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INTRODUCTION

Sea turtle research and conservation in the Americas began with the efforts of Dr. Archie Carr in the late 50's with his studies and conservation projects in Florida and Tortugera, Costa Rica. His book, "So Excellente a Fishe", continues to be required reading for sea turtle biologists and conservationists around the world.

During the 1970's, organized efforts for the protection of sea turtles were initiated in the southern USA. Although at that time data on sea turtles was limited, it was obvious the need to adopt a strategy to protect nesting habitat and the nests themselves from poachers and uncontrolled beachside development.

In Central America as well as in other areas of the developing world, due to various cultural and economic factors, the meat and eggs of sea turtles have for centuries been a source of protein and income for local populations. It is for this reason as well as the underlying poverty of the region that sea turtle conservationists have had to develop more participatory protection strategies based on the concept of sustainable use and the active involvement of local communities. A good example of this approach is Ostional in Costa Rica, a site of the famous "arribadas" mass nesting of olive ridleys (*Lepidiochelys olivacea*), where the local community manages the collection and commercialization of the eggs in a sustainable manner.

SEA TURTLE CONSERVATION IN GUATEMALA

Hatcheries

The history of sea turtle conservation in Guatemala is one based almost entirely on the use of hatcheries. These hatcheries necessarily have a community focus based on the fact that the majority of the eggs collected are the result of voluntary donations on the part of local egg collectors; a marked contrast from many other countries where sea turtle conservation projects are initiated by outside organizations, NGOs or universities with little input from the community.

In 1971, the National Forestry Directorate (DIGEBOS), part of the Ministry of Agriculture, established the first sea turtle hatchery in Guatemala in the village of Hawaii, a small fishing community 8 kilometers east of the main Pacific coast resort of Monterrico. In the following years, DIGEBOS and the National Fisheries Directorate (DIGESEPE) built various other hatcheries along the Pacific coast and one on Caribbean coast near the village of San Francisco del Mar.

Over the years, the number of functioning hatcheries in the country has varied between 16 and 25, depending on the resources and sponsors available. Sponsorship and management of these hatcheries has involved a variety of actors, including universities, government institutions, the military, NGOs, private companies and individuals.

Research

Although the history of sea turtle conservation in Guatemala spans over 25 years, it is surprising how little research has actually been carried out. What little research that has been carried out has tended to focus only on the management of hatcheries without looking at the appropriateness of using hatcheries vis-à-vis other strategies for the conservation of sea turtles.

In 1987, the Center of Conservation Studies (CECON) of the University of San Carlos and the Peace Corps carried out a study to determine the optimal conditions for hatcheries in Guatemala to insure a high hatchling success rate and a favorable temperature for the production of a 50/50 sex ratio in hatchlings. The

result of the study, "Guia Para el Manejo de Tortugarios", continues to be the principle field guide in Guatemala for the construction and management of hatcheries.

In 1981-82, DIGESEPE, with the support of the Food and Agricultural Organization (FAO) carried out research on the Pacific coast of Guatemala on the management of hatcheries and morphologic data on nesting females. It also carried out a program to tag females and head-start hatchlings. The results of this research was reported by Ramboux ('82) and Rosales ('85).

In general, however, there have been no research efforts to look at the Guatemalan sea turtle population as a whole and to analyze conservation strategies on a national level.

Turtle Excludor Devices

In 1996, under threat of an embargo by the United States and thanks to the technical advice of Randall Arauz of the Earth Island Institute as well as the collaboration of the Pacific Naval Base (BANAPAC), the Guatemalan shrimping fleet voluntarily installed Turtle Excludor Devices (TEDs) on their nets. These devices are grates of aluminum tubing that are sewn into trawling nets and, when used properly, deflect turtles and other large objects out of nets while only slightly lowering yields on shrimp catches.

Presently, BANAPAC checks shrimp boats at the dock to verify that they have TEDs properly installed before allowing them to sail. However, no open-sea checks have been carried out to see whether TEDs are actually being used correctly. (Please see "Suggestions for Future Research") This is an important aspect of proper enforcement given the fact that in many other parts of the world it has been shown that fishermen sew the TEDs shut once they leave port. For example, an undercover study carried out by the Audubon Society in the United States among shrimpers there determined that only 55% of the shrimp boats were using TEDs correctly.

