

1636
*Caroline -
please discard
earlier draft -
Comments welcome!*

**** SECOND DRAFT ****

May 1989

SEA TURTLE RECOVERY ACTION PLAN
for the UNITED STATES VIRGIN ISLANDS

Prepared by the
Wider Caribbean Sea Turtle Recovery Team
(WIDECAST)

Written by
- Dr. Karen Lind Eckert -
Lead Team Member

I. INTRODUCTION

Sea turtles have long played an important role in the culture and economy of the United States Virgin Islands (USVI). St. Thomian residents alive today remember their fathers and grandfathers describing the turtles as so abundant that they were a "danger" to fishermen working in small hand-crafted boats; the men complained that they could not complete two strokes without a paddle glancing off the carapace (=shell) of a sea turtle. Nesting turtles (predominantly hawksbills) were so plentiful on the beaches that they unavoidably dug up eggs laid by turtles preceeding them. This is not the case today. The islands are still characterized by countless small and often undeveloped beaches, but sea turtle nesting densities are low throughout. There are still areas where one may consistently observe green turtles and/or hawksbills foraging, but nowhere does the density approach historically reported levels.

The reasons for this are probably multifarious, but the first evidence of decline can be traced to the initiation of commercial exploitation. Nineteenth-century fishermen depended upon the abundance of turtles, both hawksbills and green turtles, to feed their families. The fishery was a sustainable one; human populations remained low and a 200-400 pound turtle fed a family for a long time. According to Joe LaPlace, a life-long resident of St. Thomas currently employed by the Division of Fish and Wildlife, nets were commonly set in the evening in front of coral ledges and crevices. Turtles were ensnared as they ventured out in the morning. There was no import or export of turtle meat or shell at this time. Eggs were taken opportunistically and shared among friends. Both men and women viewed them as a source of strength; they were associated with medicinal and aphrodisiac qualities.

In the 1920's, dealers began to buy hawksbills and export the beautiful carapace scutes (known as 'tortoiseshell') to Panama and South America. With wages averaging \$0.50/day, the \$28/lb paid for the scutes presented an irresistible temptation to catch turtles far in excess of that required for household consumption.

The waste is described as awesome. Within two years there were fewer turtles in the water and carcasses were a common sight on the beaches. Wooden turtle-shaped buoys began to be used by the fishermen in an attempt to attract turtles to the nets. The disk-shaped decoys were carved of cedar. In addition to the netting, hawksbills were captured during nesting. They were killed only for the scutes; the rest of the animal, including the meat, was discarded. There was no local cottage industry for tortoiseshell and residents do not know what became of the scutes once they were exported. However, the market was apparently a lucrative one and the dealers made a large profit. The buying came to a halt after World War II with the advent of plastics and nylon.

After the War, residents found their sea turtle populations severely depleted, particularly the formerly abundant foraging juveniles. But subsistence hunting continued (even increasing to keep pace with the expanding human population) and the harvest now had a much greater effect on remaining stocks than had been the case before commercial trade flourished some two decades earlier. Turtles were soon being imported from other islands to meet the demand. Fishermen from Dominica and St. Lucia arrived at St. Thomas in boats filled with green turtles (400-500 of them at a time) taken from Aves Island. They were purchased by butchers on St. Thomas for \$2.00 each.

The pressure on remaining sea turtle stocks continued into the 1950's. Seaside development, particularly on St. Thomas, reduced available nesting habitat. Turtles were increasingly sold to local restaurants as tourists discovered the tropical beauty of the islands. Turtle meat brought a good market price, approximately \$2.50/pound, compared to approximately \$0.50 for fish. On less developed St. Croix, however, the price may have been considerably less. George Church, a Ranger for the National Park Service in Christiansted, reports that hawksbill meat sold for 0.70/pound on St. Croix in 1969 (Park Service memo, 13 October 1969).

Some hotels used live turtles as attractions. The Virgin Island Hilton on St. Thomas sponsored "turtle races" during the 1950's and 1960's. One resident remembers being paid \$25.00 per turtle for providing four turtles to the hotel each month to be "raced" in the pool for the entertainment of the guests. The turtles were noose-caught in order to avoid injuring them in any way and they were released at the end of the month. During this same era (specifically the early 1950's), a Frederiksted resident recalls that a frequent form of entertainment among teenagers during the long summer evenings was to locate leatherback sea turtle nests on Sandy Point, St. Croix, and toss the eggs into a bonfire. "We never ate them", she said, "we just liked to hear them pop -- like firecrackers."

In 1972 it became illegal to harvest turtles nesting on the beaches of the USVI, but turtles could be taken from the water between October and April (section 4.21). The following year, the territorial law was superseded by the Federal Endangered Species Act of 1973 which declared it illegal to kill hawksbills and leatherback turtles in the United States. Initially the law was hard to enforce because it was difficult to prosecute a fisherman for unintentionally drowning a hawksbill in a net that had been legally set for green turtles. Enforcement difficulties were eased when legal protection was afforded the green turtle (1978), but populations have never recovered. Areas such as Wilks, Hard, and Sandy Bays (St. Thomas) that supported heavy nesting in the 1930's now boast 5-10 turtles per annum among them. Hull Bay and Magen's Bay also lost a considerable number of nesting turtles as

development increased. Hull Bay once supported leatherbacks, hawksbills, and green turtles; today only an occasional hawksbill is reported. In 1864, when the LaPlace family purchased Hull Bay, they never went further than the Bay for all their fishing and turtle needs (Joe LaPlace, USVI Division of Fish and Wildlife, pers. comm.). That would be impossible today.

It is interesting to note that sea turtles never played a large role in the cuisine or economy of St. Croix. According to life-long resident and current conservation enforcement officer Otto Tranberg, turtles were "never a big thing". They were considered a delicacy and the meat (mostly green turtle and hawksbill) was sold alongside fish in the market, but fishermen did not commonly target the turtles. Turtle meat was a bit more expensive than fish and was available primarily during summer and fall, when the nesting females were close to shore. Males were ensnared using buoyed (=decoyed) nets.

It is also interesting that the leatherback turtle was never harvested to any great extent on any of the U. S. Virgin Islands. Otto Tranberg remembers salted and cured leatherback meat available only infrequently in the markets. The oil, prized in the adjacent British Virgin Islands for purported medicinal qualities, was never in demand. However, there are reports of leatherbacks being killed because people were afraid of them, or because they were considered "ugly".

Today, all sea turtles are protected in the USVI by both territorial and federal law (section 4.21 this document). In addition, import and export of sea turtles or sea turtle products is forbidden under the Convention on International Trade in Endangered Species (CITES) (section 4.31). There is some evidence that the numbers of juvenile green turtles and hawksbills feeding in USVI waters are increasing. Many excellent research projects started since 1980 have raised the level of awareness about sea turtles among both government officials and the public at large.

II. STATUS AND DISTRIBUTION OF SEA TURTLES IN THE USVI

2.1 Caretta caretta, Loggerhead Sea Turtle

There are no indigenous common names applied to this species; the preferred name is "loggerhead". The loggerhead is recognized by its large head, thick, somewhat tapered carapace, and characteristically 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 molluscs and hard-shelled crabs; tunicates, fishes, and plants are also eaten. Adults attain a carapace length of 120 cm (straight-line, nuchal notch to posterior tip) and weigh up to 200 kg (Pritchard et al., 1983).

The species has a predominantly temperate distribution, with the greatest numbers of nesting females recorded along the Atlantic coast of Florida (USA) and Masirah Island (Oman). Nesting is occasionally reported in the Greater Antilles and along the Caribbean coast of Central America (e.g., Belize, Nicaragua) (Sternberg, 1981). Loggerheads are not known to nest in the USVI and they are rarely observed offshore. There are presently no data available to specify what age/size classes are observed, or whether the loggerhead is a year-around resident. Preferred foraging areas have not been delimited. In Caribbean waters, the species is considerably rarer than either the green turtle or the hawksbill.

2.2 Chelonia mydas, Green Sea Turtle

Local common names for the species include "green turtle" and "green back". The green turtle is recognized by its round, blunt beak (slightly serrated) and smooth carapace plates (=scutes) that do not overlap as they do on the hawksbill (section 2.4). The carapace is generally devoid of barnacles. Adult West Indian green turtles attain weights of 230 kg, considerably larger than their conspecifics in Central America (150 kg). Adults generally measure 95-120 cm straightline carapace length (nuchal notch to posterior tip). Individuals of varying sizes are present throughout the year.

Green turtles feed on seagrasses (Thalassia, Syringodium, Halodule) and algae. Individual turtles exhibit a tendency to return to the same area of seagrass meadow everyday to graze. Grazing creates "foraging scars" which are maintained by regular cropping for several months. The new growth, rich in nutrients and low in lignin, is preferred. Eventually the cropped grasses show signs of stress (blade thinning, increased inter-nodal distance) and the turtle abandons the scar, moving on to another area to graze.

Green turtles have been traditionally netted in the USVI (section I). The harvest of green turtles is now illegal at all times of the year (section 4.21), but a low level of illegal take continues.

Green turtles are reported nesting on many beaches in the USVI, though nowhere in large numbers (Table 1). Beaches such as Jack's Bay on St. Croix are reported to have been favorite harvesting beaches and once supported many more green turtles than are seen today. Turner's Hole, Grapetree Bay and Jack's Bay are the main nesting beaches for the species today, with Turner's Hole being the best area (Teddy Skov, pers. comm.). One Christiansted resident tells of applying fluorescent paint to the shells of green turtles nesting on Sandy Point beach (St. Croix) in an effort to assess the number of nesting females. In the early 1960's, 40-50 turtles were marked within a week! Today fewer than 10 green turtles nest during an entire year on Sandy Point.

Nesting frequency is not known but 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 are laid 12-14 days apart. The nesting season is not clearly defined and apparently extends from February into September or October. The number of eggs deposited per nest generally ranges from 125 to 150.

2.3 Dermochelys coriacea, Leatherback Sea Turtle

The leatherback is the largest and most pelagic of the sea turtles, often weighing 300-500 kg. Leatherbacks lack a bony shell and cornified epidermal scales. The smooth, black skin is spotted with white. The carapace is strongly tapered, measures 130-165 cm in length (straightline, nuchal notch to posterior tip), 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 and arriving asynchronously to nest on USVI beaches between February and July (Eckert and Eckert, 1988). Sandy Point National Wildlife Refuge on St. Croix supports 18-46 nesting females per annum (Brandner et al., 1987). A research program was initiated by the USVI Division of Fish and Wildlife on Sandy Point in 1981 and is ongoing. Since each nesting female is identified by a numbered flipper tag, the repeated sightings of tagged individuals (on the beach) has greatly increased knowledge of adult morphometrics, clutch size and frequency, remigration intervals, etc. Seasonal hatch success has been nearly doubled as a result of the efforts of scientists to collect eggs (as they are laid) from erosion-risk zones and rebury them in stable areas of the beach. Known nesting beaches are summarized in Table 1.

