss of nesting habitat are the major problems [facing sea turtles] today." Her statement is still true.

The removal of sand from beaches for building purposes has been very destructive (see section 4.131) and is the main cause of the poor condition of Curaçao beaches. Sand mining no longer occurs, but for occasional incidents of theft. However, good sandy beaches are nonetheless hard to find. The situation is aggravated by the fact that the geological history of the island has resulted in very few sandy beaches. The problem is recognized by the Curaçao government, which has already restored some of the beaches, and plans to do so with others, by adding a new

layer of sand (section 4.135). While sand mining has occurred to the largest extent on Curaçao, it also presents a problem on Bonaire. Playa Grandi on the north coast of Bonaire was a former sea turtle nesting beach, but vanished after the sand dunes were mined away. Beach destruction can also result from natural causes such as hurricanes, particularly in the Windward Islands, or the shifting and disappearance of beaches through changes in current patterns. However, natural coastal erosion is a phenomenon with which turtles have evolved and, presumably, to which they have adapted. Both Saba and St. Eustatius have beaches which are susceptible to modification due to changing currents.

It is equally important to recognize existing threats to the marine environment, especially since there is ample evidence that several species of sea turtle utilize the coastal zone for feeding, resting, and/or migrating. Domestic pollution, especially around urban areas, poses a threat because not all the raw sewage generated is collected via a sewer system for subsequent treatment. Much of this waste disappears directly into the sea. In other areas the sewage is collected, but is then pumped through a pipeline into deeper water, untreated. At the present time the offshore pipeline in Curaçao is broken, and sewage is routinely spilled near shore. A plan to treat all sewage using a few large capacity treatment plants is being implemented. Two treatment plants are already in place, but it will take some time to clean up the damage done over the years. Similarly, urban coastal development is occurring around the inner bays, especially the Spaanse water (Curaçao) and Simpson Bay/Simpson Bay Lagoon (St. Maarten), and in these sensitive areas adequate sewage collection and treatment infrastructure is not yet available. St. Maarten recently installed a sewage treatment plant for Philipsburg, but it is not yet operational.

In addition to land-based sources of pollution, ships release operational discharges, sewage, and other refuse at sea. International sailing boats routinely dump their sewage in the bays, and the increase in motor-boat traffic causes degradation of the marine habitat through increased pollution and disturbance. Hazardous waste can involve small accidental spills of oil from the refinery or from shipping movements, or can take on larger proportions, as when a tanker runs aground or experiences a major accident. Fisheries and marine tourism (SCUBA diving) may also have negative effects on the marine environment, especially when considered cumulatively. In particular, coral reef destruction is an increasingly worrisome problem due to anchoring, line fishing (self-made anchors are found everywhere along the reef), discarded or broken fishing lines, garbage (plastic in particular), and the activities of recreational divers, the latter involving the touching and trampling of corals. Divers can also frighten sea turtles away from their feeding or resting activities.
In some cases, whole ecosystems have been altered or destroyed by construction and development projects. These have had an unquantified, but surely in most cases negative, effect on sea turtles. Wagenaar Hummelinck (1977) offers a rather sobering discussion of recent modifications. The beautiful Schottegat, formerly the largest inland bay of Curaçao, is now one of the largest seaports in the Western Hemisphere and the site of a large Shell oil-refinery. Spaanse Water, to the southeast, is today a watersports center. The Rifwater also underwent major changes because of the growth and modernization of the capital of Willemstad, while Caracasbaai became an important bunker station. Piscadera Bay, west of Willemstad, is now hemmed in by large hotels and the outer bay suffers from tourist activities. In June 1972, the entrance to the Piscadera inner-bay was widened by dredging; the water is very turbid and land-based sources of pollution are at times serious. It is likely that at one time these bays, like the

present-day Lac Bay, Bonaire, served as rich foraging grounds for sea turtles, particularly green turtles. This can no longer be the case.

In St. Maarten, again according to Wagenaar Hummelinck (1977), the rapid development of tourism has brought considerable changes to the natural environment. The formerly quiet Great Bay is now bustling with activity reaching as far as the deepwater pier at Point Blanche. The spacious Simpson Bay Lagoon became hypersaline after its narrow entrance became closed during the construction of a new bridge, after the old one had been destroyed by a hurricane. A few years later a new connection with the sea was made at the opposite northeastern French side, while in 1972 the original entrance was opened again. Now the Lagoon has two openings, and a growing importance for recreation purposes. Meylan (1983) noted that in former times green turtles could be seen foraging in the harbor at Philipsburg, St. Maarten, but with the construction of the deep-water pier at Point Blanche and the accompanying increase in ship traffic, turtles are now rarely sighted. Near Oranjestad, St. Eustatius, a 300 meter long pier was constructed in 1976 (and will be replaced by a new one in 1992/93) and an oil terminal and jetty were built at Tumble Down Dick Bay. These developments have radically changed the natural character of the northwestern region of the island.

The extent to which we have already displaced our sea turtles can never be known, but now that we are wiser about the importance of maintaining the integrity of our marine environment, perhaps we shall be more balanced in our approach to coastal development in the future. Eliminating or restricting the harvest of sea turtles and their eggs will not be sufficient to restore their numbers if sea grass meadows, coral reefs, and sheltered bays are allowed to deteriorate. Of course, in this case it is not only the sea turtles which will suffer, but also our livelihood (e.g., fishing, diving tourism) and our entire natural heritage.

3.2 Disease or Predation

Little is known about the natural predation of sea turtles on the beaches or in the waters of the Netherlands Antilles. Neither nesting nor hatching is commonly observed, although a report some years ago quoted local fishermen to say that crabs may dig out eggs and *sòldachis* (hermit crabs) eat baby turtles. Certainly there is also some level of mortality to the hatchlings as they enter the sea and are consumed by a variety of predatory fishes; this mortality is unquantified in the Netherlands Antilles. Similarly, we assume that sharks and other large predators consume juvenile and adult turtles in our waters.

Since 1989, green turtles with a tumor disease have been sighted and caught by fisher-men in Curaçao (see also section 4.144). The disease is diagnosed as fibropapilloma, a herpes-virus-like infection which has been reported elsewhere in the Caribbean Sea and Pacific Ocean (Jacobson, 1990; NMFS, 1990). To date, no tumor-diseased turtles have been reported from other islands of the Netherlands Antilles. Informal warnings have been issued not to eat the meat of afflicted turtles. Green turtle fibropapilloma has also been reported from neighboring Venezuela (Guada et al., 1991) and it is extensively documented in Florida (Ehrhart, 1991). The cause of this debilitating and often fatal disease is unknown. The full extent to which the disease afflicts green turtles in the Netherlands Antilles is not known.

It is possible that foraging areas have been or are being degraded by a recent disease phenomenon known as "bleaching" in Caribbean reefs. Monitoring programs were established by

CARMABI and the Marine Parks staff to investigate this phenomenon and, although reports from other areas suggested that the problem may have been severe, the amount of bleaching was not extensive in the Netherlands Antilles. By July 1988, all affected species of coral were showing signs of recovery. However, new cases of bleaching were reported in 1989 and 1990, and the situation became quite serious between September 1990 and January 1991. Data are still being processed, but it appears that during the peak, in October, up to 85% of some of the major reef building corals (e.g., Montastrea annularis) were locally affected.

Other natural causes of death in coral reefs and associated organisms which provide food and refuge to sea turtles, especially to hawksbills, in the Netherlands Antilles are the "white band" disease affecting mostly staghorn coral (Acropora cervicornis), the "black band" coral disease, and the 99% death of the black sea urchin (Diadema antillarum) during 1983-1984. Because of the probable natural origin of these disasters and thus far no available remedy or cure, not much can reasonably be done to mitigate their effects.

3.3 Over-utilization

Utilization of sea turtles at the moment is mostly through catch by fishermen. Take of nesting female turtles occurs on an opportunistic basis, but can be considered low because nesting is so rare. There are few data available to evaluate whether or not the at-sea harvest is conducted in a biologically sustainable manner. However, it is significant that, at least in Bonaire, the number of turtles caught annually at present (±250, estimated by the author) is less than half what it was a decade ago (±500, estimated by fishermen). In addition, the size of turtles caught has decreased. In earlier years, small turtles were released. Today, all turtles caught are kept and they are usually 30-50 cm in shell length. This is an indication that the population being fished is stressed.

In Bonaire, both hawksbills and green turtles are net-caught, mostly during the period of June-December. Catch is limited during the rest of the year because of rough water conditions. According to an older, reliable fisherman, annual catch in the late 1970's was about 40-50 per month (about 500 per annum, green turtles and hawksbills combined). Today, according to the same fisherman, catch has declined to approximately 20 turtles per month. Bonaire has a local tradition of turtle meat consumption (green turtles are preferred for eating) and all turtles caught are used locally. Turtle steak is served in some restaurants (e.g., Zeezicht, Bonaire) and is comparatively expensive, about NAf. 8.5 (US$ 5) per steak. Some snack bars offer turtle *saté* (turtle meat on a small skewer) for NAf. 1.7-2.5 (about US$ 1) per stick. There is no ornament trade in Bonaire anymore; however, the shells from turtles caught for food are often sold. In June 1991, a fishermen offered Karen Eckert of WIDECAST the shell from an adult green turtle he had butchered four days earlier at Lac Bay, Bonaire, for the price of NAf. 30. On 26 June 1991, the Island Council of Bonaire amended the Marine Environment Ordinance of 1984 to include the total protection of all sea turtle species (section 4.21).

In Curaçao, there is no special protection for sea turtles (section 4.21). There is no directed turtle fishery, but turtles are taken quite regularly as bycatch by the fishermen. There is one specialized dealer on the island who keeps the turtles alive until they are sold. Demand is not high. The fishermen say they can catch more turtles if necessary, up to three per day per boat. There are certain places, such as St. Joris Baai and the eastern tip of the island, where fishermen say they are sure to catch turtles. Green and hawksbill turtles are caught in roughly even numbers, the

fishermen make no distinction between them, and the two species appear to be valued equally. Turtle meat and soup are offered at a few restaurants on Curaçao, but consumption is not very high. Prices per kilo of meat range from NAf. 8.5 to NAf. 17 (US$ 5-10) depending on the quantity. There is no demand for eggs. There is also some import of turtle meat and shells from Venezuela, despite the fact that CITES regulations in Venezuela forbid the export of turtles. The fishermen know very well that this is illegal, but still meat can be obtained by requesting it of the sellers in the "floating market". This market consists of Venezuelan fishermen who regularly come to Curaçao to sell their catch. Whole shells (>50 cm) are sold for approximately NAf. 25.5 (US$ 15). Shells are not processed into ornaments.

In St. Maarten the harvest of turtles is very low. There is some spearfishing of turtles for local use, but there is no evidence that nets are still used to purposefully ensnare turtles. The low catch probably reflects a small demand. There is no indication that turtle meat is sold in markets or special places and there are no restaurants offering turtle steak. This represents a marked change from the situation in the early 1980's, when Meylan (1983) observed that turtle meat was in great demand by tourists. She noted that the depleted nature of local stocks necessitated travel by the divers (who captured turtles using spearguns) to neighboring islands, such as Anguilla and St. Eustatius. To the extent that there is consumption today, it appears to be strictly local and not by tourists. There is one fisherman who sometimes brings in turtles caught near St. Eustatius. The price for turtle meat is approximately NAf. 8.5 (US$ 5) per pound, which is cheaper than snapper (fish) or lobster. According to the fishermen, there is more labor involved in the processing of turtle meat than there is for fish or lobster. Since the price is lower for the turtles, it is not generally economical to target turtles. However, there are reports that fishermen from neighboring islands (e.g., French islands) come and fish turtles.

In St. Maarten, turtle shells and ornaments made from the shells can still be found for sale. The shells found in souvenir shops are imported from other places and are rumored to come from the Dominican Republic and/or Haiti. Demand by tourists is unquantified, but it is probably low. Since the Dutch part of the island caters strongly to the North American tourist and the USA forbids the import of turtle products (including ornaments), demand is not likely to increase. Again, this stands in marked contrast to an earlier assessment by Meylan (1983) that souvenirs made from turtles were in great demand by tourists a decade ago. It is good to see the improvement in the attitudes of our visitors who are today perhaps better educated as to the laws concerning international trafficking in protected species, such as hawksbill sea turtles.

