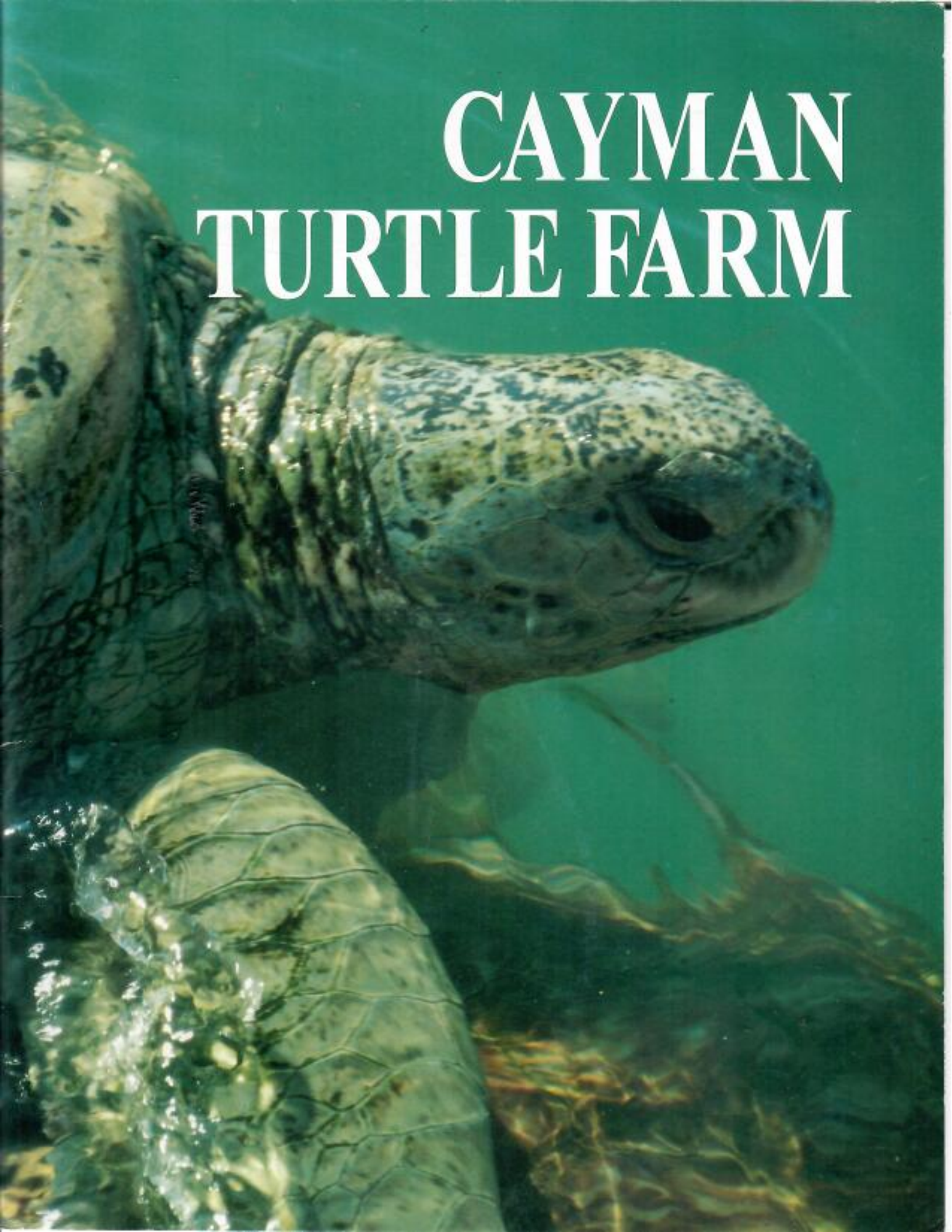


CAYMAN TURTLE FARM



A VISIT TO CAYMAN TURTLE FARM

As one of Grand Cayman's main tourist attractions, the Farm is visited by more than 250,000 people annually. A visit

to the Turtle Farm is unique and educational as the visitor actually views an operating farm.



Visitors may move leisurely around the tanks observing green sea turtles from the tiniest hatchlings in shaded tanks, to the massive adults swimming in the breeding pond. A selected group of young turtles are set aside so one can snap a picture of a friend holding one of these turtles. An array of signs throughout the Farm provides interesting information about turtles and turtle farming. During



June through December, eggs and hatchlings, awaiting transfer to the tanks, are on view through the large windows enclosing the hatchery. Besides the green sea turtles, a visitor to the Farm may see loggerhead, hawksbill, and ridley sea turtles on exhibit. The Farm's breeding colony of Kemp's ridley



are seen in the breeding pond where their smaller size and color distinguishes them from the green sea turtles.

Visitors may relax in the Farm's air-conditioned snack bar. A display of Caymanian turtling tools of the trade and a colorful pictorial review of the

sea turtle's natural history and cultural links to man are on exhibit in this same area.

Local flora and fauna of the Cayman Islands complement the turtle tour, and visitors may enjoy the opportunity of photographing the Cay-



man green parrots, ground iguanas, agoutis, crocodile and hicatees.

To complete the tour, the Farm's shop carries an assortment of Island and turtle souvenirs. Turtle shell jewelry and polished back shells are on display and highlight the remarkable beauty and diversity of shell patterns. Visitors may choose from a variety of t-shirts, hats, black coral jewelry, coins, and souvenirs to remember their visit to the Turtle Farm and the Cayman Islands.

FARMING THE GREEN SEA TURTLE

The Cayman Islands, a British Crown Colony, are a group of three small islands located in the Caribbean Sea approximately 480 miles south

of Miami, Florida. The Islands are internationally recognized for excellent skin diving and SCUBA diving and as a financial center. The

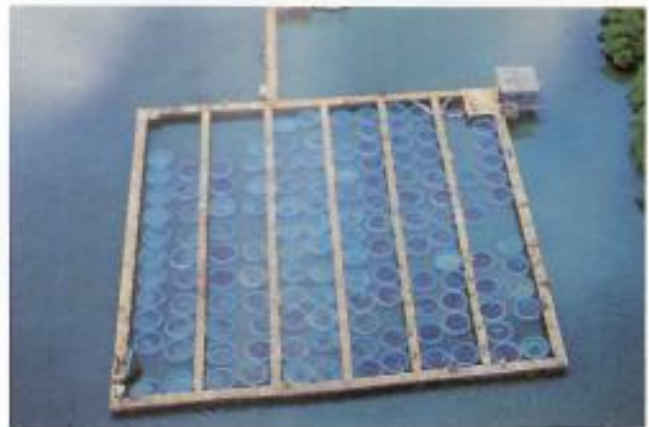




warm water temperatures and politic and economic stability attracted investors to the Islands in 1968 when Mariculture Ltd. was established. Now operating as Cayman Turtle Farm (1983) Ltd., CTF, commercially raises the green sea turtle *Chelonia mydas*. CTF is unique in its scope, researching and developing commercial, captive culture of a historically and biologically intriguing species.