Leatherbacks are rarely seen offshore during the nesting season, but courtship has been observed in February off of Green Cay and in April off of Baron's Bluff, St. Croix (Toby Tobias, pers. comm.). In 1988, there were sightings of leatherbacks off Buck Island Reef National Monument (late March to June), mostly in the early morning hours (Zandy Hillis, National Park Service, pers. comm.). Recent studies have shown that the gravid females spend most of their time diving to great depths (max: 1300 m) in deep offshore waters (Eckert et al., 1986, 1989). Since leatherbacks are believed to feed predominately on jellyfish and other soft-bodied prey, the impetus behind the diving behavior may be to feed on deepwater siphonophores in the "deep scattering layer" (DSL); that is, to feed within the strata of plankton that migrate to the surface of the ocean at night and descend just below the depth of light penetration during the day. The diving may also represent thermoregulation behavior, or predator escape.

2.4 Eretmochelys imbricata, Hawksbill Sea Turtle

The hawksbill is distinguished by a narrow, pointed beak with which it prys sponges and other soft-bodied organisms from the reef. The carapace is often posteriorly serrated and the carapace scutes overlap, like shingles on a roof. Adults rarely exceed 80 kg and a carapace length of about 90 cm (straightline, nuchal notch to posterior tip). Bright mottled coloration (brown, orange, gold) is common.

Hawksbills have proven difficult animals to study and very little is known about Caribbean populations in general. Gravid females often nest on tiny, isolated beaches (including those flanked by exposed coral and rock) that are hard for biologists to reach on a consistent basis. Nesting apparently occurs with little seasonality throughout most of the year; clutches of some 120-200 eggs are laid at 13-18 day intervals. Nesting females are easily frightened and routinely retreat as far as possible into supralittoral vegetation (e.g., Coccoloba uvifera, Hippomane mancinella) before nesting. Consequently, little evidence of the nest exists aside from a faint asymmetrical crawl (about 0.7 m wide) leading to and from the ocean. Known nesting areas are summarized in Table 1.

Despite full protection during all months of the year (section 4.21), hawksbills are occasionally net-caught and occasionally speared.

2.5 Lepidochelys kempi, Kemp's Ridley Sea Turtle

There are no records of the Kemp's ridley foraging or nesting in the USVI.

2.6 Lepidochelys olivacea, Olive Ridley Sea Turtle

There are no records of the olive ridley foraging or nesting in the USVI.

III. STRESSES ON SEA TURTLES IN THE USVI

3.1 Destruction or Modification of Habitat

Briefly, the destruction or modification of terrestrial (beach) habitat has been accomplished by sand mining (section 4.131) and shorefront development (sections 4.132, 4.133). Marine degradation has resulted primarily from industrial discharges (section 4.143), oil refining (section 4.145), and dredging and indiscriminate mooring (section 4.147).

3.2 Disease or Predation

There are no data on the extent to which disease affects sea turtles or their prey items in the USVI. Two green turtles with small papillomas (0.5-1.5 cm) were caught off St. Thomas as part of an ongoing tag and recapture study; they were not subsequently recaptured (Ralf Boulon, USVI Division of Fish and Wildlife, pers. comm.). Other cases of disease have not been reported for sea turtles. With respect to prey items, there were concerns that a natural coral bleaching phenomenon that recently swept the Caribbean (1986-1987) would significantly degrade coral reef habitat. Fortunately, coral reefs affected by the disease in the USVI showed almost total recovery by 1988 and the USVI experienced < 5% mortality of corals due to the bleaching (R. Boulon, pers. comm.).

Natural causes of mortality in sea turtles differ among life stages. Eggs are lost primarily to beach erosion, feral animals (e.g., dogs) and exotic species (e.g., mongooses). Boulon (1982) estimates that 23% of the hawksbill eggs on St. John (1980-1981) were lost to mongooses, feral dogs, and/or beach erosion. On Buck Island Reef National Monument (BUIS), 9% of hawksbill nests were lost to erosion in 1988, 8% to predation (Zandy Hillis, National Park Service, pers. comm.). In the absence of ongoing efforts to move leatherback eggs in danger of inundation on Sandy Point National Wildlife Refuge (St. Croix), approximately 50% of the eggs would be lost to erosion per annum (Eckert and Eckert, 1985). The USVI Division of Fish and Wildlife (in cooperation with EARTHWATCH, Inc.) initiated this successful research and conservation program on Sandy Point in 1982.

Hatchlings are lost to feral and exotic animals, crabs, night herons, ants, sea birds and reef fishes. A large land crab (*Cardisoma guanhumi*) borrowed into four hawksbill nests on BUIS during the 1988 nesting season, consuming eggs and developing embryos (Hillis and Mackay, 1989). Boulon (1982) reports that 50-60% of the hawksbill nests on BUIS were depredated by mongooses during 1980-1981. Fortunately, intensive mongoose eradication programs on BUIS are believed to have been successful; the level of depredation on sea turtle eggs or hatchlings by all predators (including mongooses) fell below 10% in 1987 and 1988 (Z. Hillis, pers. comm.). As a result of nocturnal supervision, mongooses, ants and night herons consume <0.05% of leatherback hatchlings on Sandy Point beach, St. Croix (Eckert et al., 1984).

Juveniles and adults presumably fall prey to offshore predators such as sharks. The scutes (=carapace plates) from an approximately 28 kg hawksbill turtle were found in the stomach of a 4-meter tiger shark (Boulon, 1982).

3.3 Over-Utilization

Over-utilization of hawksbills and green turtles has been a problem throughout this century (see Section I). Turtles were harvested both for commercial purposes (tortoiseshell and meat) and personal consumption. The turtles were entangled in large-mesh "turtle nets" (with or without the use of wooden decoys), speared, or captured while nesting. Declines during the middle decades of this century in the numbers of juveniles and nesting females of both species are reported by older fishermen on St. Thomas and St. Croix. Today, all sea turtles in the Virgin Islands are protected by law (section 4.21). Several research projects are underway, both at sea and on nesting beaches, aimed at quantifying fluctuations in nesting and foraging populations, and the growth rate and fecundity of individual females (green turtles, hawksbills and leatherbacks).

Officers of the Bureau of Environmental Enforcement (BEE) contend that poaching (=illegal harvest) at the present time is higher on St. Croix than on St. Thomas or St. John. The officers explain that the theft of eggs is more common than the killing of turtles. Since egg poaching occurs on beaches, which are more accessible (and/or less traveled) on St. Croix, the problem is greatest there. On St. Thomas the large majority of fishermen (known as "Frenchies") are cautious; they are afraid of losing their boats if they are convicted under endangered species law (Joe Sutton, BEE Chief, pers. comm.). On St. Croix there is a different attitude. A depressed economy, a larger Hispanic populace, largely unvisited (yet easily accessible) beaches, and the presence of the leatherback turtle (whose eggs are collected as aphrodisiacs) contribute to a greater number of poaching incidents.

Because there is no legal market for sea turtles or their products in the USVI, international trade in meat, shell and oil is rare (see also section 4.34). Nonetheless, large commercial shipments are periodically discovered. For instance, the motor vessel "Jenny", a 44-foot Thompson trawler, was seized at Red Hook (St. Thomas) by the National Oceanic and Atmospheric Administration's (NOAA) Enforcement Division on 10 November 1988 because of its involvement in the import of 500-700 pounds of green turtle meat into the USVI from Anegada (British Virgin Islands). Three persons were implicated; one was fined US\$1,000 and criminal charges against the other two are pending (Mike Christian, NOAA Law Enforcement, pers. comm.).

"Personal shipment" (e.g., the store owner who purchases a small amount of tortoiseshell to sell in his shop, puts it in his suitcase and doesn't declare it) can also be a problem. Sometimes residents of the Lesser Antilles who are working in the USVI go home to visit family and return with small amounts of turtle meat for personal consumption. Often items are "imported" illegally as a result of ignorance on the part of the individual. In spite of

educational and enforcement programs that have now been in place for over a decade, some confusion exists among USVI residents with regard to sea turtles products (including meat and jewelry) which are legally purchased and possessed in jurisdictions outside the U.S. Visitors to, for example, Tortola or Virgin Gorda (British Virgin Islands) during the four month open season on sea turtles, can legally buy meat, shells, jewelry and other sea turtle products. These items are frequently brought back to the USVI, the owner not realizing that the prohibitions on importation subject the items to seizure and the possessor to possible fines.

3.4 Inadequate Regulatory Mechanisms

All species of sea turtles are completely protected at all times of the year in the USVI (section 4.21). The BEE has the responsibility for enforcing all environmental laws (mineral, fisheries, game, endangered species). In January 1986 all BEE officers were deputized to act as federal officers when making arrests under the Endangered Species Act or the Marine Mammal Protection Act. Thus, adequate regulatory mechanisms are in place. The current needs are three: (1) providing enforcement agents with the resources (e.g., marine and terrestrial transport) necessary to carry out their responsibilities, (2) encouraging the judiciary to prosecute cases to the fullest extent of the law, and (3) educating the public to participate in the enforcement process by reporting violations of sea turtle protection laws. See also sections 4.22, 4.24.

3.5 Other Natural or Man-made Factors

Boat- or fishing-induced injury (and mortality) occurs in the USVI. Sea turtle mortality due to propeller wounds was reported in the USVI in 1982 (12.5 kg/51.2 cm hawksbill turtle), 1983 (53.3 cm green turtle), 1985 (37.5 cm green turtle) and 1987 (35.0 cm green turtle) (Boulon, 1987). In addition, on 9 September 1987 a 51 cm (curved carapace measure) green turtle was found dead floating southeast of BUIS nearshore waters. The wound, a laceration across the back of the neck, was indicative of propeller cut (Zandy Hillis, National Park Service, pers. comm.).

A leatherback turtle was found entangled in a fish trap buoy line four miles north of Christiansted harbor by sportfishermen. The turtle had become entangled in the trap line inshore and dragged the entire trap off the shelf edge four miles offshore. The weak turtle was encircled by two small sharks at the time of its discovery by the sportfishermen. The turtle was released and swam away (Toby Tobias, USVI Fisheries Officer, pers. comm.). In 1988, a hawksbill was released from one of the underwater trial mooring lines by a Buck Island Reef National Monument Concessioner early in the morning. The turtle had become entangled in the hanging mooring line and had become hopelessly ensnared as it swam around and around in its attempts to escape. The turtle was released, apparently unharmed (Z. Hillis, pers. comm.). In 1989,

the crew of the longline vessel "Miss Shannon" released a small green turtle (5 kg) entangled in discarded netting south of St. Croix (Toby Tobias, pers. comm.).

Hurricanes David (August 1979) and Frederic (September 1979) caused substantial damage to shallow Acropora palmata reefs off St. Croix (Rogers et al., 1982, 1983). In 1980, some 95% of the leatherback turtle nests laid on Sandy Point beach (St. Croix) were lost to Hurricane Allen (Otto Tranberg, Bureau of Environmental Enforcement, pers. comm.). Other natural and man-made factors affecting the survival of sea turtles and eggs have not been identified in the USVI.