In St. Eustatius, consumption of turtle meat is also very low and strictly local. Meylan (1983) reported that turtles were killed on the nesting beach whenever encountered, but the extent to which this still occurs is unknown. Today restaurants are very seldom offered turtle meat by fishermen, there is no tortoiseshell industry, and trade in sea turtles is not likely a problem on this island. In Saba, sea turtle catching is subject to certain restrictions (see section 4.21). Turtle catching is nearly non-existent today in Saba; fewer than a dozen full-time fisher-men catch sea turtles opportunistically for their own consumption. During recent years, however, the spearfishing of turtles was popular among active SCUBA club members. Club members estimated in Meylan (1983) that 10-20 turtles were speared per year, but she concluded that this was an underestimate and noted with surprise that even adult turtles were taken. In order to capture a large adult, a long line and a float were attached to the spear to allow pursuit of the

turtle by boat, once the spear was well-lodged. The turtle quickly tired and was landed with relative ease. There was a small tortoiseshell souvenir trade earlier in the decade (Meylan, 1983), but today there is no such industry.

3.4 Inadequate Regulatory Mechanisms

One of the major concerns for the conservation of sea turtles in the Netherlands Antilles is the lack of legislation. The central government of the Netherlands Antilles has no legislation on nature management in general, or sea turtles in particular. With the latest decentralization plans, this responsibility is delegated to the different island governments. Only Bonaire offers full protection to sea turtles in its waters. Saba places some restrictions on the harvest, but the other islands have no sea turtle conservation legislation whatsoever (see section 4.21). In the international arena, the Kingdom of Holland has signed the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), but the Netherlands Antilles has not ratified it because we lack the necessary national legislation (see also section 4.31).

There is an inherent difficulty in the legislative framework of the Netherlands Antilles, and that is that legislation exists on three different levels; that is, the Kingdom, the central (Netherlands Antilles) government, and the island governments. Tasks and responsibilities are regulated through the "Statuut" and the "ERNA". These basic laws have proven inadequate, and it is sometimes difficult to interpret what level of government is responsible for a given task. Furthermore, with ever-changing political ideas on the status of the different islands within the Netherlands Antilles and their relationship with The Netherlands, law departments on both the central and island levels are reluctant to create new legislation. Under-staffing and general bureaucracy also contribute to the inertia. The result is that, with few exceptions, no new natural resource or conservation legislation has been accepted by legislators since 1976.

Another major problem is law enforcement. Even the existing poor legislation is not being enforced because of lack of personnel, funding, and interest by the police force. There is no special enforcement agency for environmental laws and regulations. Some persons, such as the managers of the three Underwater Parks (Curaçao, Bonaire, Saba), have special police enforcement authority. Also, the Environmental Service has personnel who have authority to enforce certain infringements of the law, such as marine pollution. As stricter environmental laws are enacted, it is the recommendation of this Recovery Action Plan that additional personnel be given enforcement authority in order to supplement the efforts of the police force.

3.5 Other Natural or Man-made Factors

In 1990, a young hawksbill (about 25 cm shell length) covered with crude oil was found in front of Kralendijk, Bonaire, and brought to Fundashon Marcultura by a fisherman. The turtle was cleaned with kerosene and detergent and remains in the care of the mariculture facility. It seems well, but does not appear to be growing (Roberto Hensen, pers. comm., 1991). Green sea turtle hatchlings are sometimes caught in the water intake systems of both the salt company and Marcultura on Bonaire. This represents only a minor problem, since few are caught and there is only one reported fatality (section 2.2). Other factors affecting the survival prospects of sea turtles in the Netherlands Antilles, beyond those discussed in the preceding paragraphs, have not been identified.

IV. SOLUTIONS TO STRESSES ON SEA TURTLES

4.1 Manage and Protect Habitat

The identification and subsequent protection of marine and terrestrial habitats deemed critical to the continued survival of sea turtles in the Netherlands Antilles is viewed as an essential component of any effective recovery program.

4.11 Identify essential habitat

There have been occasional reviews of reptiles in the Netherlands Antilles (e.g., snakes: Brongersma, 1940, 1959; lizards: Wagenaar Hummelinck, 1940; Lammerée, 1970), but, with the possible exception of Bonaire (Euwens, 1907; we were unable to obtain this paper for study), no systematic effort has been made to fully survey the islands for sea turtles. This may be because sea turtles were never abundant here, so these reptiles did not obtain the favor of early naturalists. In light of the paucity of historical data, it is especially important and should be considered a priority to implement surveys of the coastline for contemporary nesting and to interview older residents who may recollect the distribution of nesting in earlier years. To define important foraging habitat is more difficult, but should be integrated to the extent possible with the activities of SCUBA divers, fishermen, and research personnel who regularly visit particular areas and who are willing to accumulate sightings data over time. The efforts made during the 1980's under the auspices of both WATS and WIDECAST to assemble available information on the status and distribution of sea turtles have been extremely useful, and we must now build on our existing knowledge in order to effectively identify essential habitats.

Habitat necessary for the survival of marine turtles in the Netherlands Antilles consists of both nesting beaches and offshore foraging grounds. Green turtles and hawksbills are the most common resident species for which foraging grounds are vital. For green turtles, Thalassia sea grass meadows provide important forage. For sponge-eating hawksbills, coral reefs must provide the major source of food. These marine systems, sea grasses and coral reefs, are also very important to the Netherlands Antilles for reasons other than marine turtles. Sea grass beds trap sediments and prevent the adjacent reefs from becoming smothered by silt; in addition, they provide food and shelter for a variety of fish and invertebrates, including such commercially important species as the Queen conch. The reefs are home to a multitude of fish that are in part dependent upon nearby sea grass for feeding and for shelter during the early phases of their life cycles (Van't Hof, 1989).

4.111 Survey foraging areas

No thorough surveys of foraging habitat for sea turtles have been conducted. Suitable foraging areas for hawksbill turtles may exist wherever there are well developed reef habitats. General surveys of coral reefs in the Netherlands Antilles have been published by Bayer (1961), Roos (1964), and Bak (1975, 1977). The reefs of the south coasts of Curaçao and Bonaire have been mapped very accurately to a depth of 10 m (Van Duyl, 1985). A reef survey of St. Maarten was conducted by Tom Van't Hof in October 1989 with the objective to identify and roughly map coral reefs and associated ecosystems, and to describe the reefs and the quality of the reefs and associated resources. He concluded that "most nearshore reefs and reefal structures along the coast of St. Maarten/St. Martin and Tintamarre are moderately to heavily degraded" (Van't Hof, 1989). Saba Bank, in the territorial waters of Saba, is an area of interest where few ecological data are available.

Sea grass meadows are not well developed in the Netherlands Antilles. With the exception of sea grasses in some sheltered bays, such as Lac Bay (Bonaire), the only extensive grass beds are found around the island of St. Maarten (ECNAMP, 1980; Van't Hof, 1989). Van't Hof (1989) reports that these sea grass communities are generally in fairly good condition. Earlier surveys of marine vegetation provide useful overviews of algae distribution (Vroman, 1968; Van Den Hoek, 1969).

We believe that a baseline survey of coral reefs and sea grass beds is necessary before we can understand the foraging habitats of sea turtles. For now, the best information available with respect to the likely distribution of foraging areas is in the form of sea turtle sightings by fishermen, divers, and others. The discussion which follows is an overview of the rather fragmented information that has been contributed to date. Sightings of sea turtles around Curaçao are very irregular. Some locations, such as the North-West coast, are mentioned more frequently than others. On a quiet day off the North-West coast, turtles can be seen floating at the surface in fields of drifting Sargassum. Species seen are usually green turtles or hawksbills and the area should be considered important foraging habitat and/or refugia for these species.

In Bonaire, regular reports of sea turtles come from the dive operators and tourists who dive all along the sheltered coast of Bonaire, predominately western Bonaire and around Klein Bonaire. Again, most reports are for hawksbills and green turtles. Foraging areas for hawksbill turtles exist in the reefs all around Bonaire, and hawksbills are sighted regularly by dive tourists along the coast and around the island of Klein Bonaire. Green turtles are more often seen at the entrance to and inside Lac Bay where there are floating Sargassum fields and benthic sea grass. Loggerheads are sometimes observed from boats, usually in the open sea, but they have also been observed in Lac Bay.

According to the two local dive operators, sea turtles are seen frequently (on average, once per week) around St. Maarten, mostly from the boat en route to a dive spot. Around the island of St. Maarten, especially the bays, turtle grass is common. According to Van't Hof (1989), Thalassia is more abundant than described by Meylan (1983). Turtles are also reported by divers on the offshore reefs: Cupe Coy to Plum Bay, Molly Beday, Pelican Rock, Cow and Calf, Grouper Rock, East of Tintamarre (also reported by Meylan, 1983). In the vicinity of St. Eustatius, according to the only dive operator, the same "big turtles" (presumably green turtles) are often seen in specific locations. There is no indication that the foraging areas described by Meylan (1983) around St. Eustatius have changed. However, it is important to note that the foraging areas described consist mainly of marine algae (e.g., Penicillum sp.), as opposed to flowering plants such as Thalassia, and coral reefs.

All around Saba, sea turtles (mostly hawksbills) are seen regularly. An average of one turtle sighting per three dives is acknowledged by the Saba Marine Park Manager and the two dive operators. The feeding grounds around Fort Bay are no longer as extensive as described by Meylan (1983) and the reason may be that a stone crusher is causing a heavy level of siltation in Saba waters (section 4.147). Nevertheless, you can still find turtles in this area feeding on benthic algae. While turtle grass (Thalassia) is generally thought to be the primary food for green turtles, the area considered by the fishermen as the feeding area for the green turtles does not

consist of turtle grass at all, but rather algae. We found the same situation in an area on the Saba Bank, which we explored briefly. The place where green turtles are seen often (and is mentioned by the fishermen as a feeding ground for turtles) has abundant fleshy algae, but no Thalassia.

4.112 Survey nesting habitat

The contention that the frequency of sea turtle nesting in the Netherlands Antilles is very low is based on our interviews with and reports from the public. However, it is necessary to adequately survey our beaches by walking them in the early morning hours each day during the nesting season, which, when all four species are considered, would necessitate coverage from April to November, inclusive. This is seen as a priority and we recommend that island organizations such as STINAPA [the Netherlands Antilles National Parks Foundation] organize interested residents and provide them with the training needed to identify evidence of sea turtle nesting (see section 4.55). WIDECAST is able to provide data sheets and identification materials, as well as informal training workshops, on request.

Present data indicate that little nesting occurs on Curaçao, where most beaches are more or less disrupted by tourism development, high visitation, or sand mining. A recent (June 1991) hatch of loggerhead turtles was reported from Boca Manzaliña (section 2.1). Turtle tracks (one set) were reported in 1986 from Klein Curaçao, but the island is too disrupted by visitors for turtles to nest undisturbed (recreational trips and dive trips are organized regularly, mostly on weekends). In August 1991, a green turtle came shore to nest on Klein Curaçao and was killed (section 2.2). In Bonaire, old records exist for nesting on Playa Chikitu, Playa Grandi, Lagoen, Lac and Witte Pan, but few nests have been reported in recent years. These include a nest not identified as to species at Witte Pan in 1981 (Tom Van't Hof, pers. comm., 1986), green turtle nesting around Lac Bay and at Pink Beach, a 1988 leatherback nest at Lagoen, and an unknown number of hawksbill nests around the island, including at Klein Bonaire (details in section II).

A low level of nesting may continue on St. Maarten, but it is believed to be significantly lower than in the past due to coastal development and the recreational use of beaches. There is no longer any nesting along the Caribbean side of St. Eustatius where the beach was washed away a few years ago, probably due to changes in currents. Not enough information could be gathered as to what extent nesting occurs on the Atlantic side (Concordia Bay), but residents report that any potentially nesting turtles may be disturbed by the lights of a newly built hotel. Such disturbance is cited as the reason for a decline in the number of nesting turtles in recent years (Lloyd Courtar, pers. comm. *in* Van Buurt, 1984). There are two seasonal beaches on the island of Saba: Wells Bay and Cave of Rum Bay. Cave of Rum Bay could well have some significance as a nesting area because it is totally inaccessible from shore and hardly ever visited from the ocean (Tom Van't Hof, pers. comm., 1986).