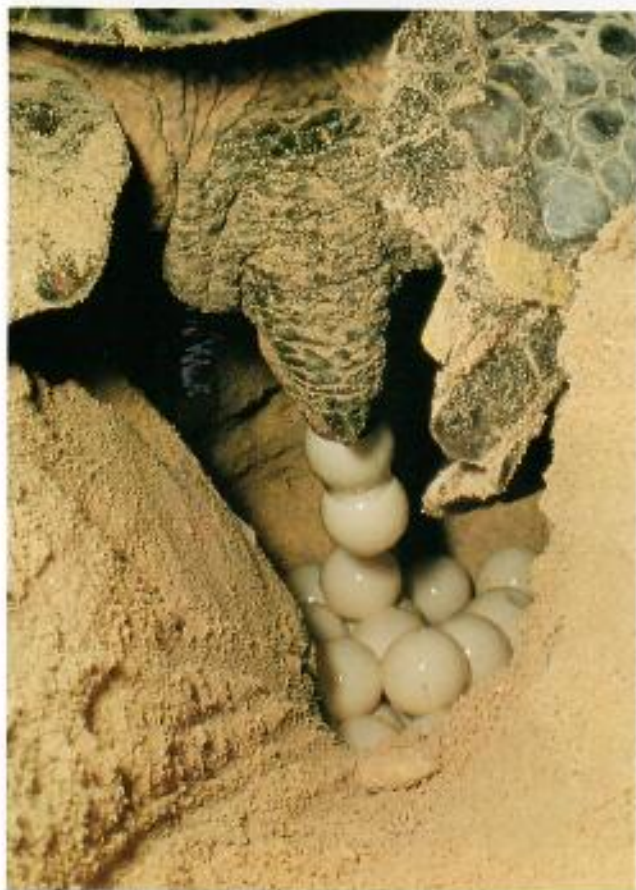
When the Farm was begun, except for a few individual turtles raised for private or public display, virtually nothing was known about raising the green sea turtle in intensive culture. The green sea turtle adapted well to culture conditions and the technology developed at the Farm is constantly being improved and modified as more is learned about the species through the Farm's research program.

The Farm was first situated in Salt Creek, a narrow tidal estuary in the North Sound of Grand



Cayman. The original concept of the Farm was to release young green turtles into the enclosed tidal creek containing beds of turtle grass, *Thalassia sp.* However, such a system quickly proved unworkable due to difficulties with herd management, and animal loss in storms. Therefore, a floating tank and pier system was constructed within the creek which housed the first substantial stock of turtles. Tidal fluctuations proved insufficient to flush the tanks of waste materials and an extensive pipeline was laid transversing the width of the island, about three quarters of a mile, to provide improved water flow for the system. During the first

couple of years the turtles were maintained on a diet of turtle grass, harvested from North Sound and an assortment of dog food, cat-fish food and frozen fish. In 1971 the Farm moved its operation to its present land based tank system on the northwest point of Grand Cayman, which allowed increased herd production, improved water quality and proper herd management.



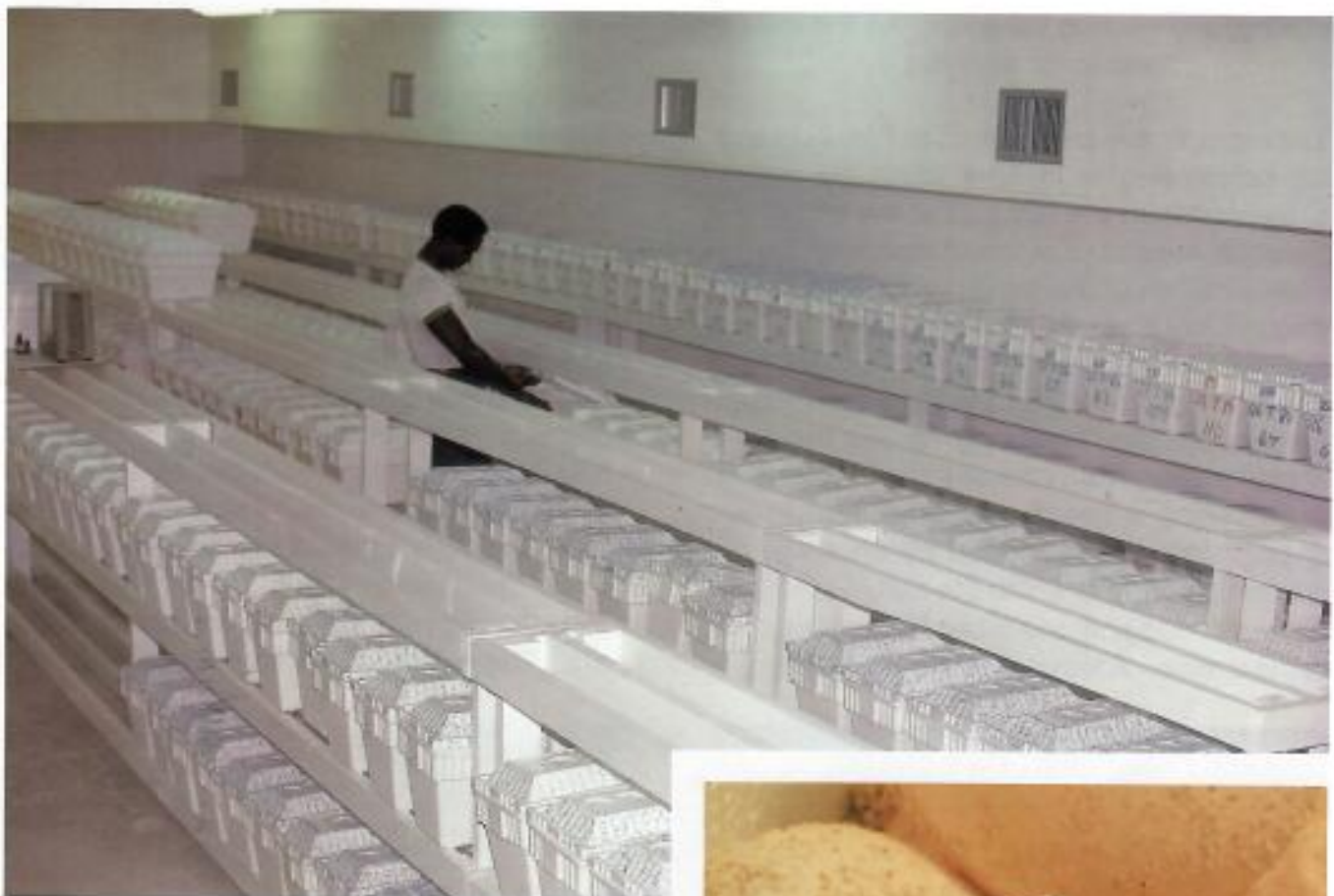
From its inception, CTF has sought to be self-sustaining, independent of wild stocks of eggs or wild breeding turtles. Until 1978, when stock production could be met by the captive breeding herd, the Farm collected eggs from the wild in Surinam, Costa Rica, and Ascension Island. All egg collections were made with the cooperation and permission of the appropriate governmental authorities. In Surinam, where the majority of the eggs were collected, eggs purchased were from beaches which would normally be eroded by tidal action, or from nests