Once a year, the US Embassy, together with the Association of Producers of Non-traditional Exports (AGEXPRONT) carries out an evaluation on the use of TEDs in Guatemala, a step that by US law must be taken in order to allow imports into the US. In the three years since the implementation of TEDs, there have been no reports of non-compliance though as mentioned above, nor have there been open-sea spot checks.

Antecedents to this Report

In 1995-6, DIGEBOS sponsored visits by biologist Randall Arauz of the Earth Island Institute to Guatemala with the objective of offering technical support on the management of sea turtle hatcheries and to promote the use of TEDs on Guatemalan shrimpers. In his final report, *"Evaluación of the Guatemalan Program of Sustained Use and Conservation of Sea Turtles",* Arauz comments on the fact that the CECON/Peace Corps hatchery handbook is outdated and there is a need to reevaluate the methodology suggested in that handbook.

Subsequently, several meetings were held with members of ARCAS, Randall Arauz, Didiher Chacon of the ANAI Association of Costa Rica, Doug Warmolts of the Columbus Zoo and Anabella Barrios of DIGEBOS, including informal meetings at the 16th Annual Symposium on Sea Turtle Conservation and Biology. At these meetings, it was pointed out the need to not only improve hatchery management techniques in Guatemala, but also to recopilate data that has been gathered over the years at Guatemala hatcheries and to begin generating data on a national scale. It was also pointed out the need to produce a national report on the status of sea turtle conservation in Guatemala as a tool to be used to influence national and regional policies for the conservation of sea turtles and other marine resources.

In November, 1996, ARCAS, with the financial support of the Columbus Zoo and in coordination with ANAI, DIGEBOS and the Earth Island Institute, organized the Regional Workshop on Sea Turtle Conservation and Hatchery Management. This workshop had the goal of improving conservation measures and strengthening the Central American sea turtle conservation network. One of the principal outputs of the workshop were suggestions for the establishment of a national sea turtle research strategy in Guatemala. Participants of the workshop emphasized that this research should directly support conservation in Guatemala and should include the following components.

OBJECTIVES OF THIS RESEARCH

Based on these antecedents, the objectives of this research and report are to strengthen sea turtle conservation activities in Guatemala and Central America by:

- *Collecting and analyzing existing data - especially hatchery data - , reports and studies and synthesizing them into a national report presented in a regionally comparable format which can be used to influence policies and strategies for the conservation of sea turtles;*
- *Conducting crawl count surveys along the Guatemalan coast in order to determine the number of nesting turtles per year as a way to begin to estimate the total Guatemalan sea turtle population;*
- *Re-evaluating hatchery management techniques based on the recommendations of the "Guia para el Manejo de Tortugarios" and to modify these techniques if necessary.*

We would like to emphasize that this report is really a work in progress and hope that it serves to prompt further, more systematic data collection and, ultimately, a national strategy for the recuperation of sea turtle populations in Guatemala. We recognize that the data presented here is not complete and that the hypothesis formulated has made a lot of assumptions. However, we hope that this report serves as a baseline for future research and that it encourages other groups working for the conservation of sea turtles to work harder to gather necessary data. We at ARCAS do not look at this report as a final product, rather, we hope to be able to continue collecting data and using it produce similar reports yearly.

PHYSICAL DESCRIPTION

Pacific Coast

Guatemala has 254kms of Pacific coastline which can be characterized as of the "high energy" type with relatively steep beaches, strong tides, large waves between 1 and 4 meters and significant erosion. There is a fairly well-defined rainy season from June to October with strong, local storms with high winds and torrential rains. However, apart from the irregularities of "El Nino", Guatemala is usually not seriously threatened by the hurricanes that plague the Caribbean. The beaches of the Pacific coast are composed of dark, volcanic sand and are straight, though broken by rivermouths every 30-50kms. These rivers affect the temperature of the nearby ocean water and during the rainy season can unleash significant quantities of garbage and driftwood, but compared to some areas of the Caribbean coast, the beaches of the Pacific are relatively uncluttered.