4.12 Develop area-specific management plans

There are presently no area-specific management plans for sea turtle habitat in the Netherlands Antilles. We face several challenges in developing such plans. First, the infrequency of sea turtle nesting and the lack of comprehensive surveys to determine foraging sites make it difficult to identify important areas; before effective long-term management plans can be implemented, suitable field surveys will have to be undertaken (see section 4.11). Second, coastal and marine management in the Netherlands Antilles is still a young discipline. Efforts to initiate this type of management through cooperation between government and non-government organizations

culminated in a workshop in November 1987 to formulate a National Marine Program.

The National Marine Program was designed to discuss and set priorities on such topics as marine pollution, coastal development, marine research, marine parks, etc. Specific management plans to protect important foraging areas and potential nesting areas can now be brought to the attention of our various governments under the auspices of this Program (now the Ministerial Council for Sea Research and Sea Activities, see also section 4.121). The Proceedings of the 1987 Workshop emphasized that, besides coastal development for recreational use, consideration must also be given to certain beaches as potential nesting areas (Richardson and Sybesma, 1988). The Netherlands Antilles Sea Turtle Project (section 4.6) has as one of its objectives the development of island legislation that would provide for the protection of important sea turtle habitat. It is the recommendation of this Recovery Action Plan that guidelines described in section 4.122 be integrated into any proposed management plan.

4.121 Involve local coastal zone authorities

The central government has a department of urban and rural planning (DROV) which includes the responsibility for coastal areas. Previously, cooperation between this department and resource conservation organizations (e.g., CARMABI, STINAPA) or other island government organizations (e.g., the Environmental Service) has been on a voluntary basis. Now, under the auspices of the new Ministerial Council for Sea Research and Sea Activities, a mechanism for improved cooperation is in place. The Council was activated in March 1990 by a Central Government Decree to serve as an advisory body to the Central Government and to the individual Island Governments. The Council, comprised of representatives from all relevant governmental and non-governmental departments and institutes, meets regularly and advises the government on a broad range of issues concerning the marine environment. It should be stressed that, in the future, by means of better cooperation between all governmental and non-governmental organizations, decisions for development of coastal areas should be based upon environmental as well as economic criteria.

4.122 Develop regulatory guidelines

Habitat conservation legislation in general in the Netherlands Antilles is deficient on all levels, except for marine conservation legislation in Saba and Bonaire. Specific regulations will, therefore, be needed to adequately protect important sea turtle foraging and nesting areas. Such regulations will be essential in order to establish a framework within which appropriate land use and development (commercial, recreational, residential) can occur. For instance, development proximal to important nesting beaches should be required to design beach-front lighting in such a way as to preclude or minimize the disorientation of hatchlings or nesting adults (section 4.132). Activities such as offshore dredging, or the construction of jetties and seawalls, should be regulated in such a way as not to result in the erosion of nesting beach habitat. Campfires and vehicle traffic on nesting beaches should be prohibited, especially during the main nesting and hatching seasons (April to November, inclusive). Native vegetation should not be removed and construction should be restricted to well behind the primary dune line or boundary of permanent vegetation. The following guidelines are recommended:

Sand mining: Regulations prohibiting the mining of beach sand (section 4.131) should be fully enforced.

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

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

Design setbacks: If development of land adjoining a sandy beach is planned, setback limits should be defined that reflect the damage likely to be caused to the beach and backshore Environment during a major storm, and that take into consideration beach and backshore characteristics. Setbacks should provide for vegetated areas including lawns and dunes between hotels, homes and similar structures, and the beach proper. 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.

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, does not directly illuminate areas of the beach, and/or emits wavelengths (i.e., 560-620 nm) which are least attractive to sea turtles (section 4.132).

Waste disposal: Dumping should not be permitted in nearshore, beach, or dune environments. On the beach, discarded glass and metal can injure turtles and larger objects obstructing the beach can prevent gravid females from finding a nest site. Trash cans and regular pick-up should be provided in high-use areas. To the extent that beach cleanup is necessary, it should be accomplished using hand tools (section 4.134).

Vegetation cover and fires: All attempts should be made to preserve vegetation above the mean high tide line, especially native plants. Creeping vines and other plants stabilize the beach, offering protection against destructive erosion by wind and waves. Larger vegetation can enhance nesting habitat for the hawksbill sea turtle, as well as offer natural shielding for the beach from the artificial lighting of shoreline development (section 4.132). Fires should be prohibited on sandy beaches. Fires are a hazard to the surrounding dry forest, create unsightly scars on the beach, may scorch sea turtle eggs and hatchlings beneath the surface of the sand, and can disorient hatchlings. Beach fires should be restricted to designated grill facilities.

In addition to the beach management guidelines articulated above, regulations are also needed in offshore areas to preclude indiscriminate anchoring in coral reef or sea grass habitats (section 4.147) and to prevent the disposal of refuse at sea (section 4.144). These are common sense measures which will not only defend important habitat for the benefit of endangered and declining sea turtle populations, but also ensure that sensitive areas are properly safeguarded for the future. A major improvement in the protection of marine habitat, including habitat important to turtles, has been the establishment of marine parks in Bonaire (1980), Curaçao (1983), and Saba (1987). Actual park management is accomplished in various ways. In Saba, and more recently in Bonaire, the resources necessary for adequate management are ensured by means of a SCUBA diver fee that is allocated to park administration. In Curaçao, a subsidy by the island government covers the day-to-day expenses of the park.

All three marine parks have put into place a system of mooring buoys to prevent boats from anchoring in sensitive areas. Strict enforcement of rules and regulations (proper mooring, prohibition of spear-fishing, coral breaking, pollution, etc.) by marine park staff who have law enforcement authority will help guarantee the protection of the marine habitat. To prevent damage and destruction to reefs and sea grasses in areas not put aside as marine parks, including St. Maarten, St. Eustatius, and a major part of Curaçao, protective legislation, such as Curaçao's Reef Management Ordinance (1976), should be enacted territory-wide. Furthermore, it is the recommendation of this Recovery Action Plan that the most important reef and sea grass areas in St. Maarten and St. Eustatius be protected by the establishment of a marine park system; in St. Eustatius there are also suitable "marine historical area" sites. The Curaçao Underwater Park should be expanded to include, at a minimum, the whole south coast of the island. In order to fully realize the legal and practical implementation of these recommendations, mechanisms for financing these protected areas and a proper management structure must also be defined and enacted.

4.123 Provide for enforcement of guidelines

Already some structure for the enforcement of legislation exists. STINAPA, the Netherlands Antilles National Parks Foundation, has independent local branches on every island. Through their marine parks organizations, where some personnel already have law enforcement authority, sea turtle conservation could be incorporated and emphasized. In those places, such as Curaçao, where a marine park does not surround the entire island or where the island does not have a marine park (St. Maarten and St. Eustatius), funding should be made available by the island governments to local STINAPA organizations to implement enforcement of marine legislation and sea turtle conservation regulations. STINAPA organizations should also control beaches that are suitable habitat for sea turtle nesting. In Curaçao, LVV [Department of Agriculture, Animal Husbandry and Fisheries] is responsible for the maintenance of beaches and could, therefore, also play a role in protecting nesting turtles and their eggs. The major problem, as always, is a dearth of supporting legislation.

4.124 Develop educational materials

If specific areas are designated as important foraging or nesting sites and protected as such, it will be necessary to design materials that can be distributed to the general public (residents and visitors alike) explaining why these areas have been chosen, what regulations must be obeyed,

and how individuals can participate in the general recovery of local sea turtle stocks. The agency, such as STINAPA, responsible for the management area will likely be in the best position to initiate the development of these educational materials. Large wooden sign boards might be placed in or near the management area describing how sea turtles fit into and contribute to the surrounding ecosystem. The more complete the public's understanding of the habitat management plan, the more likely the guidelines will be followed and the burden of law enforcement eased. Implementation of general public education programs is further discussed in section 4.4.

4.13 Prevent or mitigate degradation of nesting beaches

As stated in the preceding text, sea turtle nesting is a rather rare event in the Netherlands Antilles at the present time. Thus the priority concern is not preventing degradation to nesting habitats because this has already happened, primarily due to widespread coastal development for the tourist industry. We must instead focus on restoring former nesting beaches to a state where turtles might possibly return once again to lay their eggs, mitigating existing threats, such as beach lighting, and implementing systematic surveys of potential nesting areas (for a discussion of the latter, see sections 4.112 and 4.291). It is self-evident that if we do not act to preserve or enhance the integrity of potential nesting habitat, we will never again support significant sea turtle nesting on our islands. The following subsections discuss several specific ways in which local beaches can be made more hospitable for nesting sea turtles.

4.131 Sand mining

The chronic removal of sand from nesting beaches accelerates erosion and degrades or destroys beach vegetation by extraction or flooding (salt water inundation). In severe cases, saline ponds are formed in unsightly pits left by mining operations, shoreline trees are lost to the sea, and entire beach habitats are eliminated. With their loss, the coast's potential to support recreation, wildlife (e.g., sea turtles), tourism, and commercial development is reduced. Playa Grandi, on Bonaire near the entrance of Washington/Slagbaai National Park, was lost when the dunes were removed during a sand mining operation. To a lesser extent, Knip and Playa Abou, both suitable beaches for sea turtle nesting, have been mined for sand. Both have recently been replenished with new sand, which is still stolen in small quantities. The development of these beaches into popular recreational areas for residents and tourists makes it unlikely that they will support nesting in the future (section 4.135).

It has always been illegal to mine sand from the beaches of the Netherlands Antilles, but the regulations have only recently been enforced. The practice has now been discontinued on most of the Dutch islands, and consequently the threats it posed have lessened considerably. The discontinuation was precipitated by several factors: (a) demand for sand has grown faster than the beaches could provide, (b) restrictions on beach mining have increased, and (c) sand without salt is increasingly available. In the latter case, clean sand comes from Suriname where it is taken from the rivers or extracted from interior limestone deposits using stone crushers. It is the recommendation of this Recovery Action Plan that regulations banning beach sand mining be consistently and strictly enforced.

4.132 Lights

Sea turtle hatchlings orient to the sea using the brightness of the open ocean horizon as their

primary cue (e.g., Mrosovsky, 1972, 1978). When artificial lights, such as commercial, residential, security or recreational lights, shine on the nesting beach, hatchlings often orient landward toward these lights instead of toward the ocean horizon. The typical result is that the little turtles are crushed by passing vehicles, eaten by dogs and other domestic pets, or die from exposure in the morning sun. Nesting females are also sometimes disoriented landward by artificial lighting. Studies in Florida (USA) and Tortuguero (Costa Rica) reveal that the presence of mercury vapor lights all but eliminates nesting on affected beaches; nesting 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 beach-front owners in Florida have switched to low pressure sodium (LPS) vapor lighting, which shines primarily in the 590 nm range and has little if any effect on nesting females. Unfortunately, low pressure sodium lights do not appear to constitute a complete answer to this difficult problem because they mildly attract green turtle hatchlings, though to a much lesser extent than do mercury vapor lights (B. Witherington, Archie Carr Center for Sea Turtle Research, pers. comm., 1990).

An absence of lighting is the best guarantee that hatchlings will safely find the sea. Where this is not an option, Witherington (1990) proposes several "next-best" solutions, including (a) time restrictions (lights extinguished during evening hours when hatching is most likely to occur; e.g., 1900-2300 hrs), (b) area restrictions (restrict beach lighting to areas of the beach where little or no nesting occurs; the effectiveness of this is diminished, however, since sources of light several kilometers away can disrupt hatchling orientation), (c) motion sensitive lighting (sensor-activated lighting comes on only when a moving object, such as a person, approaches the light; this might be effective in low traffic areas), (d) shielding and lowering light sources (low intensity lighting at low elevations can be both attractive and adequate for most purposes; the glow can be shielded from the beach by ornamental flowering hedges or other bar-riers), and/or (e) alternative light sources, since LPS lighting is known to be less attractive to hatchlings than full-spectrum white light.