IV. SOLUTIONS TO STRESSES ON SEA TURTLES IN THE VIRGIN ISLANDS

4.1 Manage and Protect Habitat

It is intuitive that protecting sea turtles and their eggs from harm is only the first step in our commitment to the survival of these gentle creatures. Important foraging and nesting habitat must also be afforded protection. An important step in this direction was taken in 1984 when Sandy Point beach on St. Croix was declared a National Wildlife Refuge because of its importance as a nesting ground for the leatherback sea turtle. The National Park Service also maintains protected areas that are important nesting and foraging areas for marine turtles; these include Virgin Islands National Park (St. John) and Buck Island Reef National Monument, north of St. Croix.

The protection of beaches important to sea turtles need not mean that they be closed to the public. On the contrary, the beautiful beach at Sandy Point now enjoys more day visitation than ever before because personal safety has increased due to increased surveillance by enforcement personnel. Similarly, because research personnel are on the beach all night, fishermen and their families are more apt to visit the beach in safety. School children come to the Refuge at night under the supervision of research personnel to enjoy the thrill of seeing giant leatherback turtles nesting.

On Sandy Point, beach protection and sea turtle research support enforcement efforts. Similarly, the presence of National Park Service personnel monitoring hawksbill nesting on Buck Island Reef National Monument has resulted in a decline of illegal nocturnal activity on this small island.

In addition to the protection of nesting beaches, the management and protection of marine feeding habitats is necessary. Maintaining the integrity of coral reefs and sea grass beds not only benefits sea turtles, but maintains the integrity of fisheries resources as well. A pristine marine environment also enhances tourism, which is a major source of income to the USVI.

4.11 Identify essential habitat

Ralf Boulon (1982) estimates that the USVI includes some 278 km of coastline and 1,972 km² of continental shelf area. It is not likely that the resources requisite for a thorough survey of this territory will be available in the foreseeable future. Therefore, in order to ascertain what areas are particularly important to sea turtles, we must make use of historical records (e.g., Schmidt, 1916), the accounts of fishermen, divers, and residents, and scientific notes when available. Once areas of importance are identified, management plans should be designed and implemented (section 4.12).

4.111 Survey foraging areas

A comprehensive survey of sea turtle foraging habitat in the USVI has never been done. Nonetheless, there are excellent data available for some areas. Ralf Boulon (USVI Division of Fish and Wildlife) has spent several years observing and capturing foraging sea turtles in the waters of St. Thomas and St. John. The following table is modified from Boulon (1982); numbers are estimated from direct weekly observation from boat and beach. [*= updated numbers from Boulon, pers. comm.]

<u>Location</u>	<u>km²</u>	<u>Species (Number)</u>
Francis Bay, St. John	1.50	<u>C. mydas</u> (10-15)* <u>E. imbricata</u> (4-5)
Maho Bay, St. John	1.00	<u>C. mydas</u> (10-15)* <u>E. imbricata</u> (3-4)
Caneel Bay, St. John	2.00	<u>C. mydas</u> (1-2) <u>E. imbricata</u> (4-5)
Brown Bay, St. John	1.00	<u>E. imbricata</u> (2-3)
Hawksnest Bay, St. John	1.00	<u>E. imbricata</u> (4-5)
Salt Pond Bay, St. John	0.75	<u>E. imbricata</u> (3-4)

Estimates of foraging in some areas off St. Thomas have been gleaned from mark and recapture studies by Ralf Boulon. The following information is taken from Boulon (1982); numbers were estimated using the Schnabel population estimator.

<u>Location</u>	<u>km²</u>	<u>Species (Number)</u>
Magens Bay, St. Thomas	4.00	<u>C. mydas</u> (107) <u>E. imbricata</u> (57)
Red Hook, St. Thomas	1.50	<u>C. mydas</u> (47)
Thatch Cay, St. Thomas	1.00	<u>C. mydas</u> (33)
Smith Bay, St. Thomas	0.50	<u>C. mydas</u> (18)
Little St. James Island	1.00	<u>C. mydas</u> (59)

There have been no comparable studies on St. Croix.

4.112 Survey nesting habitat

Comprehensive beach surveys have been done in some areas, and in other areas the reports of residents and enforcement officers are available (see Table 1). Surveys for nesting activity are not difficult, but they are time-consuming and must be done in a systematic way in order to yield useful data. It would be very useful if an active membership group such as the Virgin Islands Conservation Society could sponsor a "survey" whereby members living on or near beaches would take it upon themselves to conduct morning walks 3-4 times weekly and document nesting activity (i.e., nesting crawls). The most urgent need at the present time is to clarify whether, particularly on St. Croix, hawksbill and/or green turtles are nesting on any given beach.

There are currently several small-scale projects in the planning stages by private home owners and hoteliers. Hopefully, 1989 will be a "pilot year" for cooperative beach survey programs. The St. Croix Environmental Association is assisting with the ongoing Sandy Point Leatherback Project, as well as with Manchenil as the new hotel is initiating a turtle monitoring program there ... this was from Zandy, Rafe-- can you expound? (Diamond Katura?) What about Candle Reef? 'Turtle Run'?

Bureau of Environmental Enforcement (BEE) officers have, particularly on St. Croix, made note of sea turtle activity during morning beach patrols for several years. The information resulting from this invaluable volunteer activity should be regularly collated by either the BEE or the Division of Fish and Wildlife (as was done in preparation for the WATS I and WATS II reports, see Table 1).

4.12 Develop area-specific management plans for important foraging and nesting areas

A few important foraging and nesting areas in the USVI are fully protected because they exist within National Parks (St. John and surrounding waters), National Monuments (Buck Island and surrounding waters), or National Wildlife Refuges (Sandy Point, St. Croix) (see section 4.1). Sea turtle research is ongoing in all three areas and much has been learned about sea turtle ecology from these studies (e.g., Zullo, 1986; Hillis and Mackay, 1989; Boulon et al., 1988; Eckert and Eckert 1983, 1985; Eckert et al. 1982, 1984; Basford et al., 1986; Brandner et al., 1987; Frazer and Boulon, in prep). Aside from the moving of eggs threatened by inundation (Sandy Point National Wildlife Refuge), the eradication of exotic predators (Buck Island), and the control of visitation to some heavily traveled nesting beaches within Virgin Islands National Park, no specific management plans exist for sea turtles in the USVI beyond their full protection in all places and under all circumstances.

Area-specific management may involve a wide array of options, from designation of an area as a Park or protected area (and enforcement of existing regulations barring the take of turtles and eggs) to more elaborate solutions such as the establishment of a hatchery for eggs threatened by erosion or feral animals. In any case, mooring (section 4.147), dredging (section 4.147), sand mining (section 4.131), sewage and garbage disposal (sections 4.143, 4.144), land reclamation (section 4.147), artificial lighting (section 4.132), and the construction of seawalls and jetties (section 4.133) should be closely evaluated in important foraging and nesting areas. Excellent guidelines for selected management techniques are available in the Manual of Sea Turtle Research and Conservation Techniques (Pritchard et al., 1983).

4.121 Involve local coastal zone entities

Any and all shoreline development/alteration/renovation must have a Coastal Zone Management (CZM) permit which, with the accompanying Environmental Assessment Report (EAR), is reviewed by all local and federal government agencies for environmental impact (including endangered species). Permits have in the past been denied based upon potential impacts to sea turtle nesting and/or foraging areas (Ralf Boulon, USVI Division of Fish and Wildlife, pers. comm.).

4.122 Develop regulatory guidelines

When areas are defined as especially critical to remaining sea turtle stocks, regulatory guidelines should seek 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 carry the requirement that beach-front lighting be designed in such a way as

to prevent the disorientation of hatchlings or nesting adults (see section 4.132). Activities such as jetties, sea walls (section 4.133), sand mining (section 4.131) and dredging (section 4.147) should be regulated in such a way as not to result in the erosion of terrestrial nesting habitat. Similarly, boaters should be prevented from indiscriminate mooring in reef or seagrass foraging areas (section 4.147). It is notable that the National Park Service is enforcing mooring and anchoring restrictions in all bays on St. John (R. Boulon, pers. comm.).

Several cooperative beach monitoring programs are emerging from regulatory guidelines put forth by Coastal Zone Management, Department of Planning and Natural Resources (USVI Government). Three developers have been required to design and submit sea turtle monitoring programs for their area developments. A local private contractor, BioImpact, has been involved with the design of these programs. The developments are Diamond Katura (Manchinel Beach, St. Croix), Turtle Run (on the northshore east of Green Cay Marina on St. Croix), and . These guidelines, mandating sea turtle monitoring programs, are imperative if sea turtles are going to survive continuing coastal development in the U.S. Virgin Islands.

4.123 Provide for enforcement of guidelines

Enforcement is important to the perpetuation of any management program. Guidelines should be formulated with the community in mind so that a general acceptance of the guidelines will emerge on the part of residents and users. Civic groups, proximal residents, and frequent commercial users (e.g., fishermen, divers) should be made thoroughly familiar with the management program and be responsible for reporting any violations that occur. In this way, limited enforcement personnel will not have additional burdens placed upon them. This does not lessen the importance, however, of familiarizing enforcement officers with regulations and making sure that all reports of violations are properly addressed by the appropriate enforcement entity. See sections 3.4, 4.22 and 4.24 for more discussion of law enforcement.

4.124 Develop educational materials

Public education is crucial to the long-term success of any legal protection of endangered species. There are several agencies participating in environmental education in the USVI. The Bureau of Environmental Education (USVI Division of Fish and Wildlife) has a slide show with cassette narration that is available for use by schools and civic organizations entitled, "Sea turtles of the United States Virgin Islands". In addition, in 1987 the U.S. National Park Service (Virgin Islands National Park) contracted Scott and Karen Eckert to develop a narrated slide show on USVI sea turtles for use in the Parks. The Park Service has since modified that slide show for distribution to

schools and libraries in the USVI as part of the Virgin Islands National Park Environmental Education Program. A lovely pamphlet, entitled "Season of Survival: The Nesting Ritual", was produced in 1988 by the Cooperative Extension Service (University of the Virgin Islands) to inform the public about the leatherback turtles nesting on St. Croix.

The Sandy Point Project has had a strong public outreach program since the research began in 1982. Hundreds of elementary school children have been escorted to the beach to witness the nesting process, Country Day High School students have conducted independent projects by participating in the research and, beginning in 1988, Central High School students have served as interns on the Project with the hopes of serving as guides for the Refuge in coming years.

Prior to initiating the pilot sea turtle monitoring program at Buck Island Reef National Monument (BUIR) in 1988, the Park Service conducted educational programs for the BUIR Concessioners, St. Croix Dive Club, and the general public. These programs offered education in sea turtle conservation and included a plea for volunteer participation in the nocturnal monitoring program on BUIR. This opportunity to work with the Park and to observe hawksbills nesting was also advertised in the newspaper, and response was favorable. Plans for the 1989 research and monitoring season again include a series of public presentations, possibly in conjunction with the Sandy Point Leatherback Project, to solicit volunteer participation and stimulate public concern for sea turtles in the Virgin Islands.