laid below high tide which would not survive under natural conditions. Adult wild turtles were collected from Surinam, Costa Rica, Ascension Island, Nicaragua, Guyana and Mexico to form the nucleus of CTF's breeding colony.

The present breeding herd of 330 green sea turtles consists of 163 wild caught turtles, obtained prior to 1977; 52 farm reared turtles, turtles hatched from eggs incubated on the Farm and raised to maturity on the Farm; and 115 farm bred turtles, turtles hatched from eggs conceived and laid in captivity. These farm bred turtles are technically the first generation farmed animals and their offspring are the second gen-



eration farmed animals. Second generation turtles were first hatched in 1989. The distinction of the Farm's breeding herd into captive wild, farm reared, and farm bred turtles is necessary to evaluate the biological success of the Farm's breeding program. The implications are more fully realized when trade and conservation issues are discussed.



The breeding herd is kept in a million gallon, excavated pond approximately nine feet deep sloping up to a sandy beach, where the females can lay their eggs. Constantly flowing sea water results in water turnover every hour. Stocking density varies between 4-6.5 square yard surface area per turtle. Adult sea turtles vary in size from 200-600 pounds with an average weight of 332 pounds. The breeding herd is fed twice daily a high protein, pelleted feed obtained from Ralston Purina and aptly named Purina Turtle Chow.

Because of the need to define the green sea turtle's reproductive potential, careful records are maintained on each turtle in the breeding herd. During the winter, each breeder is removed from the pond and tagged on each rear flipper with plastic tags which can be seen by observers during the reproductive season. The breeders are also carefully weighed and measured. The different groups of breeders--captive wild, farm reared, and farm bred turtles-- are generally



kept separated within the pond to facilitate evaluation of the herd's development. Turtles are observed during the reproductive season and data is recorded concerning courtship,

mating, and nesting behavior. All this data is then computerized for analysis.

The reproductive season for the Farm's breeding colony begins in April when the males, separated from the females at the end of the previous season, are introduced into the female sections of the pond. Mating continues through July and nesting is observed from May through October, with a few nests being laid in subsequent months. During the reproductive season the female green sea turtle will accept mating from one or more males, generally during a specific period of four to five days. Mating is preceded by an elaborate courtship period in which the males will follow a female, nudging and biting her until she accepts a male. A female may prevent the male

from mating her by assuming a vertical position in the water, constantly facing the male, floating high in the water or seeking refuge in shallow water or on the beach.

The female will begin nesting 30 days following mating. The female green turtle nests at night and the nesting process, from her emergence from the water to her return, may take several hours. The female will laboriously crawl up the beach, sniffing the sand until she finds a suitable site to begin digging. She then excavates a body pit with her fore flippers, throwing sand several yards around her. When her body rests below the level of the beach, she then begins to dig an egg chamber by scooping the sand with her rear flippers. The action is synchronized so that one





flipper holds and packs the sand of the chamber while the other lifts sand out of the cylindrical hole. The female may abandon one or more nest holes during her time on the beach, partially covering the false nesting site to seemingly confuse any would be predators.

Eventually satisfied with her egg chamber, the female then begins depositing her eggs--one, two, three at a time--dropping the mucous-coated, soft-shelled eggs into the egg chamber. The number of eggs laid is about 100 per nest. Females on the Farm have laid from 1 to 236 in one clutch. The eggs are about the size of a table tennis ball and weigh two ounces each. After ten to twenty minutes the female has generally finished laying her eggs and will then begin to cover her nest, first packing sand over the egg chamber and then filling the body pit, throwing sand over the nesting area as she edges away. She then returns to the water with no fur-

ther concern for her eggs or the resulting hatchlings.

During one reproductive season a female usually lays five to seven clutches, repeating the nesting process at ten day intervals. Farm females have laid from one to ten clutches during a season. The maximum number of eggs laid by any one female during a single season is 1700 eggs. Each female does not necessarily lay every year. Interseasonal nesting intervals of one to six years have been observed at the farm. The average interseasonal nesting interval is 1.6 years. The estimated average annual egg production per female among the Farm's breeding colony is 400 eggs. Among wild green sea turtle populations egg production is estimated between 100-180 eggs per female per year. Wild green sea turtles appear to nest less frequently, every 3 to 4 years, and to lay fewer eggs during a

reproductive season. Dietary and migratory constraints appear to be the limiting factors between captive and wild breeding capabilities.

Although a nesting female can easily be frightened when she first begins crawling and digging her nest, once she begins to actually lay her eggs, she is single-minded and not easily shaken from her task. This allows observers on the Farm to collect her eggs as she drops them and then pack the eggs for incubation in a temperature controlled hatchery. The eggs are carefully placed on a layer of sand in a styrofoam box. A rayon cloth then separates the eggs from another layer of sand over the eggs. Sea turtle eggs can be handled and moved with-



out damage for one to two days following nesting, after which time movement may damage or kill the developing embryo.