Two species of sea turtles nest on the Pacific coast of Guatemala: the olive ridley (Lepidochelys olivacea) and the leatherback (*Dermochelys coriacea*). The olive ridley nesting season coincides with the June-October rainy season with peak months in August and September, but these turtles will also nest infrequently all-year around. (Please see Cuadro II, Crawl Count Survey) The leatherback is much less common than the olive ridley and only nests from November to January.

Oliver Ridley *(Lepidochelys olivacea)*	-	J, J, **A, S,** O
Leatherback (*Dermochelys coriacea*)	-	N, D, J

Although no formal research has been done to the effect, if appears that olive ridleys nest more or less uniformly along the Pacific coast of Guatemala not favoring any area in particular. There is certainly nothing approaching the "arribada" behavior found elsewhere. They are also know by local egg collectors to favor nesting during a rising or setting the moon and prefer darker nights with less moonlight and surface reflection.

An interesting aspect of the nesting behavior of olive ridleys in Guatemala is their obvious preference for certain winds from an easterly direction known locally as "chubbascos". Under chubbasco conditions, olive ridleys will even nest during the daytime (personal observation). Local people are familiar with this phenomenon and during daytime chubbasco conditions, the beaches takes on a kind of carnival air with none of the menacing atmosphere sometimes present at night. Ramboux ('82) and Pritchard ('79) also

noted this tendency to nest in greater numbers during chubbasco conditions and suggested that it was a survival strategy in that the wind covers the nesting turtle's tracks and blows away the scent of freshly laid eggs.

There is some confusion on the Pacific coast of Guatemala of the presence of "tortugas negras" or black turtles. Part of this confusion stems from the mis-identification on the part of earlier researchers of the "parlama", the local name for olive ridleys, as green turtles. Steve Cornelius, in "Biology and Conservation of Sea Turtles", states that the green turtle (*Chelonia mydas*) is the most abundant species en Guatemala (Bjorndal, 1979) Perhaps because of this statement, early sea turtle conservation legislation in Guatemala also mistakenly mentioned the need to protect *Chelonia mydas* on the Pacific coast.

In addition to this confusion on the part of early researchers and lawmakers, many local people distinguish between lighter-colored olive ridleys and those with a darker pigmentation, which they to as "tortugas negras".

Nevertheless, although local fishermen report sighting foraging *Chelonia agassazi* in the waters off the Pacific Guatemalan coast, there is no reliable evidence that green turtles actually come to nest anywhere in the area.

Caribbean Coast

Although the Guatemalan Caribbean coastline is 148kms long, only 50 kms of it is suitable for the nesting of sea turtles. (Rosales, '83) This area which lies between Punta Manibique and the Montagua River is an isolated peninsula that actually is more easily accessible from Honduras, requiring a 3 hour boat ride from the main Guatemalan port of Puerto Barrios. (Please see Annex III) In contrast to the Pacific beaches, those of the Caribbean are more narrow, closely crowded by vegetation and are more heavily littered by driftwood and other organic materials which can make nesting, egg collecting and data gathering very difficult.

On the Caribbean coast of Guatemala, three species of sea turtles come to nest. In order of abundance, they are:

Hawksbill (Eretmochelys imbricata)	-	M, **J, J, A,** S, O, N
Loggerhead (Caretta caretta)	-	M, **J,** J A, S, O
Leatherback (Dermochelys coriacea)	-	F, **M,** A

DEMOGRAPHIC CLIMATE

The population growth rate in Guatemala is 2.8% and the coastal ecosystem is being severely affected by this demographic explosion as well as by the touristic and agricultural development that is accompanying it. As an example, the village of Hawaii - which now has a population of over 1500 people - was founded a mere 50 years ago. Before that time, the beaches near the Hawaii area were visited only seasonally by itinerant fishermen and harvesting pressures on sea turtle eggs as well as all other marine resources was much less. Older residents of the south coast claim that 20 to 30 years ago one could go out on the beach to collect turtle eggs and would expect to get 1-2 nests per night. Now, with more people and fewer turtles, a full-time egg collector walking the beaches every night with good luck will find 1-2 nests per week.