Community presentations about sea turtles are available upon request and are offered by the Field Directors of the Sandy Point Leatherback Turtle Research Project, USVI Division of Fish and Wildlife personnel, BEE and federal (National Marine Fisheries Service) enforcement officers, and National Park Service personnel. All of these efforts are strongly encouraged. For additional discussion on environmental education, see section 4.4.

4.13 Prevent or mitigate degradation of nesting beaches

4.131 Sand mining

With the establishment of the Sandy Point National Wildlife Refuge in 1984, legal sand mining around the salt ponds on the peninsula was terminated. Removal of sand from USVI beaches is against the law, but occurs illegally (at low levels) in several areas.

4.132 Lights

According to Boulon (1982), the following beaches are affected to a greater or lesser degree by artificial lighting: St. John: Caneel Hawksnest, Maho Bay, Chocolate Hole; St. Thomas:

Mandahl Bay, Hull Bay; St. Croix: New Fort Beach, Shoy's Beach, Teague Bay, Smuggler's Cove, Boiler Bay, Grape Tree Bay, Turner Hole, Rod Bay, Ha'penny Bay, La Grange (HESS oil refinery), Sprat Hall, Butler Bay, Hams Bay, Cane Bay, Rust-Op Twist, Turquoise Bay, Judith's Fancy. The Frederiksted public beach also has bright lighting (Toby Tobias, pers. comm.), and illumination from stadium/ballpark lights in Frederiksted is distracting to hatchlings as far away as Sandy Point (Eckert, pers. obs.).

Sea turtle hatchlings orient to the sea using the brightness of the open ocean horizon as their primary cue. When artificial lights are present landward of the nesting beach, hatchlings orient toward bright artificial light sources instead of the ocean horizon. Under these circumstances they will crawl toward security lights, street lights, private homes, recreational facilities, and other sources of night lighting. The result is that the little turtles are run over by passing vehicles, eaten by dogs and other domestic pets, or die from exposure in the morning sun. Hawksbill hatchlings have ended up on the grounds and in the cottages of Cottages-By-The-Sea in Frederiksted (St. Croix) after being attracted to security lights. In each case, cottage guests have collected the little turtles and returned them safely to the sea (Pat and Mac McFee, Proprietors, pers. comm.). Hawksbill hatchlings have also been reported to be disoriented by stadium lights (Philibosian, 1975).

Nesting female sea turtles are also disoriented by artificial lighting. On Anegada, in the neighboring British Virgin Islands, a leatherback came ashore to nest in May of 1988 and died in the morning sun after being disoriented by the security lights of a local business (Bert Lettsome, BVI Ministry of Natural Resources and Labour, pers. comm.).

It is very important that developers and residents alike understand that sea turtles are very sensitive to light during their reproductive period and as newly emerged hatchlings. Lights should be shielded from shining directly on the beach; the most common method for accomplishing this is to leave (or plant) a vegetation buffer between the sea and the development. Coastal developments in many parts of Florida (USA) are required to turn lights out during specified evening hours during the hatchling season so as to reduce the effects of disorientation.

In the USVI, an overview of the problems posed by beachfront 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 (R. Boulon, pers. comm.).

In Barbados, Dr. Julia Horrocks (WIDECAST Country Coordinator) has sent out a letter to all hotels and restaurants

built near the beach asking two things, (1) that security personnel report incidences of sea turtle nesting on the beach, and (2) that lights shining on the beach be redirected or shaded during the breeding season. If the latter is impossible, she asks if personnel would look around the grounds each morning and "rescue" hatchlings that have mistakenly crawled away from the sea. A similar notice is being prepared by WIDECAST in the British Virgin Islands. This kind of communication is encouraged in all countries of the Caribbean. Coastal developers, residents and hotel owners cannot be expected to be sensitive to an issue that they know nothing about.

4.133 Beach stabilization structures

Beach stabilization structures, such as those used at Grapetree Bay Hotel to retain artificial beach sediments, may cause accelerated erosion and the loss of adjacent natural beach sediment deposits (potentially important for sea turtle nesting). A case in point is the breakwater completed for Green Cay Marina which resulted in the disappearance of a good leatherback nesting beach just to the east.

4.134 Beach cleaning equipment

Mechanized beach cleaning equipment is not currently in use in the USVI.

4.135 Beach rebuilding projects

There are no projects planned or underway to rebuild, or "renourish", beaches in the USVI. I have heard that Carambola Resort at Davis Bay has extensively readjusted beach sands to attempt to make a larger and more "pleasant" beach -- anyone know for sure?

4.14 Prevent or mitigate degradation of marine habitat

4.141 Dynamiting reefs

The dynamiting of coral reefs (e.g., to provide access clearance for marine vessels) is not known to occur in the USVI.

4.142 Bleaching reefs

The use of chemicals, such as chlorine bleach, to stun reef fish or catch lobster is illegal in the USVI and is not known to occur. (The natural "bleaching" phenomenon discussed briefly in section 3.2 is not the intended subject of this section).

4.143 Industrial discharges

Hawksbill hatchlings have been reported floating with seaweed rafts in Christiansted harbor, therefore the raw sewage commonly

reported in the harbor may be a concern as far as sea turtles are concerned. There have not been any systematic studies conducted on the potential effects of effluents discharged by HESS Oil Refinery and Martin Marietta (the latter closed in the mid-1980's, but is currently negotiating a re-opening) on sea turtles or their habitats. Marcia -- if you could fill in with your knowledge of the "TPDES", that would be great!

4.144 At-sea dumping of garbage

The dumping of waste at sea is recognized as a growing problem in the USVI, as it is throughout the Caribbean. Dumping violations by the boating community are difficult to monitor and require a concentrated effort at public education, coupled with convenient places to safely dispose of refuse on shore and stiff penalties for offenders. In May 1988, large quantities of garbage from the cruiseship line 'Princess Cruises' was found on BUIS beaches with intact itineraries and lotion bottles which had all been dumped overboard in large green garbage bags -- presumably expected to sink. Also in 1988, a BUIS Concessioner reported spooking a hawksbill turtle from a plastic bag it was attempting to consume.

A 1986 Press Release by the USVI Division of Fish and Wildlife stated, "It has recently come to the attention of local marine biologists that a number of charter fishing boats and maybe others get rid of their used or unwanted fishing line by discarding it overboard while at sea. ...during the last several years a number of endangered sea turtles have been found entangled and/or strangled in discarded fishing line." The Release described how the nearly invisible monofilament line was a hazard both to sea turtles and to SCUBA divers and urged boaters to "put [discarded fishing line] in a box or cooler on board and dump it when back ashore." Balazs (1985) offers an excellent summary of the general problem in his article, "Impact of ocean debris on marine turtles: entanglement and ingestion".

It is a welcome sign that on 1 January 1989, laws regulating at-sea and coastline disposal of waste became effective. The U.S. ratified "Annex V" of the International Convention for the Prevention of Pollution from Ships, bringing the number of ratifiers to over 50% of the world's fleet, and effectively implementing an international anti-plastic law for one year. This law applies to all commercial vessels and to private craft over 16 feet in length. Large receiving ports and fish dealers with dockside facilities are now required to develop adequate waste management systems and will be inspected by NOAA and the Coast Guard for compliance. For more specifics (e.g., application of Annex V to military vessels), you may contact the Coast Guard at (202) 267-0931.

4.145 Oil exploration, production, refining, transport

Experimental drilling for oil was conducted north of Tortola (British Virgin Islands) during the early 1980's, apparently without success. Since that venture, no additional exploration activities have been conducted in the vicinity of the USVI.

Transport, particularly of crude oil to the HESS Oil Refinery on St. Croix, could pose a significant threat to nesting beaches (including Sandy Point National Wildlife Refuge) in the event of a spill. This has not happened, and the deep-water approach and well marked channels into the facility appear to be conducive to avoiding another EXXON Valdez disaster. Nonetheless, there are periodic "minor spills", perhaps simply cases of bilge flushing, which result in oil and tar balls washing ashore (Sandy Point, St. Croix: Eckert, pers. obs.). Are there "oil spill contingency plans" in the VI?

4.146 Agricultural discharges (runoff)

Perhaps one minor advantage of development not generally recognized is that on the islands of St. Thomas and St. John, in particular, it has resulted in the value of land escalating to the point that the agricultural use of land can no longer be financially justified -- hence, there is little threat of toxic runoff from agricultural chemicals. St. Croix still supports a limited agricultural industry, but there is no evidence that it contributes to pollution of sea turtle nesting beaches or offshore feeding areas.

4.147 Others (e.g., mooring, land reclamation, dredging)

In April 1989 there was an almost total die-off of fish, crabs, and other sealife at Enighed Pond on St. John, reportedly the result of an "oxygen deficiency". No contributing cause was identified, but a number of questions concerning the effluent from the St. John sewage plant (which flows into the pond) were raised. There has been similar concern expressed in the past concerning the runoff from the Bovoni landfill on St. Thomas, which pours into the mangrove lagoon on East End. This is a major spawning area for lobster and various species of fish. It is not apparent that the condition is having any serious consequences for sea turtles, but the general condition should not be allowed to deteriorate any further.

Dredging and land reclamation activities affecting the coastline and inshore waters are conducted only pursuant to permit after review by the National Marine Fisheries Service Habitat and Conservation Division, and the Army Corps of Engineers.

4.2 Manage and Protect all Life Stages

4.21 Review existing local laws and regulations

Virgin Islands Code, Chapter 9A, Title 12, Section 318 (21 November 1972 amendment) "Protection of marine turtles, nests and eggs; penalties" reads:

(a) It is the intent of the Legislature of the Virgin Islands to contribute to the preservation of marine turtles in the Caribbean area, said turtles now being close to extinction.

(b) It shall be unlawful for any person to take, kill, possess, mutilate or in any way destroy any loggerhead, leatherback, hawksbill, ridley or green turtle or other sea turtle, or take or possess any part thereof while such turtle is on the beaches of the Territory at any time, or to take or possess any such turtle in the Territorial waters during the months of May through September, inclusive, of each year and at such other times as the Commissioner may by rule and regulation prescribe. [Note: This open season is superseded by the Federal Endangered Species Act of 1973 which protects turtles year around]. It shall be unlawful to import, trade, sell or in any way deal in young sea turtles of any kind; Provided, however, That the Commissioner may issue written permission to any licensed or publicly owned zoo or exhibitor of marine life to capture such young turtles for purposes of live exhibition.

(c) No person may take, possess, disturb, mutilate, destroy, cause to be destroyed, sell, offer for sale, transfer, molest or harass any sea turtle nest or eggs at any time.

(d) Any person violating any provision of this section is guilty of a misdemeanor and shall, upon conviction thereof, be punished by a fine not less than one hundred (\$100) dollars not more than six hundred (\$600) dollars, or by imprisonment for a period not to exceed one (1) year, or by both such fine and imprisonment.

In addition to protection afforded by territorial law, all species of sea turtles are protected at all times of the year in the USVI under the United States Federal Endangered Species Act (ESA) of 1973. For criminal violations under the ESA, persons "shall, upon conviction, be fined not more than \$20,000 or imprisoned for not more than one year, or both." In addition to fines and/or imprisonment on each count, any equipment, vessel or other conveyance used in a violation is subject to seizure and forfeiture to the U.S. government (see section 3.3). The leatherback, Kemp's ridley and hawksbill turtles have been protected under the ESA since 1970; the green, olive ridley and loggerhead turtles were listed in 1978.