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

In the Netherlands Antilles, some beaches are being reshaped for enhanced recreational use. Others have been developed with new and major hotel complexes and/or condominiums for the development of tourism. All these activities result in more artificial lighting at night, which in

turn may discourage turtles from nesting. After the necessary surveys have been done to discover where sea turtles still nest in the Netherlands Antilles, it is the recommendation of this Recovery Action Plan that the island governments actively promote protection of the nesting beaches, perhaps including some restriction as to the type and extent of recreational and tourist development. At the very least, attractive and effective lighting should be implemented as close to the ground as possible and lights should be constructed so that they can be shielded from shining directly on the beach. We also recommend that STINAPA send a letter to all hotels and restaurants built near the beach asking that (1) security or other personnel report incidents of sea turtle nesting on the beach and (2) lights shining on the beach be redirected or shaded during the breeding season (April to November, inclusive). If the latter is impossible, the grounds should be inspected each morning in order to rescue hatchlings that mistakenly crawled away from the sea. Rescued hatchlings should be kept quiet and shaded in a bucket of damp beach sand until nightfall when they are to be released to the sea.

4.133 Beach stabilization structures

Only on the island of Curaçao have breakwaters been recently erected parallel to the coast to create a manmade beach. Other places do not have these kinds of structures, nor plans to construct them. Since some beach stabilization structures may actually accelerate erosion, often precipitating the loss of adjacent natural beach sediments, it is the recommendation of this Recovery Action Plan that the construction of solid jetties, break-waters, and sea walls be evaluated in light of potential negative effects on proximal habitats which may be important to sea turtle populations.

4.134 Beach cleaning equipment

Mechanized beach cleaning equipment can crush incubating sea turtle eggs and its use should be avoided. In the Netherlands Antilles this does not present a problem as beaches, such as those adjacent to some hotels, are cleaned by hand. Cleaning equipment is modest and there is no evidence that it is destructive to sea turtle nests. Raking seaweeds by use of a tractor or other heavy machinery, should this become necessary in the future, should be confined to beach zones below the mean high tide line in order to avoid the compaction of sand above incubating eggs. Repeated compaction will kill developing embryos. Tractor tire ruts above the high tide line can trap hatchlings and prevent them from reaching the sea.

4.135 Beach rebuilding projects

Beach rebuilding projects are only known from Curaçao. In 1987, the island used a modern sand sucker to take 150,000 cubic meters of white sand from the northern part of the sea bottom of the island. This sand was used to create manmade beaches in areas without sandy beaches and also to replenish already existing sandy beaches with more sand, especially to make them more attractive for the tourist industry. On beaches where there is some potential for sea turtle nesting, it is important that sand placed on the beach is of similar constituency to that of the natural beach. Beaches rebuilt with offshore sand are often unsuitable for turtles because of subsequent sediment compaction. The timing of these activities is also important. If there is evidence of sea turtle nesting on the beach, reconstruction should not occur during the nesting or hatching seasons (e.g., April to November, inclusive).

4.14 Prevent or mitigate degradation of marine habitat

Significant modification and even destruction of the coastal zone in the Netherlands Antilles has occurred, as has been the case throughout the Caribbean resulting from advancing industrial and touristic development. However, much has also been accomplished by the installation of marine parks to conserve and protect coral reefs, mangroves, and sea grass meadows. Despite our advances and the parks which are in place, there is still great concern about the degradation of marine habitat, especially around St. Maarten which is heavily visited and where there no protected marine areas. Preventing or mitigating degradation of marine habitat should be viewed as a priority. The following discussion highlights some of our concerns with specific regard to sea turtles.

4.141 Dynamiting reefs

The use of dynamite to stun fishes or to remove coral reef structure (e.g., to provide boat access) results in severe and sometimes permanent damage to the fragile coral. Fortunately, this practice is not known to occur in the Netherlands Antilles. The slow-growing and virtually irreplaceable reefs serve as nurseries, refugia, and foraging grounds for many species of commercial fishes. They are crucial to the sustained health of the fishing industry. They also absorb the impact of storm waves and ocean swells, thus protecting and sheltering the shoreline including commercial and residential investments. With the large number of SCUBA-oriented tourists, healthy coral reefs are a vital component of the tourism industry. Finally, and most relevant to this Recovery Action Plan, coral reefs provide refugia and forage to sea turtles. Hawksbills feed almost exclusively on reef-associated sponges in the Caribbean (section 2.4) and hawksbill and green turtles both seek shelter and rest in the structure of the reef.

4.142 Chemical fishing

The application of chlorine and other chemicals in coral reefs for the purpose of harvesting fish is not practiced in the Netherlands Antilles. Chemical fishing can cause extensive damage both to coral reef infrastructure and to the many vertebrate and invertebrate species that live in these important coastal environments. The use or discharge of chlorine and other poisons for the purpose of catching fish or other marine life should be strictly prohibited in all waters of the Netherlands Antilles.

4.143 Industrial discharges

All the islands engage in small-scale (and sometimes large-scale) industrial activities, such as docking, repair, and other industries connected with harbors. Thus far, the amount of industrial discharge appears localized and not severe when the waters of the Netherlands Antilles are considered as a whole. Nonetheless, several examples of land-based pollution are noted in section 3.1 and the extent to which industrial effluent, which is so often toxic to marine life, is fouling our waters should be carefully investigated and closely monitored. In 1992, the Council for Sea Research and Sea Activities performed an inventory of land-based sources of pollution. The results have not yet been published. A standard method provided by UNEP/RCU to estimate the levels of pollution by category was used, and the results will be included in a regional document as part of the preparation of a new protocol to the Cartagena Convention on the subject of regulating and preventing land-based sources of pollution to the marine environment of the Wider Caribbean region.

4.144 At-sea dumping of garbage

Garbage from all of the islands used to be dumped in the sea. A few years ago this was prohibited in Curaçao and landfills were opened for this purpose. The other islands are also using landfills. Recently a very weak green sea turtle was caught by fishermen at the north coast of Curaçao in the vicinity of the island's former at-sea garbage dump. The turtle was covered with tumors (see section 3.2). The extent, if any, to which the disease may be related to pollution in this area has not been defined. In addition to land-based sources of garbage, a great problem (and a universal one in the Caribbean) is the continuing disposal of garbage from boats. All vessels, from very large cruise liners to small vegetable-carrying boats coming from the mainland, dump their garbage into the ocean. Floating plastic bags are seen in the ocean more and more frequently. Plastic bags pose a very real and very serious threat to sea turtles because they can be mistaken for jellyfish and consumed. Several years ago, Mrosovsky (1981) summarized data showing that 44% of the adult leatherbacks examined had plastic in their stomachs. A large amount of the debris in our waters is made in Venezuela.

International attention is starting to focus on this problem. UNEP/IOC has just offered the Netherlands Antilles money for a debris survey and an inventory of the land-based sources of pollution. Under these programs, more information will be gathered on the state of pollution from land-based sources, as well as from other sources (e.g., ships, other countries). Further to this undertaking, all debris will be classified as to type, manufacturer, etc. Under the auspices of the Cartagena Convention and/or other regional agreements (section 4.3), Wider Caribbean legislation should be encouraged to forbid the disposal of garbage at sea. The Netherlands Antilles Central Government should then rigorously enforce such legislation.

4.145 Oil exploration, production, refining, transport

Sea turtles are potentially very vulnerable to oil spills. Behavioral studies suggest that sea turtles have a limited ability to avoid oil slicks. Physiological experiments indicate that the respiration, skin, some aspects of blood chemistry and composition, and salt gland function of 15-18 month old loggerheads are seriously affected by crude oil (Vargo et al., 1986). In both experimental and stranded oil-fouled turtles, Vargo et al. (1986) observed oil clinging to the nostrils and eyes and in the upper portion of the esophagus; oil was also found in the feces. Chemical analysis of the internal organs of the stranded turtles provided clear evidence that crude oil from tanker discharge had been ingested. Since hawksbills are of particular concern in the Netherlands Antilles (being one of the two species of sea turtle routinely encountered in local waters, see section 2.4), it is noteworthy that hawksbills (predominantly juveniles) accounted for only 2.2% (34/1551) of the total sea turtle strandings in Florida between 1980-1984, yet comprised 28.0% of petroleum-related strandings. In their study, Vargo et al. (1986) found oil and tar fouling to be both external and internal.

There is no current oil or gas exploration in the Netherlands Antilles, although some test drills have been done around the islands by different oil companies. Curaçao has a large oil refinery, and Curaçao, Bonaire, and St. Eustatius all have oil terminals for oil transshipment, oil storage and bunker facilities. In St. Eustatius, a small topping unit (oil refinery) of 10-15,000 barrels per day is under construction and should be operational by July 1992. In addition, the Bonaire island government was until very recently considering the possibility of permitting the construction of an oil refinery larger than that presently located in St. Eustatius. Local and international

communities have expressed a deep concern about these projects, especially with regard to natural resource protection and conservation, and in the case of Bonaire this concern (coupled with the hesitation of the island government in making a decision) prompted the interested oil company to pull out. One thing is clear, and that is that further development of refining and storage capacity in the Netherlands Antilles will increase the already heavy tanker traffic to, from, and between islands. Oil residues from tanker cleaning and minor operational spills (which wash ashore as "tar balls") will be more visible with the increased traffic. Already a stroll along the Atlantic shore of St. Eustatius is spoilt by tar which accumulates on shoes and feet. Early results from a research project undertaken by CARMABI in Curaçao show tar pollution on all north coast beaches and around the industrial areas of the south coast (Debrot 1992).

Large and small spills have occurred, and while the terminals are built in such a way that spills do not immediately affect the coast of the Netherlands Antilles, neighboring islands are not always so fortunate. For example, on 15 March 1992, a pipe ruptured at the Statia Terminal and spilled 3,000 barrels of crude oil. The majority of the oil was contained onshore, but some 150 barrels were released to the sea. The oil formed a slick that remained near the Terminal Jetty for two days, but later drifted northwest out across the Saba Bank where heavy seas broke it up. According to the U. S. Coast Guard, it was a "medium spill". This was not because a large amount of oil was released to the sea, but because of the potential damage that could occur to beaches on surrounding islands. Reports of beach contamination by tar balls were eventually received from both Saba and Puerto Rico; beaches on the neighboring islands of St. Maarten, St. Barth, St. Kitts, and Nevis were not affected. St. Eustatius had only minor tar balls wash ashore, which were cleaned up by Terminal personnel. A large floating slick formed in Jenkins Bay during the spill and oil was suspended in the water column; however, an investigation a week later showed no oily residues either on the beach or in the bay. The coral reefs in the bay look healthy, but the long-term effects, if any, cannot be known at this time.

Response measures taken after the Statia Terminal spill were, in general, adequate, but the Terminal was not by any means prepared to act immediately. Booms and chemical dispersants could only be used after they had been flown in. This occurred in some cases only after 48 hours. Because of the delay, the spilt oil had already spread over a large area. The Central Government of the Netherlands Antilles flew in a team of experts to investigate the damage, and to advise the government on an appropriate course of action. The Minister of Public Health and Environmental Hygiene was annoyed by the unauthorized use of dispersants Jansol (approved by the U. S. Environmental Protection Agency (EPA)) and Correxit (not EPA-approved) and threatened the Terminal with a fine for the resulting environmental damage. The island government also issued statements of concern with regard to the use of dispersants. There were no reports of wildlife being affected by the 1992 spill, but the potential is certainly there. In 1990, a young hawksbill covered with crude oil was found in front of Kralendijk, Bonaire, and brought to Fundashon Marcultura by a fisherman. The turtle was cleaned with kerosene and detergent and remains in the care of the mariculture facility (section 3.5).