Although the coastline of Guatemala has not experienced the type of commercial development on the scale of a Cancun, it has nonetheless become uniformly populated. Areas which just 50-70 years ago were completely unpopulated, now have villages of 800-1,500 people every 4-8 kilometers. The area has also been transformed in recent years with the introduction of crops that can resist the heat and sandy soils of the area such as sesame, "lufa" gourds and watermelon.

CURRENT SITUATION

Threats

The most common threats to sea turtles around the world can be characterized as the following:

1) *Harvesting/poaching of eggs;*
2) *Incidental capture and death of adults by commercial fishing operations (usually shrimp trawlers);*
3) *Touristic, urban or industrial development of nesting habitat;*
4) *Slaughter and consumption of turtle meat;*
5) *Capture and slaughter for other products (Leather in Mexico, Hawksbill shells in the Caribbean, etc.)*
6) *Marine pollution, especially chemicals and plastics*

In Guatemala's case, threats 1,2 & 3 are the most pertinent. There is no reported consumption of turtle meat and there has been no known usage of other turtle derivatives such as leather or shell. Rosales ('83) reported the existence of turtle hunting and the marketing and consumption of meat in the Livingston area but states that that industry shut down with the passing of legislation prohibiting it in 1980.

Nor are the coastal areas of Guatemala heavily developed. There is as yet not a serious problem with beach-lighting, the building of wharves, sea walls, etc, and there is relatively little pollution.

One threat to the existence of sea turtles in Guatemala that is rarely mentioned is their reported capture and slaughter by Mexican shark fishermen to be used as bait. (Please see *"Suggestions for Future Research"*)

Threat #3, *Touristic, urban or industrial development of nesting habitat* is also not a serious threat to the survival of sea turtles in Guatemala; at least in the short-term. Apart from the Puerto Quetzal/Puerto San Jose area, the tourist industry has developed in a low-key fashion, with only the construction of individual vacation homes and small hotels along the coast. However, given the demographic growth of the area and the lack of regulation, beach-lighting will almost certainly become a more serious problem in the future.

At the present time, threats #1 and #2 - *harvesting/poaching of eggs, and the incidental capture and death of adults by commercial fishing operations* - are by far the most serious threats to the survival of sea turtles in Guatemala. Although no conclusive research has been done to the effect, it is almost certain that nearly all eggs laid on Guatemalan shores are harvested. In the Hawaii area, for example, it is very rare that a nest is laid without being detected by an egg collector. It is such a rare event that locals who find emerging hatchlings are startled and, collecting them in buckets, bring them to hatcheries for advice on what to do to "help" them.

During the peak nesting weeks in August and September, the beach resembles a popular beachside boardwalk with egg collectors every 50 meters scanning the surf for emerging turtles. The emergence of a turtle often results in footraces to "claim" the turtle and occasionally even fights between egg collectors. This high level of human predation has apparently been going on for at least 25 years as Ramboux ('82) reports that in the areas of Chapeton and Las Lisas "not one hatchling has hatched naturally for the last eight years."

Legal Environment

In 1971, the first governmental decree for the protection of sea turtles was legislated giving impetus for the establishment of many of the first hatcheries. In 1981, this decree was modified in large part because it only mentioned *Chelonia mydas*. The new version recognized the need to protect all species of sea turtles as well as to regulate the capture and transport of sea turtles and their eggs.

Sea turtles in Guatemala are also protected under the Protected Areas Law which states that it is of "national interest" to protect sea turtles as well as other species in danger of extinction. It names the National Council of Protected Areas (CONAP) as the government agency responsible for the enforcement

of this law. It is important to mention here that this law is applicable not just to protected areas, but to all national territory.

The Protected Areas Law states that it is illegal to transport, exchange, commercialize or export live or dead examples, their parts or derivative products of endangered species as listed by CONAP. The penalties for violating this law range from 5 to 10 years in jail and a fine of 10,000 to 20,000 quetzals ($1,500-$3,000).