Under terms of an Cooperative Enforcement Agreement, all USVI Officers are deputized to enforce the U.S. Endangered Species Act and no cases have been filed under USVI regulations during the past twelve years. Act 3330-section 305(c) states, "Any Conservation officer may at any time seize or take possession of any salt water or aquatic products which have been unlawfully caught, taken, processed or which are unlawfully possessed or transported in violation...". Section 305(d) states, "Conservation officers ... may seize any vessel and its cargo or other equipment used in violation of this chapter of its regulations." In addition to his authority under Territorial law, the Officers also have full authority to seize under the provisions of the ESA when acting as Federally deputized personnel. This authority applies to all vessels, guns, vehicles, aircraft, equipment, etc. employed in any way in committing a violation of the ESA.

4.22 Evaluate the effectiveness of law enforcement

The Bureau of Environmental Enforcement (BEE) has the responsibility of enforcing all environmental law (minerals, fisheries, game, endangered species) (see also section 3.4). Despite this enormous responsibility, there are only 14 BEE officers on St. Thomas, six on St. Croix and one on St. John (in contrast, there are 300+ police officers). In addition, BEE officers are paid 1/3-1/2 the salary of police officers; thus, motivation and recruitment are constant challenges (Joe Sutton, BEE Chief, pers. comm.). Another obstacle to optimum law enforcement is that (boat) registration fees, mooring fees, fines, etc., go into the USVI general treasury rather than to the BEE. If these monies could be routed to the BEE, they could assist in the purchase of transportation and equipment. Finally, it has been difficult, in the past, for officers to gain permission to work over-time, or to work at night. Since sea turtles nest during the night, protection of nesting females has been limited. It has recently been proposed that BEE officers (on St. Croix) work in shifts which will allow surveillance of beaches at least until 0300 hrs. This proposal is strongly encouraged, and hopefully it will be initiated on St. Thomas as well.

It is essential to the morale of BEE officers that cases are prosecuted to the fullest extent of the law. Unfortunately, the cooperation and support of the judiciary has not always been high. Under the present system, an officer has the choice of routing the prosecution of a documented violation through criminal or civil court. In the criminal system, the problem in the past has been with the Magistrate (judge). Even when a guilty verdict is handed down, the "penalty" has been as lax as 6 days of unsupervised probation. Equally frustrating is the fact the jail time, when awarded, has not proved to be an effective deterrent (J. Sutton, pers. comm.)

Civil prosecution, resulting only in a fine and not in a jail sentence, has been more effective than criminal prosecution in cases of sea turtle violations. The major challenge here is collecting the fine (which is currently levied at \$2,500 for the first violation). The convicted person has 30 days within which to appeal. Following this period, the fine becomes binding and a schedule for payment is set. Often the schedule requires only that a token amount be paid each month (e.g., \$5-50), but there is no collection agency and the fine is easily ignored. There is no penalty for the non-payment of fines unless suit is brought by the National Marine Fisheries Service in U.S. Federal Civil Court. During this process, the judge can order payment of the fine and, if it is not forthcoming, find the convicted person in contempt of court and order a jail sentence. However, this is a moot point because suit has never been brought and, as has been stated, jail has not been shown to deter poaching.

Despite the difficulties posed by low wages, a shortage of officers, and an inadequate equipment budget, law enforcement is surprisingly effective. A summary follows:

1984: Twenty investigations were made pertaining to reported endangered species violations in the USVI. These activities resulted in the seizure and forfeiture to the U.S. government of: 1 stuffed green sea turtle, 7 green sea turtle shells, 2 hawksbill sea turtle shells, 2 commercial shipments of sea turtle jewelry (valued at \$500) and 8 pounds of sea turtle meat. Agents conducted five arrests for the taking and possession of endangered species parts with civil fines totalling \$9,250.

1985: Endangered species investigations conducted within the USVI territorial limits consisted of 15 activities resulting in seizure and forfeiture to the government of 3 hawksbill sea turtle shells and 4 green sea turtle shells. Five arrests for taking and possessing sea turtles parts resulted in civil fines totally \$15,000.

1986: Endangered species investigations conducted within the USVI territorial limits produced 15 civil cases comprised of 69 counts of possession, taking and import. These activities resulted in the seizure of 83 pounds of turtle meat, 4 hawksbill shells, 2 hawksbill carcasses, 9 green sea turtle shells, 1 live green sea turtle, and 43 pieces of jewelry. Dispositions of the cases included 9 abandonments to the government, 3 forfeitures to the government, and \$8,750 in fines.

1987: Three civil cases comprised of 5 counts of possession and taking resulted in the seizure of 5 pounds of green sea turtle meat, 108 green sea turtle eggs, and 130 hawksbill sea turtle eggs. In addition, two criminal violations were processed for two green turtle carcasses (195 pounds of meat) and 538 green sea turtle eggs. Dispositions of the civil cases include three forfeitures to the government and one \$5,000 assessment. The

criminal cases resulted in sentences of one year in jail with no time off for one subject (a repeat offender), and one year in jail with 8 months suspended for the other.

1988: Investigations of endangered species violations within the Territory of the Virgin Islands during CY 1988 produced three civil cases and five criminal cases. Civil "Notices of Violation" resulted in the forfeiture of \$150.00 in tortoiseshell jewelry boxes, one hawksbill and one green sea turtle shell, and penalties of \$500.00. Criminal charges resulted in the forfeiture of 50 pounds of green sea turtle meat, 13 green sea turtle eggs, and one vessel appraised at \$140,000.00. Sentences included a \$1,000.00 fine and one year suspended jail sentence, and two sentences of six months with one year probation and 80 hours of community service. Cases against two of the criminal defendants remain pending -- one subject with an extensive arrest record fled the islands and is currently being sought by NOAA on a Federal warrant.

4.23 Propose new regulations where needed

Existing regulations are adequate for the protection of eggs, nesting females, and juveniles; no new regulations are deemed necessary. All species are covered by existing legislation (section 4.21).

4.231 Eggs

4.232 Nesting females

4.233 Immatures

4.234 Unprotected species

4.24 Augment existing law enforcement efforts

Commercial divers and fishermen should be encouraged to support local law enforcement efforts. Both groups are in unique positions to monitor offshore damage to habitat and illegal harvest, as well as to exert peer pressure to prevent violations. The owners of residential and commercial (e.g., hotel) beach-front property should also be enlisted to report sea turtles caught (or eggs collected) and any incidences of degradation to the coastal environment (careless mooring, at-sea-dumping, reef destruction, sand mining, vehicles on the beach). Report to the Division of Fish and Wildlife (St. Croix: 809-772-1955; St. Thomas: 809-775-6762), the Bureau of Environmental Enforcement (St. Croix: 809-773-3250; St. Thomas: 809-774-3320), or the NOAA National Marine Fisheries Service Law Enforcement Division (St. Thomas: 809-774-5226).

4.25 Make fines commensurate with product value

With current fines standing at \$2,500 for a first offense (section 4.22), fines are commensurate with product value. Eggs, for instance, sell (illegally) for approximately \$2.00 each in the USVI.

There is currently no indication that illegal endangered species products are being exported from the USVI to neighboring islands, and the additional risk of detection associated with such shipment makes it unlikely that this situation will change. Recent publicity involving the seizure of a \$140,000.00 vessel for endangered species violations and an increasing awareness on the part of the public that foreign or interstate transportation of illegal products can result in felony convictions under the Lacey Act, have provided additional deterrence.

4.26 Investigate alternative livelihoods

This is not of great concern to the fishermen in the USVI, for the general consensus is that no one makes a living from sea turtles. While there is some directed (illegal) catch and subsequent sale to local restaurants, most of the harvest is used for personal consumption and is not intended to provide a primary income.

4.27 Promote the use of the TED, or similar methodologies

There is no local or foreign shrimping in the USVI and thus commercial trawling poses no threat to the continued survival of sea turtle stocks. TEDs ('Turtle Excluder Devices', or 'Trawler Efficiency Devices' as they are sometimes called) are not needed.

There is an increasing level of longline fishing in the USVI, but this activity has resulted in minimal harassment to sea turtles (Mike Christian, NOAA Law Enforcement, pers. comm.). In 1988, NOAA Enforcement received one confirmed report of a leatherback caught in longline gear and reportedly released alive. Later that year, a green turtle was caught in longline gear off St. Croix and likewise released unharmed (Vikki Hillis, pers. comm.). Leatherback turtles have been entangled in longlines set off Anegada in the adjacent British Virgin Islands (Laurens Blok, BVI Fisheries Officer, pers. comm.) and Hillestad et al. (1982) report that leatherbacks and green turtles have been captured by longlines off Ireland and Florida, respectively.

Leatherbacks are reported entangled and drowned in fish trap bouy lines (R. Boulon, pers. comm.). The crew of the longline vessel "Miss Shannon" released a small (5 kg) green sea turtle found entangled in green polypropylene tuna mesh netting south of St. Croix in January 1989 (section 3.5). Fishermen should check their trap lines on a timely basis in an effort to avoid as much as possible the incidental drowning of sea turtles. Incidents of

entrapment should be reported to the USVI Division of Fish and Wildlife or NOAA National Marine Fisheries Service Law Enforcement (phone numbers in section 4.24).

4.28 Supplement reduced populations using management techniques

There is evidence that the number of turtles, both nesting and foraging, in the USVI has declined throughout this century (section I). In an attempt to redress this situation, marine turtles were afforded full protection in 1973 (section 4.12). There is some evidence that full protection has resulted in slight increases in juvenile size classes foraging in the waters of St. John and St. Thomas (fishermen and others agree that there are more juvenile turtles in USVI waters today than there were 20 years ago), but it is too early to tell whether this trend is a lasting one. Sea turtles are long-lived vertebrates and their natural populations often fluctuate dramatically in size, reflecting the success of survival and recruitment over many decades.

Some specific management techniques, initiated in addition to complete protection under the law, were discussed in section 4.12. These include the reburial of leatherback eggs at risk from inundation on Sandy Point National Wildlife Refuge and the eradication of exotic mongooses (which prey upon sea turtle eggs and hatchlings) on Buck Island National Monument. These efforts, in consonance with law enforcement, public education, and careful shoreline development -- as well as efforts to protect turtles in adjacent countries -- will greatly strengthen the sea turtles' chances of survival in the USVI.

4.29 Monitor stocks

4.291 Nests

Aside from ongoing efforts on Sandy Point National Wildlife Refuge (St. Croix), Buck Island Reef National Monument (BUIR), and Manchenil Beach (started by Tom Adams and expected to be continued by the beach's developer), there are no systematic efforts underway to monitor sea turtle nesting anywhere in the USVI. Consequently, while there are several beaches in the USVI where nesting occurs (Table 1), there are no definitive data concerning the species present, or the level or seasonality of nesting activity. It would be of great benefit if persons living on (or near) any sandy beach would monitor said beaches for nesting and hatching activity (see section 4.112). WIDECAST materials are available from the St. Croix Environmental Association that describe how to conduct morning beach surveys and explain how to differentiate between the various species of sea turtles -- in particular, how to identify species from evidence seen on morning beach surveys (i.e., turtle tracks in the sand or stray hatchlings).