It is essential that in the case of a spill or other marine disaster, the island and national governments be in a position to move quickly to contain the damage. In this issue, the promotion of tourism works on the side of conservation because it is the crystal-clear water that attracts the tourists. Although Curaçao has finished an Oil Spill Contingency Plan and similar plans are now

being developed for Bonaire, St. Eustatius, and the Netherlands Antilles as a whole, the pace at which such plans are developed and implemented is agonizingly slow. The Terminal accident in St. Eustatius showed with perfect clarity that small islands are by no means capable of immediate action in combating even minor spills. With the exception of some harsh words, there was no leadership or direct action on the part of the Central Government either. It is clear that oil companies with facilities in the Netherlands Antilles must work according to the highest safety standards available to them. In the event of an oil spill, all materials to neutralize the effects of the accident should be on site and fully functional. In the recent case of Statia Terminal, critical material had to be flown in which resulted in major delays. Companies should not be the only ones held accountable for remiss safety practices. Island and national government officials should regularly inspect these oil facilities and should close down the operations if environmental safety standards are not up-to-date.

It is the recommendation of this Recovery Action Plan that a national Oil Contingency Plan, comprised of island-specific actions, responsibilities, infrastructure and legislation, be developed and made operational without further delay. In addition, it is the recommendation of this Recovery Action Plan that Venezuela and the Netherlands Antilles finalize their negotiation of a bilateral treaty for combating oil spills. This kind of international cooperation is essential. It is noteworthy in this regard that the Netherlands and Venezuela are both party to the Cartagena Convention, with its Protocol Concerning Cooperation in Combating Oil Spills in the Wider Caribbean Region (see section 4.32). Article 3 states, "Contracting Parties shall, within their capabilities:

(a) 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) 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 runoff and sewage

Most of the islands of the Netherlands Antilles do not have extensive agriculture or agricultural discharges, but the run-off of rain water occurs on all islands during the rainy seasons. Because of increasing coastal development, the siltation of nearby fringing reefs is quite possible. Siltation can smother and kill coral reefs and sea grass beds, which are essential habitats for sea turtles, commercial fisheries, and tourism. We recommend that vulnerable marine areas be closely monitored for affects due to runoff. On Saba and Bonaire this may be implemented under the auspices of the Underwater Parks; on the other islands it should be a priority for island governments. Mitigating measures, including erecting barriers against runoff during coastal construction, should be a prerequisite for obtaining coastal construction permits.

In the absence of an adequate sewer system to collect sewage for treatment, untreated waste, especially around urban areas, often disappears directly into the sea (section 3.1). In other areas

the sewage is collected, but is then pumped through a pipeline into deeper water, untreated. At the present time the offshore pipeline in Curaçao is broken, and sewage is routinely spilled near shore. It is the recommendation of this Recovery Action Plan that all raw human sewage be centrally treated in large capacity treatment plants. Urban coastal development near ecologically sensitive inner bays, especially Spaanse water (Curaçao) and Simpson Bay/Simpson Bay Lagoon (St. Maarten), should be required to incorporate adequate sewage collection and treatment infrastructure. Finally, sea-based sewage disposal, such as when international sailing vessels dump their sewage in the bays, should be strictly forbidden.

4.147 Anchoring

Indiscriminate anchoring on coral is a severe and growing problem in some parts of the Netherlands Antilles, as it is in the Wider Caribbean as a whole. Since there are now inexpensive and effective mooring systems available (e.g., Halas, 1985), there is little reason to continue to allow anchoring in reef or sea grass habitats. Anchoring by fishermen and recreational vessels is done both in the shallow and drop-off areas in the Netherlands Antilles. In the leeward islands the sea bottom gradually slopes to a depth of 10 m (± 25 feet), then drops off at a 45° angle to a depth of around 60 m (± 150 feet). At this depth it plateaus before dropping off again to depths of more than 600 m. This relief is observed 50-150 m from shore and on this profile a well-developed fringing coral reef has developed. The highest abundance of corals is on the edge of the slope, locally referred to as "the blue edge" because the color of the water changes from light blue (shallow area) to dark blue beyond the drop-off.

In the Underwater Parks boaters are encouraged to use either the permanent moorings or sandy areas; in Bonaire this is mandatory for boats longer than 12 feet. In Curaçao there is no mooring legislation whatsoever. Nevertheless, an additional 30 mooring buoys have recently been placed along the coast between the boundary of the Curaçao Underwater Park and West Punt in order to protect the reefs there. This mooring expansion was paid for by the island Government of Curaçao and highlights the government's continuing interest in both protecting coral reefs and stimulating diving tourism. However, local fishermen do not, for the most part, use these moorings. Serious thought should be given to implementing island legislation requiring the use of fixed moorings in designated areas, particularly in Park and other notable areas.

St. Eustatius has a variety of sea bottoms but anchoring appears to be a problem only in the vicinity of Oranjestad, where tankers throw huge anchors on top of galleons sunk during the last century, and in deeper water, where anchoring also damages live corals. In front of Oran-jestad there is a shallow sandy area with intermittent algal cover that has many historic remains of old ships. The ships are overgrown with corals and attract a wide variety of fish. Going fur-ther offshore, the sandy bottom changes gradually to patchy coral structures, sometimes with small ledges. Healthy, well-developed coral reef ridges on the southwest coast are suitable for controlled dive recreation. Snorkeling, led by a local dive shop, is already being done in shallow coral patches in Jenkins and Kay bays. At the Atlantic side, some coral development on steep slopes near shore gives way to a sandy bottom. It is the recommendation of this Recovery Action Plan that specific and mandatory anchoring locations be designated in St. Eustatius, and that the placing of special anchor buoys for large tankers be considered.

St. Maarten has well sheltered shallow sandy bays with sea grass ("turtle grass") beds (section

4.111). Many recreational sailboats anchor in these bays. According to Van't Hof (1989), "anchoring may be responsible for uprooting of the sea grasses, and this may explain the sandy craters exposing the root system of the sea grasses that were found in some areas." Unfortunately, no attempt has been made to systematically monitor the extent of damage by anchors. This should be a priority in the near future. Saba is a steep volcano rising from the sea bed thousands of feet below. As a result, only in the neighborhood of Fort Bay, Ladder Bay, and Wells Bay is there shallow bottom to anchor. At Fort Bay there are some feeding grounds for sea turtles, but the influence of the stone crusher (section 4.111) is currently much more severe than the anchoring of sailboats. New legislation has prohibited anchoring around the island except in specially appointed anchor zones and an expanded mooring buoy system is now in place around the whole island. After a few warnings by Park personnel, who patrol daily, compliance by yachts and other vessels is high. Credit is also due to a high-profile public awareness campaign. Every new boat or yacht coming through the harbor master's or marine park authority's office is given a brochure explaining the rules and regulations of the Saba Marine Park. Information is also sent to yacht guide books and related publications.

4.2 Manage and Protect all Life Stages

4.21 Review existing local laws and regulations

On a national level, the Netherlands Antilles government has passed a new fisheries law in its territorial waters (at the moment this is 12 miles, but a request has been made to the Kingdom's government for the establishment of a 200-mile Exclusive Fisheries Zone). As part of this new law, fishing on all sea turtles and marine mammals in territorial waters (in due time, to 200 miles) by commercial ships, defined as larger than 12 m and/or storage capacity larger than six bruto registered tons (GMT), is prohibited. Smaller fishing vessels must be handled by local (=island) legislation as these boats fish only near the coast. Unfortunately, only Bonaire has passed legislation which completely protects sea turtles in its coastal waters. All island laws need to be reviewed and updated. In most cases there is no specific turtle protection legislation; thus, new legislation is urgent. Relevant legislation consists of the following:

Curaçao: Island Reef Management Ordinance of 1976.

Prohibits spear fishing and the breaking and removal of live coral. No special protection of turtles, nests or eggs. STINAPA proposed in 1989 to the island government, by means of a concept decree under article 3 of the Reef Management Ordinance 1976, to grant protection to all sea turtles, spiny lobster, and queen conch. The government has not yet responded.
Bonaire: Marine Environment Ordinance (A.B. 1984, no. 21), as amended 27 June 1991. Article 14 reads:

1. It is prohibited to disturb or destroy sea turtle nests or to remove eggs from the nests; it is prohibited to be in possession of, to have for sale or delivery, to offer for sale, to sell, to buy, to trade in, to donate or to transport eggs of sea turtles.
2. It is prohibited to kill, catch or be in possession of sea turtles.
3. It is prohibited to offer for sale, sell, buy, trade in, donate, or offer as a dish in any way in public, sea turtles, sea turtle meat or other products of sea turtles.
4. Sea turtles are understood to comprise the following species: Chelonia mydas (Tortuga blanku), Caretta caretta (Kawama), Eretmochelys imbricata (Karet), Dermochelys coriacea

(Drikil), and Lepidochelys kempi.

5. The prohibition as meant in paragraph 2 can be suspended for periods of up to one year (renewable as necessary), after a hearing by the Marine Environment Commission and provided that the condition of the sea turtle population permits such a measure. This action would be administered through an Executive Council decree, which would provide regulations for the catch of sea turtles, the species, the season, quota, and minimum and maximum sizes.

The penalty for violation of the new law in Bonaire is a maximum of NAf. 5000 and/or one month in jail; relevant equipment (spear gun, car, boat) can be confiscated.

St. Maarten: No regulations.
St. Eustatius: No regulations.
Saba: Marine Environmental Ordinance of 1987.
Catching of sea turtles by foreigners is prohibited; island residents are allowed to catch two turtles per person each year. There are no size restrictions; however, no female turtles are to be caught from April to November and all turtles caught have to be reported to the Saba Marine Park Authorities. It is prohibited to disturb nests or remove eggs. The reporting system seems to work reasonably well; in any event, very few turtles are landed. Penalties for violation are a maximum of NAf. 5000 and/or one month in jail; equipment (spear gun, car, boat) can be confiscated. There have been no convictions.

4.22 Evaluate the effectiveness of law enforcement

Law enforcement is poor to nil. Regular enforcement agencies, such as the police, are over-burdened and under-staffed. The issue is complicated by the fact that environmental legislation is sometimes technical and can be too difficult for agencies trained only in general law-and-order to understand and/or to act upon. It is the recommendation of this Recovery Action Plan that island governments install special law enforcement authorities for nature conservation in general. Curaçao, Bonaire, and St. Maarten should have at least five environmental law officers each; St. Eustatius and Saba perhaps one or two each. Environmental law officers would be responsible for fisheries and wildlife law, mineral extraction, pollution and air/water quality, etc. Suitable training is essential, and should logically be provided and integrated at the national level (see also section 4.24). Finally, a larger (national) capacity to patrol and monitor marine areas is also needed.

4.23 Propose new regulations where needed

Regulations that fully protect sea turtles need to be adopted throughout the Netherlands Antilles, ideally in the context of holistic marine conservation legislation. A great advancement in this regard was made in Bonaire when, in June 1991, the Island Government of Bonaire incorporated unconditional protection to sea turtles under the amended Marine Environment Ordinance (see section 4.21). It is the recommendation of this Recovery Action Plan that the other islands quickly follow the example set by Bonaire in passing such legislation, especially since sea turtles are now fully protected by an international treaty to which The Netherlands is a Party (section 4.32). It is noteworthy that simply proposing new regulations is not enough. Once legislation has been submitted, follow-through by concerned citizens is necessary. By repeatedly asking about the status of proposed legislation, and stressing its importance, pressure can be put on the

acceptance of new and better legislation by the island governments. In the case of Curaçao, an amendment to grant protection to sea turtles was submitted by STINAPA in 1989, but government action has yet to be taken (section 4.21).

4.231 Eggs

The collection of sea turtle eggs is prohibited by law on Bonaire and Saba. Sea turtle eggs should be fully protected on all islands in the Netherlands Antilles. Nesting is relatively rare on our islands and we cannot afford to loose any of the annual breeding effort to human consumption.