Once the eggs are packed they are placed on racks to remain undisturbed until hatching. Incubation temperatures below 75°F or above 90°F generally result in no hatch success. As the sex of the green sea turtle is dependent upon the incubation temperature, the eggs are incubated at 82° F to produce an equal number of males and females. At cooler temperatures all males are produced and at warmer temperatures all females are produced. Hatching occurs after 60 days.

After 55 days of incubation, the top layer of sand and rayon cloth is removed from the styrofoam box. As the hatchlings emerge, they are placed in a tray on a layer of sand for two to three days before being transferred to water. Under natural conditions hatchlings would emerge from their shells in the nest chamber which is two to three feet below the surface. Upon hatching, the tiny turtles have a reserve food supply, the yolk sac, which is attached to their bellies and furnishes nourishment until they reach the surface of the beach in two to three days. In the Farm's hatchery, the yolk sac is absorbed during the time they remain in the sand filled trays. When the hatchlings, weighing less than two ounces, are transferred to the hatchling tanks they exhibit the swimming frenzy which, in the wild, would carry them rapidly down the beach and out to sea. This swimming frenzy continues for a day or two. Seasonal hatching success at the Farm has ranged from 15 to 60 percent.

Hatchlings are kept in rectangular, concrete tanks containing 150 gallons of sea water chlorinated at 1 to 2 ppm. During their first year of growth they are fed a modified Purina

Trout Chow containing 40% crude protein, 8.0% crude fat and less than 5.0% crude fiber. Stocking density varies from 300 to 30 turtles per tank as the turtles grow. A year old turtle weighs about six pounds and has a carapace length of eight to ten inches.

After the turtles reach a year old they are transferred through a series of fiberglass or concrete, circular tanks of 775 gallons to 32,000 gallons water capacity. Complete water turnover occurs in most tanks every 20 to 30 minutes. Tank size and stocking density increases as the turtles grow. The turtles are ready for processing at four years of age and weigh 45-70 pounds. The growing stock is fed Purina Turtle Chow containing 35% crude protein, 3.5% crude fat and less than 5.0% crude fiber. The daily ration varies from 2.0% to 0.4% body weight per day depending upon the size of the turtle. Food conversion ranges from 1.2 to 6.5 units of diet fed to unit of weight gain. The turtles are fed by pouring the feed along the edges of the tanks.

The Farm's stock is periodically weighed to accurately assess its growth and development. The health of the herd is monitored by carefully checking tanks and removing any ill animals. Mortality is highest among the hatchlings with survivability of 60% expected at one year. Less than 3% mortality per year is observed among turtles over a year of age. All tanks are routinely drained and cleaned. As in any intensive culture system, disease problems do occasionally occur. Maintenance of adequate food supplies, proper stocking densities and clean, continually changing water serves to effectively control most disease problems. Water temperature also appears to determine the morbidity of some diseases and water temperatures greater than 77°F would appear to be the minimum desired for maintaining the health of the herd.

A few turtles from each year's production are selected for potential breeders. The remaining animals are processed in the Farm's abattoir. The turtles are killed with a captive bolt pistol and then processed. Meat products include stew, a mixture of steak pieces, liver, fin, lung, calipee and fat, which is consumed locally; and turtle steak, a highly valued culinary delight distributed primarily to the tourist oriented restaurants. Shell products are sold as either polished whole backs or as scutes which are converted into jewelry and other decorative items. Soup products include calipee and calipash, a gelatinous material obtained from boiling of the plastron and carapace of the turtle. The marketing and distribution of sea turtle products is determined by changing laws and economic conditions affecting utilization of products from endangered or threatened species.



FLORA AND FAUNA OF THE CAYMAN ISLANDS

Although CTF is an operating turtle farm, because of its unique attraction for tourists and its facilities for maintaining wildlife, the Farm displays some of the flora and fauna

special to the Cayman Islands. The Cayman Islands are well known for their extensive marine life, but also have a variety of terrestrial flora and fauna. Several plant and animal





species are endemic to the Cayman Islands. The islands support 601 indigenous or naturalized plant species. Some of the flora species used to create a natural habitat for the indigenous animal species on display at the Farm are the silver and green buttonwood (*Conocarpus erectus sp.*) sea grape (*Coccoloba uvifera*), coconut palm (*Cocos nucifera*), royal palm (*Roystonea regia*), thatch palm (*Coccothrinax proctorii*), yellow allamanda (*Allamanda cathartica*), purple allamanda (*Strophanthus gratus*), frangipani (*Plumeria obtusa*), wild cotton (*Gossypium barbadense*), crinum (*Crinum americanum*), lily (*Hymenocallis latifolia*), yucca (*Yucca aloifolia*), and agave (*Agave sobolifera*).

There is an abundance of invertebrate species indigenous to the Cayman Islands, including beautiful butterflies, large beetles and the pesky mosquito. Among the indigenous vertebrates, there are 2 amphibian species, 1 freshwater turtle species, 8 lizard species, 4 species of snakes (all harmless), 1 freshwater fish species, 45 bird species, and 1 mammal--a bat. Additional animal species have been introduced to the Islands by man and are now self propagating. The hickatee, agouti, green parrot and ground iguanas are displayed at the Farm.

The freshwater pond turtle *Chrysemys decussata granti* is found extensively in Grand Cayman, but

is uncommon on the lesser islands. Adults grow to 12 or more inches, with the female larger than the male. The male may be distinguished from the female by its longer tail and retention of the spotted and grey-lined juvenile shell pattern; whereas, the adult female shell is uniformly dark. Locally known as the "hickatee", the turtle bites readily when handled.

The Cayman agouti or Cayman "rabbit", *Dasyprocta sp.*, commonly occurs in the Eastern districts of Grand Cayman and was introduced



from Central America in the 19th century. Like all rodents, agoutis are particularly adapted for running, with long, thin legs and hoof-like claws, three toes on the hind feet and five toes on the forefeet.



Agoutis are used for food, but are also easily tamed and kept as pets.

The Cuban parrot, *Amazona leucocephala*, inhabits the mangroves and woodlands of the Cayman Islands. The Grand Cayman subspecies *A. l. caymanensis* is fairly common and easily seen during the season when fruit trees are bearing. The Cayman Brac subspecies *A. l. hesterna* is

less common and is smaller with darker plumage than its relative. The species nest in cavities in trees during April and May with the usual nest of 4 eggs hatching in 18 days.