4.292 Hatchlings

On beaches where sea turtle nesting occurs, it is necessary to identify causes of mortality to emerging hatchlings. If certain causal agents stand out as potentially threatening to the survival of the population (e.g., feral dogs, erosion), mitigative measures can be designed in cooperation with the USVI Division of Fish and Wildlife (Contact Ralf Boulon, St. Thomas, 809-775-6762).

4.293 Immatures and adults

The monitoring of juvenile and adult turtles requires special preparation and can be much more difficult than counting nests or evaluating hatchling mortality. In order to monitor foraging juveniles, systematic surveys to specific foraging grounds must be undertaken. If such survey work is undertaken in conjunction with a tagging program, it is possible to evaluate the foraging periodicities of individuals, their movements (should a tagged turtle turn up at some point distant from where it was tagged, for instance), and their growth rate. Ralf Boulon (USVI Division of Fish and Wildlife) directs an ongoing capture/recapture program designed to study the foraging ecology and growth rates of green turtles and hawksbills off St. Thomas and St. John. Less rigorous, but still valuable, information can be gained by repeatedly observing specific foraging areas and reporting the number of turtles seen. The public is encouraged to participate in this type of data gathering.

In order to monitor the number of nesting adult turtles, it is necessary to monitor a beach consistently enough so that one knows exactly how many nests are laid (and by what species) per night. Using this information and the known nesting periodicities of the various species, one can fairly accurately estimate the number of nesting females by the number of nests laid. Systematic morning nest counts are essential for this kind of estimation, as is the accurate assessment of whether or not eggs were actually deposited (a turtle sometimes comes ashore and returns to the sea before successfully nesting). Local groups are encouraged to participate in systematic beach surveys under the guidance of the Division of Fish and Wildlife (section 4.112).

To calculate more precisely the number of females nesting on a particular beach (and determine return intervals both within and between seasons), all-night patrol must be undertaken by trained personnel and nesting females tagged (this activity is ongoing on Sandy Point National Wildlife Refuge and was done for many years by Tom Adams on Manchenil Bay beach, St. Croix). Tagging should not be undertaken lightly; it is time-consuming and can be expensive. Most importantly, one does not learn much about population dynamics from tagging for a year or two. One must be willing to enter into a long term research commitment (whereby females are consistently tagged for a decade or more) in order to

learn anything that is not learned from daily nest counts. At the present time, valuable population information can be gained simply by walking beaches on a regular morning schedule, documenting nesting activity, and reporting the fate of eggs and hatchlings.

4.3 Encourage and Support International Legislation

4.31 Encourage non-signatories to join CITES

The United States ratified the Convention on International Trade in Endangered Species (CITES) on 14 January 1974. As a result, it is illegal to import or to export endangered species (or parts thereof) into or out of the USA (including the USVI). The Center for Marine Conservation in Washington D.C. is currently engaged in a campaign to encourage all wider Caribbean nations to ratify CITES.

4.32 Encourage States to cooperate through relevant regional or global Conventions

In 1940, the Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere was negotiated under the auspices of the Pan American Union. Twelve of the parties to the Western Hemisphere Convention are in the wider Caribbean region. However, the Convention contains no mechanism for reaching decisions binding upon the parties, but leaves each party to implement the treaty's provisions as it find "appropriate".

The Bonn Convention for the Conservation of Migratory Wild Animals, if ratified by enough nations in the wider Caribbean, could be an effective tool in the conservation of migratory species, such as sea turtles. It was developed to deal with all threats to migratory species, including habitat destruction and taking for domestic consumption. Unfortunately, only France, the Netherlands and the United Kingdom, among nations of the wider Caribbean, have signed this Convention.

The regional environmental Convention that shows the most promise at this point is the United Nations Environment Programme's (UNEP) Regional Seas Convention in the Caribbean, known as the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (or, the "Cartagena Convention"). The Convention is coupled with an Action Plan, known as the Action Plan for the Caribbean Environment Programme (APCEP). The First Intergovernmental Meeting on APCEP was convened by UNEP in cooperation with the Economic Commission for Latin America (ECLA) in Montego Bay, Jamaica, 6-8 April 1981. The representatives of Governments from 22 States in the region, including the United States, adopted APCEP at this meeting and established the Caribbean Trust Fund to support common costs and activities associated with the implementation of the Action Plan.

In March, 1983, a Conference of Plenipotentiaries met in Cartagena, Colombia to negotiate the "Cartagena Convention". Representatives from 16 States participated, including the United States. The Conference adopted both the Convention and a Protocol concerning cooperation in combating oil spills in the region. The Convention describes the responsibilities of Contracting Parties to "prevent, reduce and control" pollution from a variety of sources (i.e., pollution from ships, from at-sea dumping of waste, from land-based sources, from sea-bed activities, and from airborne sources). Article 10 is of special interest in that it addresses the responsibilities of Contracting Parties to "individually or jointly, take all appropriate measures to protect and preserve rare or fragile ecosystems, as well as the habitat of depleted, threatened or endangered species, in the Convention area." The United States ratified the Convention on 31 October 1984.

4.33 Establish subgroups in consultation with the 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 International Union for the Conservation of Nature and Natural Resources (IUCN) Species Survival Commission (SSC). The group is a valuable source of information for technical advice on local projects.

4.34 Encourage states with common stocks of turtles to develop agreements for their management

Leatherback oil, reportedly originating in Barbados (and trans-shipped through the BVI), is sold directly off small commercial vessels moored in Charlotte Amalie (St. Thomas) for \$12 per 6 ounces. Furthermore, there is some evidence that tortoiseshell arrives in the USVI from Martinique, the British Virgin Islands (BVI), the Dominican Republic and Haiti (Mike Christian, pers. comm.). Import of these turtle products is illegal, even though the turtle(s) may have been legally harvested in the exporting country. Large shipments of green turtle meat imported to St. Thomas from Anegada (BVI) were seized in November 1988 after the meat was sold to an undercover federal agent in St. Thomas (section 3.3). In this case, since sea turtles cannot be harvested in the BVI between 1 April-30 November, both the harvest and the shipment of the meat were illegal. Enforcement of sea turtle laws would be greatly facilitated if Caribbean nations developed bi- and multi-lateral agreements concerning the harvest and shipment of sea turtles and their products.

In the widest sense, the nations of the Caribbean hold their sea turtle resources in common, as sea turtles migrate great distances during their developmental decades before returning (presumably) to their natal beaches to breed. On a finer scale, it is highly likely that foraging turtles are shared between St.

Thomas and St. John, and between St. John and adjacent British Virgin Islands, such as Tortola. It has long been a point of contention between enforcement agencies in the USVI and BVI that the BVI has an open season on turtles (currently, 1 December-31 March; 1 September-30 June prior to 1986). Fishermen on St. Thomas argue bitterly that "their" turtles were being slaughtered for profit in the BVI and it makes no sense to protect them and nuture them in the USVI for fishermen in the BVI to eat.

Inconsistencies in legal protection give rise to illegal poaching and sale between nations. USVI fishermen take turtles legally in BVI waters and then smuggle them into the USVI; BVI fishermen cross into USVI waters to take turtles and then retreat to BVI waters before enforcement officers can apprehend them. Customs officers can never hope to check every private vessel, or keep track of merchandise passing on hourly ferries between the islands. Thus it was with relief that USVI officials greeted the 1986 amendment to the BVI Turtles Ordinance that closed the season on turtles between 1 April and 30 November. During the winter season, few turtles are taken because sea conditions often preclude it. The BVI is encouraged to phase-in full protection of marine turtles as soon as possible.

It would be of immense value -- both in terms of law enforcement and in terms of sea turtle survival -- if all nations in the West Indies sought to establish common laws for the protection of sea turtles. The moratorium on sea turtles and sea turtle products currently under consideration by the nations of the Organization of Eastern Caribbean States (OECS) would be a great step forward in this regard.

4.35 Ask groups such as IUCN and WWF to provide support and legal expertise to implement above steps

The support of international agencies, such as the International Union for the Conservation of Nature (IUCN) and World Wildlife Fund (WWF) is always welcome.

4.4 Develop Public Education

4.41 Local residents

Many programs are available to inform the general public about the ecology and behavior of sea turtles. These include school programs, narrated slide shows, pamphlets, and visitation to the Sandy Point National Wildlife Refuge to see nesting leatherbacks turtles. The agencies involved include the USVI Division of Fish and Wildlife, territorial (BEE) and federal (NOAA/NMFS) enforcement agencies, the U.S. National Park Service, and the Cooperative Extension Service (University of the Virgin Islands). Nongovernment organizations, such as the St. Croix Environmental Association, are also playing a key role in public education. See section 4.124 for further discussion.

Future efforts should be concentrated on developing educational programming for use in all USVI schools. Educational units that make use of coloring books and games are useful for elementary children, while simulation exercises for high school students teach them to weigh the evidence and make decisions in a complicated world of unemployment, resource scarcity, increasing coastal development, tourism, cultural and economic concerns, rising human populations and declining wildlife populations.

4.42 Tourists

At present there is little education directed specifically toward tourists. Nonetheless, the education of tourists is vital to water quality (degraded, for example, by the disposal of waste from pleasure yachts), to sustainable fisheries resources (tourists should be made aware of the laws pertaining to the take of lobster, conch, and sport fish), to the survival of endangered species (sea turtles, black coral, pelicans), to water resources (water is scarce!), and to beach protection (it is illegal to drive vehicles on the beaches of the USVI; it results in erosion of the shoreline, compaction of sea turtles nests, and unsightly tire ruts which can trap hatchlings). The Tourist Bureau is encouraged to actively develop educational materials for tourists specifying USVI resource laws and asking cooperation in ongoing efforts to keep the islands beautiful and wildlife populations healthy.

Large permanent airport displays have been effectively used on other Caribbean islands to catch the attention of tourists. Such displays could be erected both on St. Croix and on St. Thomas. Information available at hotels would also be useful. Finally, regular articles appearing in "WHERE Virgin Islands" (part of a network of magazines distributed in over 2500 hotels across the USA and Canada) would reach many potential travelers.

The consumer market for products made from endangered wildlife supports a large and lucrative (and often illegal) industry throughout the Caribbean. Even though rare birds, tortoiseshell jewelry and stuffed sea turtles are not for sale in the USVI, tourists should respect international wildlife laws whenever and where ever they travel. In the absence of a demand for these products, the animals from which they are made would have a greater chance of surviving the coming decades.