4.232 Immature turtles

It is the recommendation of this Recovery Action Plan that island legislation be designed and implemented to protect all size classes of sea turtle at all times, on land and at sea. It is widely known that no one in the Netherlands Antilles can claim to depend on the capture or sale of sea turtles for their livelihood. All indications are that stocks are depleted and the time has come for protection. If harvest is deemed essential and unavoidable during some interim period, only immature turtles under a certain size should be caught. Further, the harvest should be confined to loggerheads and green turtles. In both cases, an upper size limit of 60 cm (24 inches) curved shell length should be mandated. Hawksbills, olive ridleys, and leatherbacks should be completely protected; the first two because of their very endangered status in the Wider Caribbean (Groombridge, 1982; Groombridge and Luxmoore, 1989) and the leatherback because only gravid females are likely to be encountered. It is emphasized that any harvest of juvenile turtles should be considered on a brief *interim* basis only, and only until such harvest can be phased out completely. Targeting the smaller size classes will not promote stock recovery, but it will be an improvement over the current situation (except on Bonaire, where full protection exists and the consideration of a continued harvest is not relevant) and it will provide the necessary protection to breeding adults. The spear-fishing of sea turtles should be prohibited in all areas and at all times.

4.233 Nesting females

Nesting females are protected by law on Bonaire (all times) and on Saba (April through November). Since adult females must come ashore for the purpose of egg-laying and are very vulnerable to capture during this time, it is the recommendation of this Recovery Action Plan that (1) full protection to nesting females be extended year-around on Saba and (2) Curaçao, St. Maarten, and St. Eustatius should adopt measures to protect unconditionally all sea turtles encountered on land. There is no doubt among sea turtle biologists that one of the most important components of any sea turtle population are females of breeding age (e.g., Crouse et al., 1987; Frazer, 1989). Mature sea turtles represent decades of selective survival and are very difficult for a population, especially a declining population, to replace. Furthermore, some tagged females in long studied populations, such as in Georgia (USA), have returned to the same nesting beach to lay their eggs for more than two decades (Jim Richardson, University of Georgia, pers. comm., 1991). To continue harvesting the last of our breeding turtles is to invite the extinction of remaining populations.

4.234 Unprotected species

It is the recommendation of this Recovery Action Plan that all species of sea turtle, including the rare ones, be protected by law. This will preclude enforcement complications that arise when all

species are not afforded equal protection. It is also the recommendation of this Recovery Action Plan that the new legislation protecting sea turtles in Bonaire be amended to include the olive ridley (Lepidochelys olivacea), which is declining dramatically at its primary Western Atlantic nesting grounds in Suriname (see section 2.6) and should be fully protected throughout the Wider Caribbean.

4.24 Augment existing law enforcement efforts

Until a proper environmental law enforcement authority is provided by the government, this task may logically be given to STINAPA, which is already doing these kinds of enforcement within the marine parks. It is necessary, therefore, to initiate a dialogue with the government to establish an enforcement unit within an organization like STINAPA and funded by the government. Furthermore, other local non-government environmental protection organizations should be considered for enforcement capabilities. As this Recovery Action Plan goes to press, a new island-wide clean-up campaign has been announced in Curaçao, as has the installment of a special environmental police unit. It is possible that this unit could eventually patrol beaches and enforce legislation to protect sea turtles and their eggs. Unfortunately, Curaçao has yet to enact any such legislation (section 4.21).

In the interim before all islands have established an environmental police unit, it is the recommendation of this Recovery Action Plan that a national workshop be convened for law-and-order police to familiarize them with environmental regulations. A good example of a successful initiative of this kind can be found in the British Virgin Islands, where in February 1986 a workshop entitled "Environmental Law Enforcement" was sponsored by the Eastern Caribbean Natural Areas Management Program (ECNAMP) on Tortola. All government Ministries were involved. The purpose of the workshop was to bring conservation law to the attention of all parties, and in particular the law enforcement officers. In November 1991, a Surveillance Workshop sponsored by the OECS was convened in Tortola to inform enforcement personnel from Customs, Police, Immigration, and the National Parks Trust about existing environmental legislation and the necessity for vigilant enforcement. Both workshops were well-attended (Julie Overing, BVI Conservation and Fisheries Department, pers. comm., 1992).

4.25 Make fines commensurate with product value

Very high fines should be levied for all violations of environmental or natural resource laws. This is the only way that unscrupulous persons will obey such legislation. If chances are good that offenders will be caught, that they will lose their gear and be liable for heavy fines, they may think twice before acting against the law. The current maximum fine of NAf. 5,000 in Bonaire and Saba is adequate, since the average profit from a sea turtle's meat is estimated at NAf. 400. There are no fines or other penalties in place elsewhere in the Netherlands Antilles, since the other islands lack sea turtle conservation legislation (section 4.21). To my knowledge, no one has ever been arrested or fined for violating sea turtle conservation laws.

4.26 Investigate alternative livelihoods for turtle fishermen

In the Netherlands Antilles, nobody depends exclusively upon the meat or products of sea turtles for their livelihood or for a major portion of their income. Thus, it seems reasonable that alternative livelihoods need not be considered at this time.

4.27 Determine incidental catch and promote the use of TEDs

Trawling is not done in the coastal waters of the islands because of the reef structure on most of the bottom. Thus, turtle excluder devices (TEDs), designed to let captured sea turtles escape from trawls, are not needed. However, large pelagic fish purse seiners and long-liners are present in our territorial waters and it is recommended that the Netherlands Antilles government initiate a vigorous program to control the activities of these foreign ships and to assess whether they are catching sea turtles during the course of their operations. The capture of leatherback turtles by long-lines has been documented in the northeastern Caribbean (Cambers and Lima, 1990; Tobias, 1991), the southeastern U. S. (Witzell, 1984), and in the Gulf of Mexico (Hildebrand, 1987).

At the present time, as a result of the new national fisheries law (section 4.21), all vessels larger than 12 m or six GMT are required to have a permit which states that sea turtles and marine mammals cannot be captured, nor can marine mammals be used as fish bait. This law should be enforced to the maximum extent allowable by law.

4.28 Supplement reduced populations using management techniques

The situation in the Netherlands Antilles with respect to sea turtle management is a very difficult one, due to the fact that sea turtles are not presently known to nest anywhere on our islands in any concentration. The immediate action in management is to work on better legislation and enforcement, in particular to protect beach and coral reef environments and to protect sea turtles both at sea and during egg-laying (section 4.23). In the longer term it is necessary that we adequately survey potential nesting and foraging areas in order to identify habitats important to our remaining populations (section 4.11). No expensive and/or heavily manipulative strategies, such as captive raising or "head-starting", are recommended since there are no data to show that such strategies benefit wild populations of sea turtles. Simpler technologies, such as moving eggs to protect them from dogs, traffic, poachers, or erosion, should be considered if necessary. The Conservation Manual from the Western Atlantic Turtle Symposium (Pritchard et al., 1983) includes guidance on this account, and WIDECAST is able to provide local training workshops on management techniques.

4.29 Monitor stocks

4.291 Nests

With relatively few exceptions (see Figures 2-6), sea turtle nesting is no longer reported in the Netherlands Antilles. It is partially because densities are so low that systematic nesting beach surveys have not been initiated. Consequently, the precise distribution and abundance of nesting activity has not been quantified. We are certain only that levels of nesting are much reduced from what they were a century ago. Coincident with working to improve legislation (sections 4.23, 4.3) and develop public awareness and education programs (sections 4.124, 4.4), it is necessary that the Netherlands Antilles strongly support at the government and/or non-government level a systematic survey of potential nesting habitat (see also section 4.11). This should be done daily in the early morning hours during the nesting season (April-November, inclusive) by personnel, ideally persons living near the beach, who have been trained to identify and to document evidence of sea turtle nesting. STINAPA-affiliated offices on each island are in a good position to coordinate and implement nest surveys. The WIDECAST regional Sea Turtle

Recovery Team can assist in the development of materials and seminars on basic beach monitoring techniques and sea turtle species identification. Accurate information about the distribution and abundance of sea turtle nesting would allow us to make more informed decisions regarding the conservation of remaining populations, and to monitor the numbers of animals breeding under our jurisdiction.

4.292 Hatchlings

Hatchling emergence is rarely reported. The most recent report was that of a loggerhead hatch on Curaçao in late June 1991 (section 2.1). The extent to which nesting occurs is not fully known, nor has the level of egg poaching been quantified. Nest monitoring efforts (recommended in section 4.291) should logically incorporate an assessment of hatching success. WIDECAST can provide materials upon request which will assist interested persons in the identification of sea turtle hatchlings, and their proper release should they be found disoriented or stranded.

4.293 Immature and adult turtles

Information about sea turtles from fishermen and other parties should be updated regularly. This is important to see any changes in fishing effort (or techniques) by fishermen, and to glean some information about the relative occurrence of these animals in our waters. Estimates of adult females nesting on our beaches can be made from beach surveys designed to measure such activity; estimates of juveniles and adults at sea are much more difficult to obtain. At this time we do not consider the precise quantification of juvenile turtles residing in our waters to be a priority. This will involve many years of systematic effort and our limited resources may better be spent in protecting habitat and strengthening and enforcing conservation legislation.

4.3 Encourage and Support International Cooperation

A Committee, installed by the Minister of Transportation and Communication and the Minister of Public Health and Environment (Landsbesluit 22 April 1991, no. 33; no. 5196/ JAZ), is currently working to improve national implementation of important international treaties on shipping, especially focusing on the protection of the marine environment (e.g., MARPOL, Cartagena Convention). Another judicial commission is working on the national implementation of CITES (section 4.31). Several international treaties regarding pollution of the marine environment by ships have been signed by the Kingdom of Holland, and therefore are also applicable to the Netherlands Antilles. However, as long as enabling legislation is not passed on a national level, these treaties cannot come into force. Many of these treaties are at the moment processed by the Ministerial Committee. We recommend that this process be expedited and brought to fruition as soon as possible. The most important treaties in this regard are MARPOL 1973 (with Protocol 1978) and the London Dumping Convention 1972.

The MARPOL 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. Although this will not necessarily change the environmental problem of garbage in the Caribbean (only shift it from the sea to the land), it will certainly be a positive step for sea turtles and other marine life. Since the Netherlands Antilles has not yet brought this Convention into force, we can at this time guard only against oil pollution under the existing OILPOL Convention (1954, 1962, 1969, 1971) with its national equivalent (PB 1959, no. 72; PB 1976, no. 27).

The London Dumping Convention regulates the intentional dumping of garbage and sewage at sea. It consists of a "black list" of substances that are forbidden to be disposed of at sea, and a "gray list" of substances that can only be dumped with a permit. The status of this Convention in the Netherlands Antilles is the same as with many others. It will only come into force when national legislation has been put into place. In 1986 the national equivalent of the London Dumping Convention was officially published but, due to text mistakes and other problems, it never came into force. To date, these mistakes have not been corrected. There are also other international agreements which are important with regard to the protection of the marine environment and which should be implemented by the Netherlands Antilles. These include the Intervention Convention (1969, and Protocol of 1973), the COLREG Convention (1972) to prevent marine collisions, and the recently developed Convention on Oil Preparedness, Response and Co-operation (1990).

4.31 CITES

The 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) was established to protect certain endangered species from over-exploitation by means of a system of import/export permits. The Convention regulates international commerce in animals and plants whether dead or alive, and any recognizable parts or derivatives thereof. Appendix I lists endangered species (including all species of sea turtle), trade in which is tightly controlled; Appendix II lists species that may become endangered unless trade is regulated; Appendix III lists species that any Party wishes to regulate and requires international cooperation to control trade; Appendix IV contains model permits. Permits are required for species listed in appendices I and II stating that export/import will not be detrimental to the survival of the species. CITES is one of the most widely supported wildlife treaties of all time. With the accession of Uganda in July 1991, the Convention has 112 Parties (WWF, 1992).

The Netherlands ratified CITES on 18 July 1984 (Bräutigam, 1987), but the Netherlands Antilles has not implemented the Convention because national legislation is at present inadequate. However, as a result of negative publicity in the international press on trade in protected and endangered species by the Netherlands Antilles, a Commission has recently been formed and is working to improve local legislation. The implementation of CITES now appears imminent. For the time being, an interim national decree under the Ordinance on Import and Export (PB 1968 no. 42) will come into force in 1992 that will prohibit all import and export of species listed under Annex I of CITES. It is the recommendation of this Recovery Action Plan that the Netherlands Antilles implement enabling legislation for the enforcement of CITES at the earliest possible opportunity.