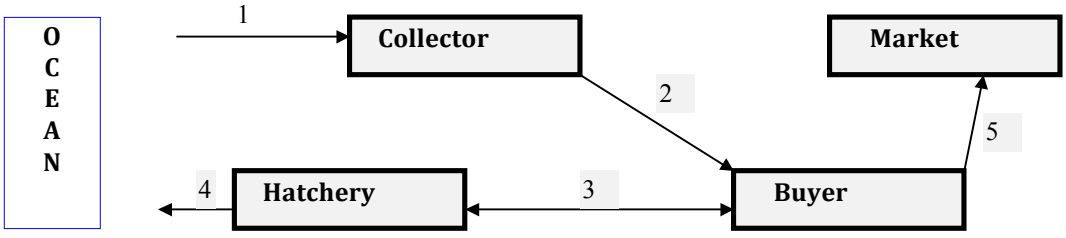
The Convention on the Trade of Endangered Species (CITES) was ratified by the Guatemalan government in 1980. CONAP is the government agency responsible for implementing this international convention and has been charged with each year drawing up a list of species threatened with extinction in Guatemala. CONAP is also responsible for issuing permits for the use and commercialization of non-endangered species. It is important to point out that although CONAP is the government agency responsible for issues regarding endangered species, it to date has taken no active role in the protection of sea turtles in Guatemala.

THE DONATION SYSTEM

Although sea turtles are on paper completely protected in Guatemala, the reality is very different. Behind this facade of laws and governmental decrees is an informal system of unwritten agreements and understandings which, though very weak, afford the sea turtle the only degree of protection it gets in Guatemala.

This informal arrangement, known as the Donation System, was initiated in the early 1980s and strives, but falls far short of setting up a system for the sustainable use of sea turtle eggs. Under the Donation System, an egg collector is given the "legal" right to sell and market a nest of eggs as long as he/she donates one dozen eggs of that nest to a hatchery. It functions in the following way:

1. *An egg collector finds a nesting turtle and harvests the eggs.*
2. *The collector then sells the eggs to a local buyer or middleman, who discounts the donation of one dozen eggs from the total that is paid to the collector.*
3. *The buyer then delivers the donation to a local hatchery who in exchange gives the buyer a voucher stating how many eggs were donated. This voucher gives the buyer the "legal" right to transport and sell the eggs.*
4. *Donations are then buried in the hatcheries and after incubation, the hatchlings released into the sea. Many hatcheries also augment these donations by searching for nesting females themselves or by receiving whole nests donated by tourists or other concerned vacationers.*
5. *The buyer then transports the eggs to sell in the various markets in Guatemala City, Mazatenango and other large cities.*



The Donation System is far from perfect and many collectors and buyers do not comply. In addition, there is a marked lack of resources and will on part of the authorities to enforce even this token effort at conserving such a valuable natural resource. According to our observations in the Hawaii area, it is roughly 50% of the collectors that abide by the one dozen Donation System, and this in an area that is relatively well monitored and enforced.

On the other hand, there are some advantages to the Donation System. Being entirely voluntary in nature, it encourages community participation and lets local people feel that they are taking part in the conservation of sea turtles while not seriously affecting them economically. In addition, because the buyers don't actually lose money in deducting the one dozen egg donation from the total that they buy from collectors, they actually facilitate the collection of eggs on the part of the hatcheries. If hatchery workers had to go out on the beach and collect donations from individual collectors they would in no way be able to collect as many eggs.

It is very important to point out the positive role that the Naval Base of the Pacific (BANAPAC) plays in the functioning of the Donation System and conservation of sea turtles in Guatemala in general. Although it has no real legal mandate to do so, it is by far the government institution that lends the most field-level support to the hatcheries on the south coast of Guatemala. Periodically, it sends troops out to set up roadblocks in strategically important areas such as La Avellana and Iztapa where they check the cargo of buses loading marine products from the coast to be transported to Guatemala City and other inland cities. They check to see that the buyers transporting sea turtle eggs have the required vouchers attesting to the fact that they have donated one dozen eggs to a hatchery. In the case that the buyer does not have the required voucher, the eggs are confiscated and taken to the Naval Base where they are reburied in the hatchery there. This enforcement pressure on the part of Naval Base is essential for the smooth functioning of the Donation System as when roadblocks and searches on buses are carried out, the degree of compliance and number of donations received at hatcheries jumps noticeably.