4.43 Fishermen (e.g., preventing incidental catch)

Local enforcement and Fisheries officers actively seek to educate fishermen about the laws pertaining to sea turtles, and marine resources in general. Current problems include sea turtles becoming entangled in nets and pot lines (sections 3.5, 4.27), and an increasing number of longline vessels (18 vessels off-loaded catch on St. Croix in 1987-88; Toby Tobias, pers. comm.) may

constitute a threat to sea turtles in the near future (section 4.27). Incidental catch in trawl nets is not presently a problem, as trawling does not occur in USVI waters. All incidences of entanglement should be reported to the USVI Division of Fish and Wildlife (phone numbers in section 4.24). When turtles are injured and in need of care, the Division of Fish and Wildlife, Coral World (St. Thomas), or the West Indies Laboratory (St. Croix) should be notified. It is illegal for a citizen to retain a sea turtle in captivity.

4.44 Non-consumptive use of sea turtles to generate revenue (e.g., natural history expeditions to Parks)

Not necessary in the USVI.

4.5 Increase Information Exchange

4.51 Marine Turtle Newsletter

The Marine Turtle Newsletter is available free of charge and provides a means for scientists, conservationists and decision-makers to remain informed about sea turtle activities around the world. The Newsletter is currently published by Karen and Scott Eckert, Department of Zoology, University of Georgia, Athens, Georgia 30602 USA.

4.52 Western Atlantic Turtle Symposium (WATS)

The USVI participated in both Western Atlantic Turtle Symposia (WATS I, Costa Rica, 1983; WATS II, Puerto Rico, 1987) and is encouraged to continue participation in this valuable regional data base.

4.53 WIDECAST

Members of the WIDECAST network in the USVI have been active in nesting beach surveys and in educating the public about sea turtles. The volunteer efforts of WIDECAST participants throughout the Caribbean have been instrumental in alerting government and non-government entities to the plight of rare and endangered sea turtles. This process is essential if sustainable development is to be achieved, and wild species of plants and animals are to be maintained for future generations to learn from and enjoy. Ralf Boulon, Endangered Species Coordinator for the USVI Division of Fish and Wildlife, is the WIDECAST Coordinator in the USVI.

4.54 Caribbean Newsletter

In 1988, the Caribbean Conservation Association (CCA) published the premier issue of a new journal "Caribiana", dedicated to the Caribbean Environment. WIDECAST supports the efforts of the CCA to bring the issues of the Caribbean environment to the attention of all Caribbean peoples.

4.55 Distribute WATS Manual

The "WATS Manual" (the Manual of Sea Turtle Research and Conservation Techniques) is available for perusal at USVI Division of Fish and Wildlife offices. It is also available for purchase from the Center for Marine Conservation (formerly the Center for Environmental Education) in Washington D.C.

4.56 Workshops on research and management (after WATS Manual)

Research currently underway in the USVI is accomplished under the auspices of the USVI Division of Fish and Wildlife (e.g., the Sandy Point Leatherback Turtle Project) or the U.S. National Park Service (e.g., St. John and Buck Island hawksbill turtle nesting surveys). Both agencies are well versed in the techniques of sea turtle conservation and management and their methods concur with those outlined by the WATS Manual. In addition, workshops have been held by Dr. Karen Eckert (WIDECAST) for members of the St. Croix Dive Club on sea turtle identification and the collection of data relative to sea turtle foraging habitats. Similar programs have been held for the National Park Service concessioners (Buck Island Reef National Monument) on sea turtle identification and how the concessioners can participate effectively in sea turtle survey programs initiated by the National Park Service. Continuing efforts to involve the public in sea turtle conservation and management are encouraged.

4.57 Exchange of information among interested local groups

Many non-government groups are interested in the conservation of sea turtles, including the Virgin Islands Conservation Society (and their St. Croix chapter, the St. Croix Environmental Association), St. Croix and St. Thomas Dive Clubs, Virgin Islands Dive Association, and the Audubon Society (St. John chapter). Coordination of activities relative to educational programs and outings is encouraged.

V. REFERENCES

- Balazs, G.H. 1985. Impact of ocean debris on marine turtles: entanglement and ingestion. In: R.S. Shomura and H.O. Yoshida (editors), Proc. Workshop on the Fate and Impact of Marine Debris. NOAA Tech. Memo. NOAA-TM-NMFS-SWFC-54:387-429.
- Basford, S.J., R.L. Brandner, and R.H. Boulon. 1986. Tagging and nesting research on leatherback sea turtles (Dermochelys coriacea) on Sandy Point, St. Croix, 1986. (unpubl.)

- Brandner, R.L., S.J. Basford, and R.H. Boulon. 1987. Tagging and nesting research on leatherback sea turtles (Dermochelys coriacea) on Sandy Point, St. Croix, 1987. (unpubl.)
- Boulon, R. Jr. 1982. National Report for the United States Virgin Islands. Western Atlantic Turtle Symposium, San José, Costa Rica, 1983. 40pp.
- Boulon, R. Jr. 1987. National Report for the United States Virgin Islands. Western Atlantic Turtle Symposium II, Puerto Rico, 1987. 29pp.
- Boulon, R. Jr., K. Eckert and S. Eckert. 1988. Dermochelys coriacea (leatherback sea turtle) migration. Herp. Rev. 19(4):88.
- Eckert, K.L. and S.A. Eckert. 1983. Tagging and nesting research of leatherback sea turtles (Dermochelys coriacea) on Sandy Point, St. Croix, USVI, 1983. Ann. Rept., U.S. Fish Wildl. Ser., USFWS Ref. MIN 54-8480119. 38p.
- Eckert, K.L. and S.A. Eckert. 1985. Tagging and nesting research of leatherback sea turtles (Dermochelys coriacea) on Sandy Point, St. Croix, USVI, 1985. Ann. Rept., U.S. Fish Wildl. Ser., USFWS Ref. MIN 54-8680431. 58p.
- Eckert, K.L. and S.A. Eckert. 1988. Pre-reproductive movements of leatherback sea turtles (Dermochelys coriacea) nesting in the Caribbean. Copeia 1988(2):400-406.
- Eckert, K.L., S.A. Eckert and R.H. Boulon. 1982. Tagging and nesting research of leatherback sea turtles (Dermochelys coriacea) on Sandy Point, St. Croix, USVI, 1981/82. Ann. Rept., U.S. Fish Wildl. Ser., USFWS Ref. MIN 54-8480019. 41p.
- Eckert, K.L., S.A. Eckert, and D.W. Nellis. 1984. Tagging and nesting research of leatherback sea turtles (Dermochelys coriacea) on Sandy Point, St. Croix, USVI, 1984, with management recommendations for the population. Ann. Rept., U.S. Fish Wildl. Ser., USFWS Ref. MIN 54-8580175. 60p.
- Eckert, S.A., D.W. Nellis, K.L. Eckert, and G.L. Kooyman. 1986. Diving patterns of two leatherback sea turtles (Dermochelys coriacea) during internesting intervals at Sandy Point, St. Croix, U.S. Virgin Islands. Herpetologica 42(3):381-388.
- Eckert, S.A., K.L. Eckert, P. Ponganis, and G.L. Kooyman. 1989. Diving and foraging behavior by leatherback sea turtles (Dermochelys coriacea). Can. J. Zool. (in press).
- Hillestad, H.O., J.I. Richardson, C. McVea, Jr., and J.M. Watson, Jr. 1982. Worldwide incidental capture of sea turtles. In: K.A. Bjorndal (editor), Biology and Conservation of Sea Turtles. Smithsonian Institution Press. pp.489-495.

- Hillis, Z.M. and A.L. Mackay. 1988. Research report on nesting and tagging of hawksbill sea turtle (Eretmochelys imbricata) at Buck Island Reef National Monument, U.S. Virgin Islands, 1987-1988. Annual Report to the U.S. National Park Service.
- Philibosian, R. 1975. Disorientation of hawksbill turtle hatchlings, Eretmochelys imbricata, by stadium lights. *Copeia* 1975(4):824.
- Pritchard, P., P. Bacon, F. Berry, A. Carr, J. Fletemeyer, R. Gallagher, S. Hopkins, R. Lankford, R. Marquez, M., L. Ogren. W. Pringle, Jr., H. Reichart and R. Witham. 1983. Manual of sea turtle research and conservation techniques, Second edition. K. Bjorndal and G. Balazs, editors. Center for Environmental Education, Washington D.C.
- Raymond, P.W. 1984. Sea turtle hatchling disorientation and artificial beachfront lighting: a review of the problem and potential solutions. Center for Environmental Education, Washington D.C.
- Rogers, C.S., T.H. Suchanek, and F.A. Pecora. 1982. Effects of hurricanes David and Frederic (1979) on shallow Acropora palmata reef communities: St. Croix, U.S. Virgin Islands. *Bull. Mar. Sci.* 32(2):532-548.
- Rogers, C.S., M. Gilnack, and H.C. Fitz III. 1983. Monitoring of coral reefs with linear transects: a study of storm damage. *J. Exp. Mar. Biol. Ecol.* 66:285-300.
- Schmidt, J. 1916. Marking experiments with turtles in the Danish West Indies. *Meddelelser Fra Kommissionen for Havundersogelser. Serie: Fiskeri, Bind V, Nr. i.*
- Williams, S.L. 1988. Thalassia testudium productivity and grazing by green turtles in a highly disturbed seagrass bed. *Mar. Biol.* 98:447-455.
- Zullo, E.S. 1986. Sea turtle nesting at Virgin Islands National Park and Buck Island Reef National Monument, 1980-1985. USNPS Final Report. 27p.

Table 1. Records of green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), and leatherback (*Dermochelys coriacea*) sea turtles nesting on beaches in the United States Virgin Islands. Species abbreviations are C.m., E.i., and D.c., respectively. When a species is listed in parentheses, it is suspected to nest but has not actually been observed. "[C.m./E.i.]" indicates that the species in question is a thecate (hard-shelled) turtle and not a leatherback. A question mark in parentheses indicates that nesting is reported, but the species is unknown. "WATS I" = Boulon (1982) USVI National Report for the Western Atlantic Turtle Symposium, Costa Rica, 1983. "WATS II" = Boulon (1987) USVI National Report for the Western Atlantic Turtle Symposium, Puerto Rico, 1987. "BEE" = data reported to the author by officers of the USVI Bureau of Environmental Enforcement.