4.32 Regional treaties

It is recognized that while the majority of our energy should be funneled towards much needed local protection and management of sea turtles and their habitats, there should also be coordinated actions at the field enforcement level with nations with whom turtle stocks are shared. The UNEP Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (Cartagena Convention) and its Protocol concerning Specially Protected Areas and Wildlife (SPAW) serve as important tools for the regional conservation of sea turtles. In March 1983, a Conference of Plenipotentiaries met in Cartagena, Colombia to adopt this Convention. Representatives from 16 States participated, including the Kingdom of the Netherlands. 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 seabed activities, and from airborne sources). Article 10 is of special interest in that it addresses the responsibilities of Contracting Parties to "individually or jointly, take all appropriate measures to protect and preserve rare or fragile ecosystems, as well as the habitat of depleted, threatened or endangered species, in the Convention area." The Netherlands ratified the Convention on 16 April 1984.

In January 1990, 16 nations, including the Kingdom of the Netherlands, attended a Conference of Plenipotentiaries in Kingston, Jamaica that adopted the SPAW Protocol. At a subsequent meeting in Martinique (November 1990), Jeffrey Sybesma represented the Netherlands Antilles as an invited participant at the First Meeting of the Ad Hoc Group of Experts for the Development of Annexes to the SPAW Protocol. The Group voted by consensus to recommend all six species of Caribbean sea turtles be included in Annex II, which provides full protection from all domestic harvest. This recommendation was later adopted at the Meeting of Plenipotentiaries in June 1991 in Kingston, Jamaica. The decision to include sea turtles in Annex II is a significant victory for sea turtle conservation. This single decision has the potential for prohibiting the take of sea turtles throughout the Caribbean region, at least among the Contracting Parties to the Cartagena Convention. Specifically, Annex II listing prohibits (a) the taking, possession or killing (including, to the extent possible, the incidental taking, possession or killing) or commercial trade in such species, their eggs, parts or products, and (b) to the extent possible, the disturbance of such species, particularly during periods of breeding, incubation, estivation or migration, as well as other periods of biological stress.

The Netherlands has played an important role in the adoption of the new SPAW Protocol and its Annexes, having attended both the January 1990 and June 1991 Conferences. The Netherlands ratified the SPAW Protocol in 1990 (Trb. 1990, 115) and the Annexes on 2 March 1992.

4.33 Subregional sea turtle management

We recognize that the highly migratory nature of sea turtles prevents us from discussing sea turtles that belong solely to the Netherlands Antilles. With respect to green turtles foraging in our waters, for example, we may share these stocks with the nations of Central and/or South America (in the case of Aruba, Bonaire and Curaçao) or, in the case of our Windward Islands, with neighboring West Indian nations. Further, the numbers of foraging turtles, and recruitment rates into our populations, may depend largely on the status of distant nesting colonies. None of "our" populations can be conserved if we do not take at least a binational, and preferably an international, approach to their protection. This should be done for the Leeward Islands with

Aruba, Colombia and Venezuela. For the Windward Islands, neighboring Anguilla, St. Barthelemy, and St. Kitts and Nevis should be approached and encouraged to support cooperative programs. A Consultation Mechanism between the Netherlands, the Netherlands Antilles, Aruba, and Venezuela has now been established where topics like these can be discussed and agreed upon. Recent topics of discussion have included CITES, oil spill readiness, and the protection of the marine environment.

4.4 Develop Public Education

This, concurrent with legislation and enforcement, may be the most effective way to reverse the long-term downward trend of the sea turtles. The development of educational materials on such specific topics as sea turtle conservation and the stewardship of habitats important to sea turtles must be incorporated into the programs being developed by the educational officer of STINAPA, as well as into the educational efforts of other island organizations. In STINAPA publications (STINAPA series and STINAPA documentation series), the importance of nature and its management, including sea turtle conservation, has been brought to the attention of the public for many years. To commemorate its 25th anniversary, STINAPA published a poster with educational material and the need for turtle conservation was featured. Also, the managers of the different marine parks have the authority to develop specific educational tools for certain aspects they feel need special attention.

The Environmental Service of Curaçao has a newsletter called "Imagen Ambiental" that reaches governmental desks and can be used to educate government personnel. In February 1985, a lengthy and very informative article was published in Imagen Ambiental on the subject of sea turtles (Van Buurt, 1985). In addition, Defensa Ambiental/Amigu di Tera publishes a newsletter for their members which includes important environmental information and is read by local citizens. Information regarding sea turtles should be highlighted in these publications. WIDECAST has recently designed and distributed a very useful, full-color miniposter which features photographs of the six species of Caribbean sea turtles and a simple explanation of how to distinguish one species from another. The National Sea Turtle Project Coordinator is also a key person in the development of educational material. By means of the sea turtle network, he can distribute material, such as the WIDECAST poster, throughout the Netherlands Antilles.

4.41 Residents

Local residents of the different islands should be taught the need for natural resource conservation, including endangered sea turtle protection, in school by means of their biology curricula. To stimulate the teachers to do so, STINAPA has a full-time teacher to develop such programs (section 4.124). Other initiatives from the private sector to establish educational programs for schools should be advocated and supported by STINAPA, as well as by other knowledgeable local organizations. Gerard Van Buurt has noted his interest in updating a recent Imagen Ambiental article on sea turtles (Van Buurt, 1985), translating it into Papiamentu, and providing the article to local schools. Many residents commonly eat turtle meat and need to be progressively weaned of this practice by means of a thoughtful awareness program, especially in Bonaire now that sea turtles are completely protected there (section 4.21).

The post-school age public should be addressed regularly by the different organizations that manage and protect sea turtles through the local media. The effort should be done, for example,

by STINAPA but also through the Environmental Service or local private organizations. In addition to the more traditional media (radio, newspapers, television), fixed information would be very useful in several well-visited places. For example, Lac Bay, Bonaire, is a protected area and legislation is being considered which will further restrict aquatic activities there. A large and colorful wooden sign-board on the shore of the bay near the snack bars would be an effective way to explain to residents and visitors alike the fragile and complex ecosystem of the bay, and could include information on the many turtles which forage there.

4.42 Fishermen

This is a high priority on every island, and requires a diversified approach. Fishermen on all of our islands should be made aware of fines and other penalties due for violating turtle protection laws. It will also be essential to explain why these protection laws have been necessary. Every avenue should be explored which will assist local fishermen in their efforts to make a living off native fish stocks. On those islands where there is a government fisheries department (LVV Curaçao, LVV Bonaire), it should be the duty of the fisheries officers to inform all fishermen regarding new and existing laws protecting sea turtles. Environmental organizations such as STINAPA, the Conservation Foundation, Friends of the Earth, WIDECAST, Greenpeace, etc. could participate in the educational and awareness effort by distributing informative leaflets and brochures in the fishermen's communities, sponsoring appropriate local events, and working with the public news media.

4.43 Tourists

Tourists should be well informed of laws protecting sea turtles. St. Maarten in particular, with its potential for turtle nesting and its boom in tourist development, should give strong attention to the effect of tourism on sea turtle conservation and management and should develop programs to inform tourists. Such education is also important on islands where tourists may be purchasing sea turtle products. Educational materials for tourists should be placed in airports, tourist offices, hotels, dive shops, etc. STINAPA will be working with WIDECAST to design brochures and other informative materials. In addition, a large airport display, perhaps designed to rotate among the island airports, could highlight the plight of turtles in the region, and in the Netherlands Antilles specifically. Visitors would be encouraged to avoid consuming turtle meat and purchasing turtle shells or ornaments. Importantly, an attempt to bring such items home is illegal for tourists from the United States and many other countries where endangered species products are confiscated by border officials (see CITES discussion, section 4.31).

4.44 Non-consumptive uses of sea turtles to generate revenue

It would be useful if income could be generated from the protection of sea turtles, rather than from killing them. Some hotels in the Caribbean (e.g., Jumby Bay, Antigua) sponsor and support sea turtle research and conservation projects on their beaches. At Jumby Bay, accommodations are provided to trained biologists during the breeding season and hotel guests are professionally guided to the beach to quietly witness the egg-laying. This has been extremely popular with the guests and promotes an awareness within the hotel regarding beach cleanliness, minimizing the disorientation of hatchlings due to artificial lighting, etc. If beaches are found in the Netherlands Antilles where sea turtles still nest in appreciable numbers, it may be useful to organize expeditions to allow the public to view this activity in a controlled and responsible manner. Of course if these activities are not properly controlled, the turtles may be driven away by the

disturbance. If the beach is protected as a Park, it is recommended that revenue generated from expeditions be recycled into Park conservation or interpretive programs.

Revenue is needed in support of sea turtle conservation throughout the Netherlands An-tilles, and there have been some very innovative and successful fund-raising campaigns which should be highlighted here. In 1990, Mr. Albert de Soet, a resident of Holland, spent a holiday in Bonaire and fell in love with the natural beauty of the island. One day he encountered a mature green sea turtle tied up and lying on its back awaiting slaughter on the shores of Lac Bay. He was so moved by the helplessness of the creature that he purchased the turtle from the fisher-man who had caught it and took the turtle to the other side of the island to release it. Mr. de Soet could not forget this incident, and he decided to try and do something for the turtles. With this goal in mind, he established the Bonaire Turtle Club with the objective of raising funds for the protection of the sea turtles of Bonaire. He also commissioned a specially designed sea turtle necktie that now sells for Nfl. 100 (ca. US$ 50) as a collector's item in Holland.

In addition to the sale of neckties, a major public relations campaign in Dutch magazines and newspapers has attracted a lot of attention for the Club. In February 1992, a NAf. 1000 (US$ 555) per plate fund-raising dinner was organized in Bonaire to raise money for local sea turtle protection efforts. Wealthy persons from Holland and the Netherlands Antilles were invited to attend, and speakers, including myself as the Executive Coordinator of the WIDECAST project in the Netherlands Antilles, and Roberto Hensen, Bonaire island WIDECAST coordinator, were also invited. The Prime Minister of the Netherlands and his wife (who is the patron of the Turtle Club) were in attendance. An amount of NAf. 25,000 (US$ 14,000) was raised and donated to the local representative of the Turtle Club, who is also a member of the Netherlands Antilles WIDECAST network. The money will be used to promote the conservation of sea turtles, with highest priority put on the design and distribution of a brochure and/or poster depicting the biology and status of local sea turtle species.

We highly commend the efforts of Mr. de Soet, a concerned citizen who saw a need and decided to get involved in a very real way in order to make a difference to conservation in the Netherlands Antilles. We hope that his actions, and those of the Bonaire Turtle Club, will encourage others to become involved, as well.

4.5 Increase Information Exchange

4.51 Marine Turtle Newsletter

The Marine Turtle Newsletter (MTN) is presently received by CARMABI (Curaçao), the Curaçao Underwater Park office, and the Fisheries Section (Department of Agriculture and Fisheries, Curaçao). Other interested persons are encouraged to receive the Newsletter, which is distributed free of charge and enables readers around the world to keep abreast of sea turtle research and conservation efforts. It is the recommendation of this Recovery Action Plan that all STINAPA and Marine Park offices, as well as all relevant government agencies, receive the Newsletter. The MTN is published quarterly in English and Spanish. To subscribe, write to: Editors, Marine Turtle Newsletter, Hubbs-Sea World Research Institute, 1700 South Shores Road, San Diego, California 92109 USA.

4.52 Western Atlantic Turtle Symposium (WATS)

The Netherlands Antilles was not represented at the WATS I symposium in Costa Rica, although data were compiled by Van Buurt (1984) and submitted. At the WATS II symposium in Puerto Rico, Jeffrey Sybesma was the Netherlands Antilles National Representative. He collected all available data on sea turtles in the Netherlands Antilles and presented these in a national report (Sybesma, 1987). The Netherlands Antilles hopes to continue to be involved in this valuable regional data base. The WATS Manual for Sea Turtle Research and Conservation Techniques (Pritchard et al., 1983) provides instruction and background for many sea turtle survey and management methods. It will be followed to the fullest extent when sea turtle conservation programs are implemented.