The Cayman ground iguanas, *Cyclura nubila caymanensis* and *Cyclura nubila lewisi* are endemic only to the Cayman Islands. *C. nubila lewisi*, characterized by blue skin coloration, is found only in Grand Cayman and is considered critically endangered. *C. nubila caymanensis* is still fairly common in Little Cayman, but their existence is increasingly threatened by feral cats and development. The iguanas are most active during the day when they forage for food or sun themselves. The adult male is generally larger than the female. The female will generally lay 8 to 20 eggs in May or June in a large burrow in the sand.

The American crocodile, *Crocodylus acutus*, displayed at the Farm, may obtain lengths of 20 or more feet. Several skull remains have been collected in the Cayman Islands, and along with early verbal records of sightings and the presence of suitable brackish to salt water swamp habitat on

Cayman Islands Turtle Farm

Turtle Release

The tradition will be upheld

THE CAYMAN TURTLE FARM has held a long-standing tradition of releasing some of the turtles that have been bred in captivity at the Farm. This tradition was initially inspired by the Cayman Turtle Farm's commitment to both its conservation initiatives of ensuring the continuation of the species and of the on-going research that will help biologists learn more about turtle migration and nesting habits. Since 1983, the Cayman Turtle Farm has released over 30,700 turtles into the waters surrounding the Cayman Islands.

Every year, any turtles above and beyond the number required to satisfy the production goals of the Farm are released into the wild. The Cayman Turtle Farm was hit by a severe storm surge from Hurricane Michelle on November 4, 2001, just two days after the public release of 300 yearlings. This resulted in the loss of over 75% of the breeding herd and thousands of turtles from three months to six years old. As a result of this, meat supply to the local market and the release program has been greatly reduced. In spite of this, a token number of 36 yearlings were released in 2002. It is hoped that this tradition will continue with the release of small numbers of turtles each year until things return to normal, although how long this will take is difficult

to predict. The rescued breeders have been put into a new breeding pond, which was completed in late 2002 and a number of young turtles have also been selected and added to the pond as future breeders.

Research is a sincere focus of the Cayman Turtle Farm. One of the greatest problems of obtaining data from turtles over a long period of time is the tagging method. Although many tagging methods have been tried, the most permanent has been the "living tag" developed by Professor John Hendrickson of the University of Arizona, and his wife Lupe. This tagging process involves the grafting of a tiny piece of the white belly shell into the dark top shell of a turtle a few days after it hatched.

Continued on page 12...

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Turtle Release

Continued from page 11

As the turtle grows this white area grows with it. The results collected so far are exciting, as the tag return data indicates that these turtles are surviving in their natural habitat. In fact, during the summer of 2002, three turtles that were released by the farm 17 to 19 years ago returned to the beaches of Grand Cayman to nest.

Since the Farm started to release turtles into the wild, sightings of green turtles around the shores of Grand Cayman seem to be on the rise. To assess the extent of the Cayman turtle population, the Farm, with the co-operation of the Cayman Islands Government, initiated a tag and recapture program, as well as aerial and ground surveys of beaches and waters around the islands. The public has contributed greatly by providing information on turtle sightings and nesting. This programme has been expanded and maintained by the Department of the Environment.

The 2003 turtle release is going to be a little different than in other years. With only 10 turtles to release, the Farm will be holding a raffle to select those who are able to take part. The release will take place on October 28 with an entry deadline of October 24.

To register for the release raffle and for more information on the Cayman Turtle Farm, visit our website at www.turtle.ky

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both islands, the past presence of the species on Grand Cayman and Little Cayman has been established. This endangered crocodile will lay 30-50 eggs a season which hatch in about 90 days. The female crocodile helps the young crocodiles from their eggs and is protective of both the nest and the young. During these times, the crocodile will most likely display aggression. Recently several skulls of *Crocodylus rhombifer* have been excavated. This crocodile is known to easily cross breed with *Crocodylus acutus*.

Other species, non-typical to the Cayman Islands, are displayed at the Farm, as the Farm has become a depository for specimens entering the Islands inadvertently. The green iguana *Iguana iguana* is common throughout the tropical Americas, but is not native to the Cayman Islands. Reaching lengths of 6 feet, these lizards feed on insects and plants. They vary in color from grey-brown to orange-yellow to green. The blue and yellow macaw, *Ara arauna*, ranges from Panama to Paraguay. Richly plumaged and capable of being trained to talk and respond to commands, this member of the parrot family is highly valued as a pet.



THE RELEASE PROGRAM AND TURTLES IN THE CAYMAN ISLANDS

The people of the Cayman Islands have a history tied to the turtle. In the 1600 and 1700's, the Cayman Islands became a provisioning

stop for vessels sailing the Caribbean because of an abundance of green sea turtles which could be caught and kept alive on board as a



source of fresh meat. Permanent settlements developed on the Cayman Islands in the seventeenth century and turtling became a means of income as well as providing a local source of food. However, the turtles around the Islands were depleted by the early 1800s and the turtling industry focused around the Miskito Cays off the coast of Nicaragua. The Cayman turtling fleet continued operating at a sustained level until the early 1900s. By this time turtle populations were dwindling and, in subsequent years, national and international regulations and available alternative sources of income reduced the turtling industry to a negligible level. The appearance of the turtle on the Islands' flag, seal and currency reflects the close association the people have to the turtle.

Prior to the farm becoming self-sufficient in 1978 (totally independent of eggs or breeding adults from natural populations) the Farm collected approximately 460,000 eggs. From these eggs 2,300 year old turtles were returned to the area of their collection for release to the wild. This represented about one half of one percent of the total collections. Estimates for the chance of survival of the turtle in the wild to maturity ranges from one in 100 to one in 10,000 eggs. The early releases made by the Farm of a percentage of eggs collected from the wild were to help negate any possible depletion of wild stocks, although collections were made of eggs from beaches eroded before incubation completed or of eggs sold locally to generate revenues for a country's conservation program.