ST. CROIX

<u>Beach</u>	<u>species</u>	<u>source</u>
Sandy Point	D.c. (80-250 nests/yr) C.m. (<10 nests/yr) E.i. (10-20 nests/yr)	Eckert et al., 1984, Eckert & Eckert 1985
Whim	E.i. (1-2 turtles/yr)	WATS II
White's Bay/Concordia	C.m. E.i. (2-4 turtles/yr)	resident WATS II
Campo Rico	C.m., D.c.	BEE
Carlton (Hope to Long Point)	E.i. (<10 nests/yr), D.c. (<10 nests/yr)	Otto Tranberg
Cane-Enfield-Betty's	[E.i./C.m.]	BEE
Cooper's Envy	[E.i./C.m.] (<10 nests/yr)	Otto Tranberg
Flamboyant (Race Track)/ Manning's Bay	E.i. ($\pm$ 5 nests/yr)	BEE
Canegarden	E.i. (>10 nests/yr)	Otto Tranberg, WATS I/II
Manchenil/Ha'penny	D.c. (>10 nests/yr), E.i. D.c. (3-8 turtles/yr), C.m. (1-2 turtles/yr), E.i. (1-3 turtles/yr)	Tom Adams, Otto Tranberg WATS II

<u>Beach</u>	<u>species</u>	<u>source</u>
Longford (Sonofa Beach)	E.i. (>10 nests/yr) E.i. (1-4 turtles/yr)	Otto Tranberg WATS II
Castle Nugent Beach	E.i. (1-2 turtles/yr)	WATS II
Great Pond Beach	E.i. (0-2 turtles/yr)	WATS II
Robin Bay	E.i. (2-4 turtles/yr) (C.m.)	WATS II WATS I/II
Madam Carty (Rod Bay)	E.i. (<5 nests/yr) E.i., (C.m.)	Otto Tranberg WATS I/II
Turner's Hole	E.i. (>10 nests/yr) (C.m.)	Otto Tranberg, WATS II WATS I/II
Grapetree Bay	D.c. (<10 nests/yr), E.i. (<10 nests/yr) E.i., (C.m.)	Otto Tranberg WATS I/II
Jack's Bay	C.m./E.i. (20-30 nests/yr) D.c. (0-2 turtles/yr), E.i. (3-5 turtles/yr)	Otto Tranberg, "heavy nesting" WATS II
Issac's Bay	E.i. (>10 nests/yr), C.m. (<10 nests/yr) E.i. (1-2 turtles/yr), D.c. (0-1 turtles/yr)	Otto Tranberg WATS II
East End Bay	E.i. (0-1 turtles/yr)	WATS II
Cottongarden	(?)	BEE
Knight Bay	(C.m.)	WATS I/II
Smuggler's Cove	E.i. (1-2 turtles/yr) (C.m.)	WATS II WATS I/II
Teague Bay (Reef Beach)	D.c. (one nest), E.i. (<10 nests/yr), C.m. (<10 nests/yr) E.i. (0-2 turtles/yr)	Otto Tranberg WATS II
Yellowcliff/Solitude (Banana Ghut)	E.i. (<10 nests/yr) D.c. (0-1 turtles/yr)	Otto Tranberg WATS II

<u>Beach</u>	<u>species</u>	<u>source</u>
Coakley Bay	E.i. (20-30 nests/yr), C.m. (<10 nests/yr) E.i. (0-2 turtles/yr), D.c. (0-3 turtles/yr)	BEE WATS II
Pull Point/Prune Bay	D.c. (<5 nests/yr), [E.i./C.m.] (10-15 nests/yr) D.c. (0-3 turtles/yr), E.i. (0-5 turtles/yr)	Otto Tranberg, BEE WATS II
Chaney Bay	E.i. (>10 nests/yr)	Otto Tranberg, BEE (peaks in October)
Green Cay Beach/ Tamarine Reef Beach	D.c. (<10 nests/yr), [E.i./C.m.] D.c. (0-2 turtles/yr), E.i. (0-5 turtles/yr)	Otto Tranberg Otto Tranberg, BEE WATS II
Shoy's Beach	D.c. ($\pm$ 20 nests/yr) D.c. (0-2 turtles/yr) C.m., E.i.	Otto Tranberg WATS II BEE, WATS I/II
Buccaneer Beach	D.c. (< 5 nests/yr), E.i. (>10 nests/yr), C.m. (<10 nests/yr)	Otto Tranberg
Little Bay	C.m. (<10 nests/yr) D.c. (0-1 turtles/yr)	Otto Tranberg WATS II
Fangselet/Pelican Cove	D.c. (< 5 nests/yr), E.i. (<10 nests/yr), C.m. (<10 nests/yr) C.m.	Otto Tranberg BEE (75 hatch- lings reported 8/11/86)
Judith's Fancy	E.i. ($\pm$ 10 nests/yr)	Toby Tobias
Salt River	C.m. ($\pm$ 10 nests/yr) (C.m.) E.i. (<10 nest/yr) E.i. (0-2 turtles/yr)	Otto Tranberg WATS I/II Otto Tranberg WATS II
Gentle Winds	E.i. (<10 nests/yr), C.m. (<10 nests/yr)	Otto Tranberg

<u>Beach</u>	<u>species</u>	<u>source</u>
Rust-Op Twist	C.m. (<10 nests/yr), E.i. (<10 nests/yr) E.i. (0-3 turtles/yr)	Otto Tranberg, Toby Tobias WATS II
La Valley/Cane Bay	C.m. (>10 nests/yr), E.i. (>10 nests/yr) E.i. (0-2 turtles/yr)	Otto Tranberg WATS II
North Star	E.i. (0-2 turtles/yr)	WATS II
Davis Beach	D.c. (<10 nests/yr) D.c. (0-1 turtles/yr), E.i. (0-2 turtles/yr) E.i. (hatchlings)	Otto Tranberg, Toby Tobias WATS II Fred Sladen
Annaly Bay	C.m. (<10 nests/yr), E.i. (<10 nests/yr)	Otto Tranberg
Maroon Hole	E.i. (0-2 turtles/yr), (C.m.)	WATS II
Ham's Bluff Beach	E.i. (<10 nests/yr) E.i. (0-1 turtles/yr) C.m. mating offshore	Otto Tranberg, WATS II BEE
Monk's Baths (North Side)	E.i. (<10 nests/yr)	Otto Tranberg
Butler Bay	E.i. (>10 nests/yr) E.i. (0-2 turtles/yr)	Otto Tranberg, WATS II
Sprat Hall (Williams Beach)	C.m. (>10 nests/yr), E.i. (>10 nests/yr), D.c. came ashore in 1985, no nest?	Otto Tranberg, WATS II
Rainbow	E.i. (<10 nests/yr), C.m. (<10 nests/yr)	Otto Tranberg
Prosperity	E.i. (>10 nests/yr), C.m. (<10 nests/yr)	Otto Tranberg
La Grange (Stadium)	E.i. (<10 nests/yr) E.i. (0-2 turtles/yr)	Otto Tranberg WATS II
Smithfield	E.i. (<10 nests/yr)	Otto Tranberg, Pat & Mac McFee

BUCK ISLAND

<u>Beach</u>	<u>species</u>	<u>source</u>
Turtle Bay (SE)	C.m., E.i.	Hillis and
Diedrich's Point (SE)	E.i.	Mackay, 1989
West Beach (SW)	D.c., C.m., E.i.	
Northshore (NW)	E.i.	
south and west shores	D.c., C.m., E.i.	Otto Tranberg, Zullo (1986),
	D.c. (1-2 turtles/yr),	WATS II
	C.m. (1-4 turtles/yr),	
	E.i. (10-30 turtles/yr)	

GREEN CAY

<u>Beach</u>	<u>species</u>	<u>source</u>
Green Cay Beach	E.i. (0-5 turtles/yr),	WATS II
	D.c. (0-2 turtles/yr)	

PROTESTANT CAY

<u>Beach</u>	<u>species</u>	<u>source</u>
"Probably no nesting; systematic erosion"		BEE

ST. THOMAS

<u>Beach</u>	<u>species</u>	<u>source</u>
Morningside Beach	E.i. (0-1 turtles/yr)	WATS II
Pineapple Beach	E.i. (0-1 turtles/yr)	WATS II
	D.c. (0-1 turtles/yr)	WATS II
Coki Point	D.c. (0-1 turtles/yr)	WATS II
Mandahl Bay	E.i. (0-1 turtles/yr)	WATS II
Hull Bay	E.i. (0-1 turtles/yr)	WATS II
Palm Bay	E.i. (0-2 turtles/yr)	WATS II
Clucluse Bay	E.i. (0-2 turtles/yr)	WATS II
Sandy Bay/Inner Brass	E.i. (2-4 turtles/yr),	WATS II
	D.c. (0-1 turtles/yr)	
Neltieberg Bay	E.i. (1-2 turtles/yr),	WATS II
	D.c. (0-1 turtles/yr)	

<u>Beach</u>	<u>species</u>	<u>source</u>
Penn Bay	E.i. (1-3 turtles/yr)	WATS II
Caret Bay	E.i. (1-4 turtles/yr)	WATS II
Sorgenfri Bay	E.i. (0-2 turtles/yr)	WATS II
Santa Maria Bay	E.i. (0-1 turtles/yr), (C.m.)	WATS II
Stumpy Bay	E.i. (0-1 turtles/yr)	WATS II
Bordeaux Bay	E.i. (2-4 turtles/yr)	WATS II
Botany Bay	E.i. (0-1 turtles/yr), D.c. (0-1 turtles/yr)	WATS II
West Cay Bay	E.i. (0-2 turtles/yr)	WATS II

DOG ISLAND

<u>Beach</u>	<u>species</u>	<u>source</u>
unnamed	E.i. (0-2 turtles/yr)	WATS II

GREAT ST. JAMES ISLAND

<u>Beach</u>	<u>species</u>	<u>source</u>
unnamed	E.i. (0-2 turtles/yr)	WATS II

HANS LOLIK

<u>Beach</u>	<u>species</u>	<u>source</u>
Coconut Bay	E.i. (0-3 turtles/yr)	WATS II
Dry Bay	E.i. (2-6 turtles/yr)	WATS II
Little Bay	E.i. (0-1 turtles/yr)	WATS II

LITTLE HANS LOLIK

<u>Beach</u>	<u>species</u>	<u>source</u>
unnamed	E.i. (0-4 turtles/yr) D.c. (0-1 turtles/yr)	WATS II WATS II

ST. JOHN

<u>Beach</u>	<u>species</u>	<u>source</u>
Henley Cay	E.i. (0-2 turtles/yr)	WATS II
Caneel Hawksnest	E.i. (0-1 turtles/yr)	WATS II
Denis Bay	E.i. (0-1 turtles/yr)	WATS II
Jumbi Bay	E.i. (0-2 turtles/yr)	WATS II
Trunk Bay	E.i. (0-3 turtles/yr) D.c. (0-2 turtles/yr)	WATS II WATS II
Windswept	E.i. (0-3 turtles/yr)	WATS II
Peter Bay	E.i. (0-1 turtles/yr)	WATS II
Cinnamon Bay	E.i. (0-1 turtles/yr) D.c. (0-1 turtles/yr)	WATS II WATS II
Maho Bay	E.i. (0-1 turtles/yr)	WATS II
Francis Bay	E.i. (0-2 turtles/yr)	WATS II
Salt Pond Bay	E.i. (0-5 turtles/yr)	WATS II
Grootpan Bay	E.i. (0-1 turtles/yr)	WATS II
Greater Lameshure Bay	E.i. (0-2 turtles/yr)	WATS II
Yawzi Point	E.i. (0-1 turtles/yr)	WATS II
Little Lameshure Bay	E.i. (0-2 turtles/yr)	WATS II
Eruopa Bay	E.i. (0-1 turtles/yr)	WATS II
Eastern Reef Bay	E.i. (0-2 turtles/yr)	WATS II
Genti Bay	E.i. (0-2 turtles/yr)	WATS II
Western Reef Bay	E.i. (0-4 turtles/yr)	WATS II
Cocoloba Point	E.i. (2-6 turtles/yr)	WATS II
Chocolate Hole	E.i. (0-1 turtles/yr)	WATS II