4.53 WIDECAST

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

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

The short-term objectives of WIDECAST are to provide Wider Caribbean governments with updated information on the status of sea turtles in the region, to provide specific recommendations for the management and recovery of endangered, threatened, and vulnerable sea turtle stocks, and to assist Wider Caribbean governments in the discharge of their obligations under the Protocol Concerning Specially Protected Areas and Wildlife (SPAW) in the Wider Caribbean Region (see section 4.32). The longer-term objectives are to promote a regional capability to implement scientifically sound sea turtle conservation 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, under the supervision of regional sea turtle experts, locally appropriate sea turtle management recommendations.
3. Providing or assisting in the development of educational materials (slides, brochures, posters, pamphlets).
4. Sponsoring or supporting local or subregional workshops on sea turtle biology and management.
5. Assisting governments and non-government groups with the implementation of effective management and conservation programs for sea turtles.

Beyond supporting the local and national efforts of governments and non-governmental organizations, WIDECAST works to integrate these efforts into a collective regional response to a common problem, the disappearance of sea turtles. WIDECAST is supported by the Caribbean Trust Fund of the UNEP Caribbean Environment Programme, as well as by government and non-government agencies and groups. Government and non-government personnel, biologists, fishermen, educators, developers, and other interested persons are encouraged to join in WIDECAST's efforts. Locally, WIDECAST is implemented through the Netherlands Antilles Sea Turtle Project network. This volunteer network is the most cost-effective way to gather consistent information about sea turtles, whilst at the same time promoting public awareness and support for conservation and law enforcement. For further information, please contact Jeffrey Sybesma, Sea Turtle Project Coordinator, c/o CARMABI, P. O. Box 2090, Curaçao, Netherlands Antilles.

4.54 IUCN/SSC Marine Turtle Specialist Group

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

4.55 Workshops on research and management

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 beach patrols, move eggs, survey by air, etc. Informal local workshops can be arranged by WIDECAST upon request. More formal field instruction is available from the Caribbean Conservation Corporation (P. O. Box 2866, Gainesville, Florida 32602) at their annual sea turtle training course in Tortuguero, Costa Rica.

For the most part, training needed to carry out many of the actions recommended in this Recovery Action Plan will need to be provided locally. With technical support from WIDECAST, it is recommended that STINAPA organizations on the various islands provide the necessary background to Park personnel, marine scientists, SCUBA divers, coastal developers, and other residents who are interested in monitoring the status of sea turtles. A Manual of Sea Turtle Research and Conservation Techniques, produced by the Western Atlantic Turtle Symposium (Pritchard et al., 1983), provides instruction and background for many sea turtle research and management techniques. Program managers are encouraged to follow this manual to the fullest extent when research and conservation projects are designed and implemented.

4.56 Exchange of information among local groups

Information about sea turtle research, conservation, and progress in the Netherlands Antilles is disseminated by the National Sea Turtle Research Coordinator via the various island focal points. It is then the responsibility of island-network members to further exchange this information with

specific groups interested in sea turtle conservation. Public articles, such as that recently written for "Imagen Ambiental" (Van Buurt, 1985), are useful to keep the government and the public informed and are encouraged. Only to the extent that we all remain alert and informed and agree to work together can we hope to be successful in retaining our sea turtles long into the twenty-first century. The completion of this Recovery Action Plan is a crucial first step in the exchange of information amongst concerned groups and individuals. We intend to share and use the information included herein to our maximum advantage in promoting the recovery of sea turtles in the Netherlands Antilles.

4.6 Implement Netherlands Antilles Sea Turtle Project

4.61 Rationale

Sea turtles are declining in the Wider Caribbean region. Five species of Caribbean-occurring sea turtles are recognized as *Endangered* and a sixth, the loggerhead sea turtle, as *Vulnerable* by the IUCN Conservation Monitoring Centre. A recent IUCN/CITES report on the global status of the hawksbill sea turtle states that about half the world's nesting populations are known or suspected to be in decline; in particular, "the entire Western Atlantic-Caribbean region is greatly depleted" (Groombridge and Luxmoore, 1989). Turtles are harvested throughout the Caribbean for food and are also killed for their shells, oil and skins. In addition, they are accidentally captured in active or abandoned fishing gear, resulting in death to tens of thousands each year. Oil spills, chemical waste and persistent plastic debris, as well as ongoing degradation of important nesting beaches and feeding grounds, also threaten remaining populations in our region.

Persistent over-exploitation, especially of adult females on the nesting beach, and the widespread harvest of eggs are largely responsible for the endangered status of Caribbean sea turtles. This is certainly the situation in the Netherlands Antilles (see section 1.2). The previous chapters of this Recovery Action Plan present the biology of sea turtles and what we know of their distribution around our islands. The Plan also illustrates that on all islands the living conditions for these animals have deteriorated over the years. Stresses such as habitat degradation, over-utilization, disease, inadequate regulatory mechanisms and enforcement, as well as other man-made factors have minimized sea turtle populations in and around the islands of the Netherlands Antilles. Several solutions have been proposed in this document, including the management and protection of important habitats, protection of all life stages of the different species, support for international legislation, development of public education, and greater information exchange.

In some of the islands of the Netherlands Antilles appropriate solutions have been put in place, but in others this has not occurred. Therefore, the overall picture is one of a fragmented and uncoordinated protective framework. There are many gaps. It can be concluded that, at the present time, sea turtles face a hard struggle for life in the Netherlands Antilles. Faced with this reality, a decentralized but integrated Netherlands Antilles Sea Turtle Project is proposed for immediate implementation. The details are described in the following sections. The Project takes into consideration both what we already know about our sea turtles and what we need to find out; further, it establishes priorities for short-term action.

4.62 Goals and objectives

The primary goal of this Project is to achieve a total recovery of sea turtles in the waters of the

Netherlands Antilles by eliminating all harvest and restoring living and nesting habitats. From a socio-economic perspective, it is highly unlikely that anyone will earn noticeably less money or will loose his or her job if this goal is attained. Secondary goals are to gather more data on the distribution of sea turtles in the Netherlands Antilles, with special regard to the distribution of nesting activity on the various islands, and to promote a public understanding of why the conservation and recovery of all sea turtles in the Netherlands Antilles is necessary. To achieve these goals, two objectives must be met.

First, every island of the Netherlands Antilles must implement its own sea turtle project. Because every island has its own local government, non-government organizations (NGOs) and legislation, the implementation of sea turtle conservation and recovery should be done at the island level. For Curaçao, this could be a mutual program by CARMABI and STINAPA (Dr. Walter L. Bakhuis, Director). In Bonaire, the effort should be designed and executed by the local NGO, STINAPA-Bonaire (Roberto Hensen, Director); in St. Maarten by STINAPA-St. Maarten (Francois van der Hoeven, Director); in St. Eustatius by STINAPA-Statia; and in Saba by the Saba Conservation Foundation (Tom Van't Hof, Director). Every island's sea turtle project should consist of the following elements:

1. A Lead Organization to support and execute the project.
2. A time frame within which specific objectives must be met.
3. A budget to cover expenses incurred during all facets of the project.
4. A realistic survey and monitoring program to gather data on sea turtle distribution and nesting.
5. Proposals for island legislation that provide for the complete protection of sea turtles and their important habitats; these would be submitted to local governments for consideration.
6. Increased public awareness achieved through a wide variety of media and other educational avenues.

Second, an overall project is needed at the national level to link all the island programs together. Furthermore, it is clear that important national and international legislation (CITES, MARPOL, Cartagena Convention) must be executed from the national level. The governmental agency responsible for the environment is the Department of Public Health and Environment, which is currently being restructured to place greater emphasis on the environment. As part of an effort at national integration, the following elements should be included:

1. Request/urge that every island design and implement a local sea turtle conservation project.
2. Follow-up on the different island projects and support the local organizations in their work whenever possible.
3. Draft additional legislation to protect sea turtles, ideally within the framework of much-needed national legislation to protect marine resources and the marine environment in general.
4. Produce and distribute general information (brochures or other educational materials) on regulations and the protection of sea turtles.
5. Establish communication and information exchange among the islands by means of a newsletter or other mechanism.
6. Raise and allocate funds for local sea turtle conservation projects.

Finally, it is noteworthy that STINAPA-Netherlands Antilles at Piscaderabaai in Curaçao has a special task. Being the national WIDECAST Coordinator and initiator of this Recovery Action Plan, the Curaçao office has the knowledge and the manpower to perform the task of mediator and communicator. On the national as well as on the island levels, STINAPA-N.A. can be a major partner in the implementation of sea turtle conservation projects. It can also work to identify and to obtain funding from sources where a government agency would not be competitive.

4.63 Activities

As described in section 4.62, each island project should include several activities. First, a Lead Organization needs to be selected to identify and rally other organizations for support; personnel may need to be hired or redirected to accommodate new program responsibilities. Realistic programs must be defined and implemented to accurately survey potentially important habitats (see section 4.11), assess contemporary threats (see sections 4.13, 4.14), and evaluate needed conservation strategies and management plans for critical nesting and foraging areas. Local legislation must be examined, gaps identified, and new more comprehensive legislation submitted to island councils for adoption (see sections 4.21, 4.23). Public awareness campaigns will be necessary at all levels (see section 4.4). An integrated national effort must involve educational activities such as brochures, slide presentations, regular newspaper articles, television and radio spots, etc. Fund-raising, a broad category that includes outlining a budget, identifying potential donors and submitting grant proposals, is an essential activity at all levels. Finally, actions that amplify and encourage communication are imperative. Contacts among neighboring islands should be kept alive; we must learn from each other's successes and mistakes. Regular feedback to the national government and the local WIDECAST representative will foster a greater cohesiveness amongst island efforts.

4.64 Results and outputs

Using the decentralized approach, it is anticipated that several island programs will be implemented in a relatively short period of time, perhaps by 1995. Specific results and outputs are expected to include:

1. Comprehensive legislation for each island, as well as at the national level, that protects all sea turtles at all times and major parts of their environment. The latter may be achieved by designation and support of Marine Parks or other conservation areas.
2. A better knowledge of the distribution and abundance of sea turtles, especially the nesting beaches of these animals.
3. Detailed recommendations to each island government regarding the protection and conservation of suitable nesting beaches. A balance between development and conservation must be sought in this regard.
4. A better understanding on the part of the citizenry why it is important to protect and conserve sea turtles for future generations.

4.65 Budget

Ideally we would have liked to project a budget for the activities described above so that we could proceed with fund-raising without further delay. Unfortunately this is not possible because every island needs to consider its own needs, and then tailor a program to suit its circumstances.

Nonetheless, a few observations can be made here. First, new and improved legislation for the protection of all life stages need not be costly. Specific recommendations to improve existing legislation are provided in section 4.23 of this Recovery Action Plan. Continuous pressure and persuasion at the right levels (island councils, influential political persons) will be the only way to get the required legislation in place. Second, it is likely that governments will not allocate sufficient funds specifically for sea turtle protection and conservation. Thus, it will sometimes be a better strategy to combine sea turtle protection with other actions and projects, such as habitat conservation and rehabilitation. A well written multi-faceted project proposal to the appropriate organization has a good chance of being funded.

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Figure 1. The Netherlands Antilles consists of five Caribbean islands.

The leeward islands are Curaçao and Bonaire, close to the mainland of Venezuela, while the windward islands are St. Maarten, St. Eustatius, and Saba, forming part of the Lesser Antilles archipelago. Map source: ECNAMP, 1980.

Figure 2. Reported sea turtle nesting and foraging areas in Curaçao, Netherlands Antilles (modified from ECNAMP, 1980).

Figure 3. Reported sea turtle nesting and foraging areas in Bonaire, Netherlands Antilles (modified from ECNAMP, 1980).

Figure 4. Reported sea turtle nesting and foraging areas in St. Maarten, Netherlands Antilles (modified from Meylan, 1983).

Figure 5. Reported sea turtle nesting and foraging areas in St. Eustatius, Netherlands Antilles (modified from Meylan, 1983).

Figure 6. Reported sea turtle nesting and foraging areas in Saba, Netherlands Antilles (modified from Meylan, 1983).

Figure 7. Four species of sea turtle are known to nest in the Netherlands Antilles: the Green turtle or *tortuga blanku* (Chelonia mydas), the Hawksbill or *karet* (Eretmochelys imbricata), the Loggerhead or *kawama* (Caretta caretta), and the Leatherback, *Driekiel* or *Drikil* (Dermochelys coriacea).