The Farm's captive breeding colony now produces an average of 45,000 eggs per year. Approximately eight thousand hatchlings are needed each year to satisfy current production goals. Excess hatchlings are designated for tagging and release. Over 28,000 hatchlings and yearlings have been released into the waters surrounding



the Cayman Islands. To reap the maximum benefits from these thousands of locally released turtles CTF now tags turtles with a "living tag" which was developed by Professor John Hendrickson and Lupe Hendrickson of the University of Arizona. This tagging method involves the autografting of a small, white dot of belly shell onto the turtle's dark colored back. This is done when the turtle is only a few days old. As the animal grows, the dot grows with it. This tagging method is tremendously significant in that it is the only method whereby a tiny sea turtle hatchling may be identified as a 300 pound adult more than 15 years later on a nesting beach. This tagging method may allow scientists to discover whether or not sea turtles actually return to the beach from which they hatch to nest, a hypothesis which has never been proven. Information from these tagged turtles will help



determine the benefits of head-starting, a widely used conservation technique of releasing older turtles in the hopes of better insuring their survival in the wild.

Since CTF has begun local turtle releases, the sightings of green sea turtles by divers and residents living along the coast have been common. To fully assess the re-establishment of a Cayman turtle population, CTF with the cooperation of the Cayman Islands government, has initiated both aerial and ground level surveys of the beaches and waters surrounding the islands. The public has cooperated by providing information on turtle sightings and nestings. Because of observed dog and crab predation and increased public use of all beaches, reported nests are relocated to CTF's hatchery for incubation.



All hatchlings are then returned to the collection beach for release.

A tag-recapture program is ongoing which allows for the collection of data regarding survival and growth of the turtles released by CTF. As well as the "living tag", yearling turtles are tagged with a titanium tag on their fore-flipper which identifies an individual animal. Using turtle nets, the turtles are recaptured, weighed, measured, and released immediately at the recapture site. In addition the titanium tag provides information that enables individuals finding these animals in areas away from the Cayman Islands to return capture infor-

mation to the Farm. The majority of tag returns have come from Cuba, with returns also from Honduras, Venezuela, the United States, Panama, Belize, Nicaragua, and Mexico. Information thus far correlated suggests that the turtles adapt well to natural conditions when released as yearlings, and that their release site in the Cayman Islands dictates whether or not they migrate away from the Islands or stay in Cayman waters. Significantly, the release program of the Farm has demonstrated that head-started turtles do assimilate into a natural environment.

RESEARCH AT CAYMAN TURTLE FARM

The owners and management of CTF have continually supported research at the Farm on both the development of successful hus-

bandry practices and on the biological processes of the green sea turtle.



Reproduction has necessarily been a primary research area. Mating and subsequent nesting and hatching of the green sea turtle in captivity was first achieved at CTF in 1973. In 1975, a turtle hatched at CTF and reared to sexual maturity, mated and nested on the Farm with a resultant hatch rate of 33%. CTF achieved another major success in 1989 with the production of the first second generation offspring in captivity, thus satisfying the biological definition of a farmed species.

CTF has defined many reproductive parameters for turtles in captivity which may be correlated with wild populations. The minimum age of sexual maturity of the captive green sea turtle is 8 years with an estimated average of 16 years. Turtles grow until they reach sexual maturity, averaging 200 to 400 pounds at maturity. Mating precedes nesting during a reproductive season. The female normally begins nesting 30 days following mating. A minimum amount of mating, more than 100 minutes, appears required to insure hatch success, although hatchability is not linearly correlated to mating time.

In 1980, CTF in cooperation with the Mexican government, introduced a small group of yearling and hatchling Kemp's ridley sea turtles, *Lepidochelys kempi*, to CTF. The purpose of the research program was twofold—to establish a captive breeding colony of this critically endangered species and to obtain additional biological data on this species in a controlled environment.

In 1984 the first observed nesting in captivity of this species occurred at CTF. The turtles nested at only five years of age and the production of hatchlings from this colony in subsequent seasons has opened avenues for further enhancement of this species' chance for survival. Offspring of the Farm's ridley breeding colony are being reared in captivity for release in subsequent years to determine if turtles reared in captivity can be recruited into the wild populations on release as adults and augment the nesting population.

Natural hybrids of green and hawksbill sea turtles were observed among turtles hatched from a nest of eggs collected from a natural beach in 1977. These turtles are characterized by the imbricated



carapace, double clawed fore flippers, and elongated snout of the hawksbill turtle. Their size and lower jaw dentation are indicative of the green turtle. Their head scalation and serum protein electrophoretic patterns reflect both hawksbill and green characteristics. Hybridization of sea turtle species offers a unique field of research in sea turtle culture.

Research supported or conducted by CTF has defined the quantitative amino acid requirements of the hatchling green sea turtle. This has aided in formulating a diet that is economical and nutritious for the species. Research has been done on the vitamin and energy requirements of the species. Feeding regimes and rations are constantly being checked and modified to achieve maximum productivity and health of the herd.

During the Farm's development, several pathogens have been isolated and identified allowing for preventive treatment. Disease research has been done in association with the University of Florida in Gainesville and the University of Miami, Florida, as well as with the cooperation of other leading diagnostic and control institutes in the United States.

CTF has conducted research or provided materials and facilities for studies on endocrine physiology, ultrasound and laparoscopy techniques, artificial insemination, anesthesiology, egg shell structure, thermoregulation, swimming dynamics and energy demands, social behavior, genetic diversity, biochemical comparison of tissues, population dynamics, aging studies, comparative biochemistry and physiology, and fibropapilloma etiology.

COMMERCE AND CONSERVATION

Sea turtles are characterized by their large size, their largely aquatic existence, and their specialized limbs designed for swimming. Un-

like other turtles, sea turtles are not able to retract their heads and flippers into their protective shell covering. There are seven spe-



cies of sea turtles. Five of the seven species occur circumglobally in tropical and sub-tropical seas and show little morphological diversity within each species over this extensive distributional range.

The Atlantic or Kemp's ridley, *Lepidochelys kempii*, is the smallest of the sea turtle species with the adult weighing between 40-80 pounds. Its restricted nesting range, along the east coast of Mexico, has contributed to its extreme vulnerability and it is considered the most endangered of all sea turtle species. The Pacific ridley, *Lepidochelys olivacea*, weighs between 100-200 pounds as an adult. Both *Lepidochelys* species often nest in aggregations known as "arribadas" where large numbers of females, sometimes several thousand, will nest both day and night over a period of two to three days on a single nesting beach.