Unfortunately, BANAPAC lacks in the resources to cover the entire Pacific coast. Roughly from the village of Las Lisas east to the Salvadoran border and from Puerto San Jose west to the Mexican border, there is very little control of the collection and transport of eggs. BANAPAC lacks the resources to mount roadblocks at such as distance and there are no other governmental agencies in the area to fill the authority gap. Even to carry out roadblocks in the La Avellana-Itzapa area, counterpart organizations such as ARCAS or AGEXPRONT must provide transportation and food to the soldiers from BANAPAC. The entire Caribbean coast is virtually free of any governmental control over the collection and commercialization of sea turtle eggs.

Nor is there interest on the part of other government authorities for the conservation of sea turtles in Guatemala. Although individual members or officers of the National Civil Police or the Immigration Department may show interest in collaborating with such efforts, there is little political will to launch a national effort to conserve sea turtles.

THE COMMERCIALIZATION OF SEA TURTLE EGGS

In order to transport sea turtle eggs to the market, buyers usually pack them into large baskets hidden below shipments of fish or shrimp and then loaded onto the roofs of buses that run from the coast to the markets of larger cities of the country. Once they are in these markets, there is no further control over their commercialization. Olive ridley and leatherback eggs are sold openly by wholesalers as well as at small stalls where they are served with orange or tomato juice and sometimes mixed with the gelatinous center of cow eyeballs. Many "ceviche" restaurants (a popular raw fish dish in Latin America) serve sea turtle eggs though they are usually not carried openly on the menu.

It is important to mention that there is also a fairly heavy trade in Mexican and Salvadoran eggs in Guatemalan markets. Guatemala eggs are of course much fresher and command a slightly higher price. Salvadoran and Mexican eggs are easily identifiable as less translucent and often partially cooked due to the fact that they have been hidden in the lower cargo area of pullman-type buses where they are heated by the exhaust system.

As in other areas of Latin America, some Guatemalans consider sea turtle eggs to be aphrodisiacs and they are consumed principally by men. One campesino interviewed in the Guatemala City Zone 4 market, after finishing his cocktail of two olive ridley eggs, cow eyeball and orange juice (32 quetzals/$5!), wiping his mouth, stated with satisfaction "Now I don't have to eat for two days!"

Hatcheries

Turtle conservation in Guatemala has been characterized by a reliance almost exclusively on hatcheries. Since the establishment of the first hatchery in Hawaii in 1971, the number of hatcheries in Guatemala has fluctuated year-by-year between 16 and 24. It is very probable that Guatemala is the country with the most hatcheries per kilometer of coastline of any country in the world. The sponsorship and management of these hatcheries has been a highly decentralized, un-coordinated and under-financed affair. As can be seen in Cuadro 1 and Anexo III, there are a variety of actors taking part, including ARCAS, the Austrian High School, BANAPAC, Amigos del Bosque and the Association of Producers of Non-traditional Exports.

As part of its recent privatization drive, the government of Alvaro Alzu in 1997-8 "institutionalized" and down-sized the National Forestry Directorate (DIGEBOS) and the National Fisheries Directorate (DIGESEPE) who then withdrew support for the 11 they sponsored. The remaining actors in the sea turtle conservation network have been scrambling to fill the void, but several hatcheries have had to be abandoned and large parts of the Pacific coastline and the entire Caribbean coastline are without even this minimal level of protection. In general then, we are seeing a definite privatization of sea turtle conservation activities in Guatemala with more and more of the field-level work being carried out by NGOs, educational institutions and businesses rather than the government.

THE MANAGEMENT OF HATCHERIES

Hatcheries in Guatemala are typically constructed of walls of corrugated zinc, durolite panels or other materials with roofs of coco leaves giving roughly 50% shade. They are located 20-100 meters from the beach, although the distance from the beach doesn't seem to have much bearing on hatchling success rates as long as the ground is pure sand, free of soil, vegetation, roots or other organic materials.

Hatcheries are typically managed by local personnel who, while well-intentioned, lack the training to carry out more technical activities such as the gathering of data. The situation in Guatemala is in contrast with that in many other sea turtle conservation projects around the world which are initiated and managed by outside experts from universities or international NGOs. In these communities, there is a certain amount of pride about their hatcheries and there has even developed a bit of competition among hatcheries, something that could be exploited in the future to the benefit of the sea turtles.