Two sea turtle species are primarily herbivorous, *Chelonia mydas* and *Natator depressus*. *Chelonia mydas*, the green sea turtle, weighs between 200-600 pounds as an adult and ranges throughout the Atlantic, Pacific and Indian Oceans as well as the Mediterranean Sea and Gulf of Mexico. The smaller flatback turtle, *Natator depressus* (previously

Cheloni depressa), occurs off the north coast of Australia.

The hawksbill turtle, *Eretmochelys imbricata*, is relatively small, usually weighing about 150 pounds. It is characterized by a narrow, sharply serrated carapace with overlapping scutes and an extended snout. The thick, colorful scutes of the hawksbill turtle, the traditional "tortoise-shell", has long been prized for decorative purposes.

The loggerhead sea turtle, *Caretta caretta*, is characterized by a relatively large head, from which it gets its common name. The adults weigh between 200-350 pounds.

The leatherback sea turtle, *Dermochelys coriacea*, is the largest of all the sea turtles weighing an average of 600-800 pounds, but with individuals weighing up to 2000 pounds reported. Unlike other sea turtles, the leather-like shell of the leatherback is not a solid bony shield. The leatherback lives an open ocean existence, feeds largely on jellyfish, and is often found in cooler waters than other sea turtle species. The leatherback is the sole species in the family Dermochelyidae, while the other sea turtles belong to the family Cheloniidae.





Sea turtles have been harvested in past centuries both for subsistence and to satisfy a large international market. The green sea turtle supplied soup products for the "clear" turtle soup in the European market and meat products for the southeastern USA. The hawksbill turtle supplied the tortoise shell market of Japan. The ridley turtle supplied leather products. Many coastal populations harvested both the turtles and their eggs as a primary source of red meat and protein.

Man's uncontrolled utilization of the sea turtles has attributed to the decline in sea turtle populations over the past two hundred years. In addition, large numbers of sea turtles are killed each year by becoming trapped in shrimp trawls and fish nests and drowning, because they are unable to come to the surface to breathe. For such species as the loggerhead and Kemp's ridley, which are not traditionally commercially utilized, this probably represents the major source of danger to the species. Coastal developments along previously isolated nesting beaches has substantially altered the nesting areas of all sea turtle species. Although the females may still nest along relatively populated

beaches, the hatchlings, confused by the bright lights, are often unable to orient themselves upon hatching and never find their way to the sea. Pollution has taken its toll among sea turtles. The turtles swallow plastic bags and oil soaked food supplies resulting in death. Nesting beaches are also threatened by oil spills.

Although sea turtle populations are still estimated by the tens of thousands, the declining numbers in recent decades has resulted in international awareness of the possible extinction of these species. The International Union for Conservation of Nature and Natural Resources, IUCN, has listed species of sea turtles as endangered, vulnerable, or rare for several years based upon population estimates and causal factors affecting their decline. At present all sea turtles, except *Natator depressus*, are listed as endangered, in danger of extinction, or vulnerable, soon to be endangered under present circumstances. Founded in 1948, IUCN represents international conservational interests for both flora and fauna and has focused private and governmental attention on the need to monitor and conserve living resources.

In 1968, when the Farm began operating, the green sea turtle was not protected internationally, nor was it listed as endangered by IUCN. The large existing markets for sea turtle products and the apparent logical alternative of supplying these markets with a cultured supply rather than a wild supply of turtle, prompted the Farm's formation. Since the Farm was incorporated, U.S. domestic legislation and international regulation has come into effect which has restricted and denied access to large markets, and which has, to an increasingly larger extent, determined the production level of the Farm even as culture techniques were developed and refined.

The United States offered the largest market to the Farm. In 1975, the United States proposed domestic regulations listing the green sea turtle as a threatened species and provided an exemption for the importation of sea turtle products derived from mariculture operations. Stiff opposition to the mariculture exemption came from environmental organizations who categorically opposed utilization of sea turtles. When the final rules were published in July 1978, all importation of green sea turtles was prohibited with no exception for commercial mariculture operations. A request for reconsideration was

made by the Farm, but was denied in December 1978. The Farm then filed suit against the U.S. Department of Interior and Commerce, but lost the case in May 1979 on the basis that while the decision by the U.S. was a subjective one, it was not arbitrary and capricious. From that date the U.S. market was closed to the Farm, and no turtle products could enter the U.S. or pass through any U.S. port or possession enroute to another destination. The U.S. market represented approximately two thirds of the total sales market available and the trans-shipment restriction through the U.S. (Miami being the major commercial route from the Cayman Islands) greatly impeded the possibility of providing products to other overseas markets such as Europe and Japan.

In 1973 the Convention on International Trade in Endangered Species, CITES, was formed and, in 1975, had been ratified by sufficient countries to go into effect as an international treaty. Animals or plants which the Convention felt needed protection were included on either Appendix I or Appendix II. Appendix I (Endangered) species could not be traded for commercial purposes and shipments from one country to another required an export permit and an import permit. Appendix II (Threatened)





species required only an export permit stating that the export was not detrimental to the wild population and such traffic could be for commercial purposes. The Convention specifically stated the Appendix I species bred in captivity would be downlisted to Appendix II and be subject to international trade.

The green sea turtle, *Chelonia mydas*, was not placed on Appendix I until February 1977. Between 1975 and February 1977, products from CTF were accompanied by an export permit. Following listing of *Chelonia mydas* on Appendix I, products were certified as being farm bred. This produced some confusion in that while some products were derived from animals conceived at CTF, the majority were derived from animals hatched and reared in captivity, but conceived in the wild. While the English version of CITES read bred in captivity, the other languages clearly read raised in captivity. This problem was addressed at the March 1979 meeting of CITES held in Costa Rica. A resolution was passed stating, not only that the animals must be conceived in captivity, but that the breeding herd must be managed in a man-

ner shown capable of reliably producing second generation offspring. Since CTF had hatched eggs obtained from the wild, raised the hatchlings to sexual maturity and had these animals successfully reproduce, the Scientific Authority of the United Kingdom certified that CTF was a farm. However, some other countries, including the United States, held that since the animals had been conceived in the wild, the offspring were first, not second generation. Therefore, even though all products currently being produced are from animals conceived, hatched and reared in captivity, and no wild eggs have been collected since 1978, several countries will not accept products from CTF.

At the 1981 CITES meeting, ranching was accepted as another means whereby an Appendix I species could be downlisted to Appendix II. Ranching required that the local population be sufficiently numerous to sustain the take of eggs or young which would be reared in captive conditions. Some of the reared animals must be released to repopulate the local population. The remainder would be for trade, once it could be shown that the ranched products

could be marked in such a way to allow differentiation between those from the wild population. The main difference between a farm and a ranch is that a farm breeds its own stock and is independent of wild populations, while ranches depend upon the wild population for stock.

Subsequent biannual meetings of CITES have dealt with several sea turtle ranching proposals from Surinam and Reunion and with farming proposals from CTF including a proposal based on the concept of CTF operating as a ranch, managing its captive population as a ranch and evolving into a true farm as defined by CITES. However, no sea turtle proposal involving utilization has been approved by CITES. Instead each subsequent meeting has redefined or modified guidelines to specifically prohibit trade in sea turtles although other similar species proposals, such as crocodile ranching, have received CITES approval. Sea turtles evoke a considerable emotional response against utilization, yet sea turtles, especially the green sea turtle, are very valuable and relatively substantial markets continue to exist. Markets have not disappeared and the conservation of the sea turtle may best be served if market demand is met by a reliable source of farmed or ranched products. Many conservationists believe the survival prospects of a species are enhanced if the species has commercial value, thereby providing incentive for sustained yield



utilization. CITES was established for regulating trade in threatened and endangered species, not for the prevention of trade, and at present may risk discreditation if future decisions regarding sea turtles or other species become "arbitrary and capricious".

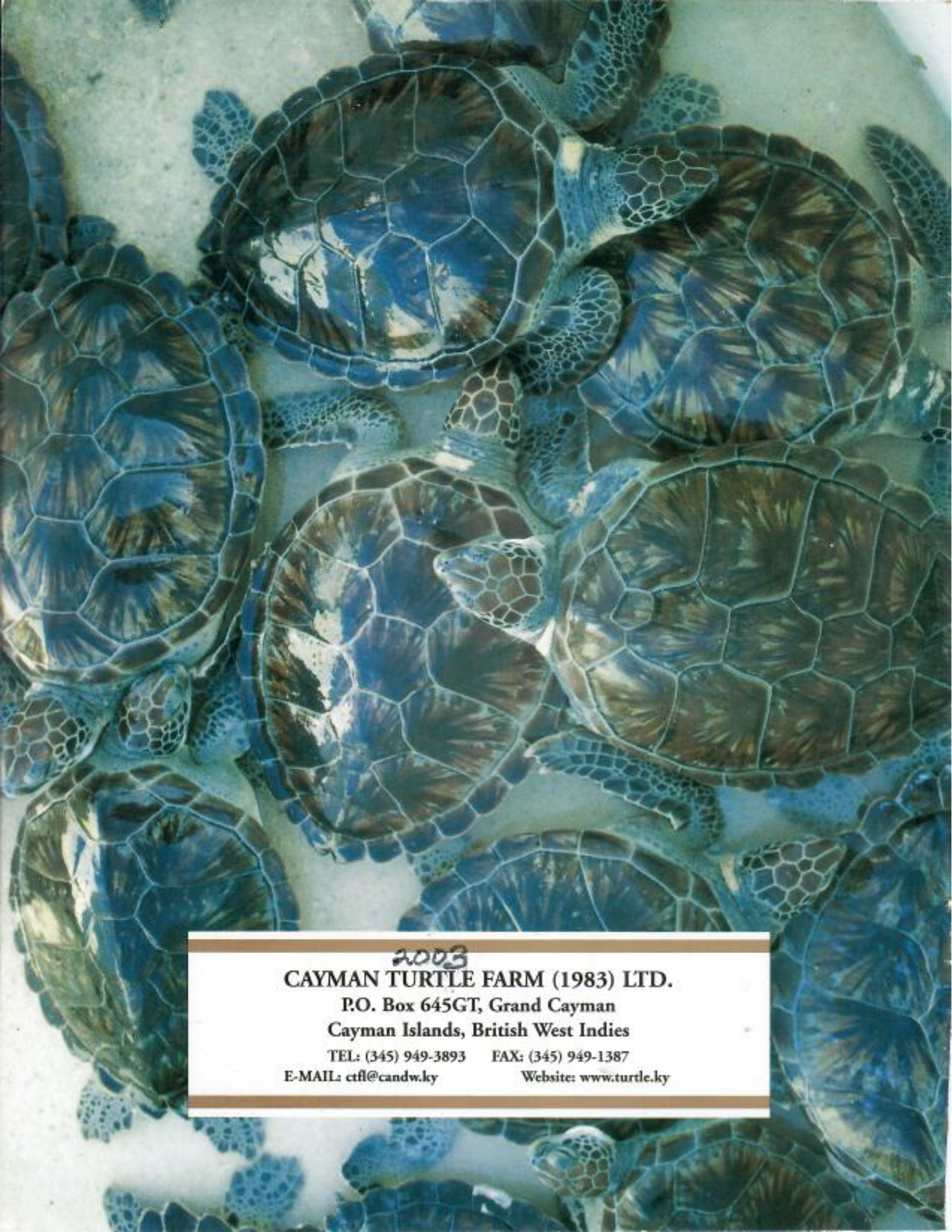
CTF continues to supply the local market with farmed turtle products and the Farm's operation has facilitated the establishment of local laws protecting the sea turtle. The continuing release program of the Farm may not only re-establish a local nesting population, but may also provide considerable information regarding growth and migratory patterns of the species. The conservational contribution of the Kemp's ridley breeding program is still to be fully realized, but has established secondary alternatives to preservation of the species. The Farm is a significant educational vehicle locally and for the number of tourists visiting the Islands. The Farm has contributed to over 100 scientific publications as well as participating in numerous international conferences on turtle biology. CTF continues to maintain a positive position in defining husbandry techniques for the green sea turtle while contributing to the preservation of the sea turtle species and offering visitors to the Cayman Islands a unique educational experience.

A CORPORATE SYNOPSIS

Cayman Turtle Farm (1983) Ltd. is a private, incorporated company of the Cayman Islands and the company's shares are held by the Cayman Islands Government. The Company was incorporated in April 1983 when the Cayman Islands government purchased the Farm from its previous owners. The Farm began operation in 1968 as Mariculture, Ltd., and operated as Cayman Turtle Farm, Ltd., between 1976 and 1983.

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Courtney Platt (pg 3, top); Steven M. Barnett (pg 4, left; pg 5, bottom; pg 6); Bonnie Charles (pg 15); Cayman Turtle Farm (all other photos).



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