Olive ridley sea turtle eggs are buried in nest of 24 eggs at a depth of 30-35cms with 30-40cms between nests. Leatherback nests are buried at 40-45cms. Eggs which are too old to bury (older than 6-8 hours) are

often set aside and traded the following night with collectors on the beach for fresh eggs. Old eggs are distinguished by a "shadow" where the embryo has already attached itself to the side of the shell.

Predators such as cats, raccoons, dogs and birds are controlled with the use of nest cages which are placed around the nest a week or so before eclosion. Compared to other parts of the world, the hatcheries of the south coast of Guatemala are surprisingly free of fungi, bacteria, insects and other micro-predators.

Although not recommended, some hatcheries still hold hatchlings in tanks or buckets of salt water for several days before releasing them so that they can "become used to" the water.

Since the establishment of the first hatchery in 1971, the number and location of hatcheries in Guatemala have varied from year to year. Anexo III lists the hatcheries in operation in 1996. Without listing them all, below is a short description of some of the principle hatcheries:

San Francisco del Mar

This is the only hatchery on the Caribbean coast. It attempts to cover the 50kms from Punto Manibique to the Honduran border, but with limited resources, it has realistically only been able to cover 12-15kms near the town of San Francisco del Mar. Green, loggerhead and hawksbill turtles nest in this area. The one dozen donation system is not used here, rather hatchery workers conduct nightly patrols in search of nesting turtles in order to collect whole nests.

Conservation in this area is complicated by the added problem of the trafficking of sea turtle eggs, iguana egg and meat and crocodiles across the nearby Honduran border.

In 1997, DITEPESCA/DIGESEPE withdrew its support for conservation efforts in the San Francisco del Mar area and since then the hatchery has been essentially abandoned.

Tilapa

This hatchery has been in existence since 1982 and is supported and managed by Amigos de Bosque. Like many of the hatcheries that exist in the western part of the Pacific coast towards the Mexican border, it operates almost completely free of government support or control.

El Banco

This hatchery is sponsored by BANAPAC and is typical of many of the hatcheries on the Pacific coast: constructed with few funds, using local materials and managed by a member of the community with no training and receiving only token remuneration.

Candelaria

This hatchery is sponsored and managed by the Austrian-Guatemalan School and in recent years has been one of the most productive hatcheries on the Pacific coast due in large part to the direct purchase of eggs on the beach.

Monterrico

The Monterrico hatchery is managed by the Center for Conservation Studies (CECON) of the University of San Carlos. It has benefited not only by the steady, constant support of the University, but also from the tourists that arrive at this the most popular Pacific coast resort. 25% of the eggs buried in the hatchery are donated by tourists and CECON holds regular turtle-release races to raise money.

Hawaii

This hatchery is supported and managed by ARCAS under a cooperative agreement with the National Forestry Institute (INAB, formally DIGEBOS). It is not only the oldest hatchery in Guatemala, but is traditionally the most productive, at times releasing more hatchlings than all other hatcheries combined. In

addition to the main Hawaii hatchery, ARCAS operates an environmental education program which includes 3 school hatcheries where students collect and bury their own eggs and then release the hatchling when they are born.

PRESENTATION OF DATA

Important Notes:

1997, the year in which this data was collected, was a year of "El Nino" which had a severe effect on the climate and ocean currents of the Guatemalan coast. (For example, several sea lions stranded on the coast, animals which are usually never seen in the area, the nearest colonies being in Baja California or the Galapagos Islands.) The olive ridleys seemed to favor the warm currents of El Nino. All the hatcheries reported higher than usual numbers of turtles than in normal years. In this context, the data presented here is perhaps not typical of a normal year.

We also recognize that the data presented here is incomplete and the hypothesis formulated perhaps is making too many assumptions. However, we hope that this report serves as a baseline for future research and that it encourages other groups working for the conservation of sea turtles to work harder to gather necessary data.

HATCHERY PRODUCTION IN GUATEMALA

One of the principle goals of this research was to collect data that has been gathered over the years by Guatemalan hatcheries that lies gathering dust in the offices of government agencies and other institutions involved in sea turtle conservation. Cuadro I is a compilation of the available data, separated by species, olive ridleys and leatherbacks.

DONATIONS

It is important to emphasize here that it is obvious that the current one dozen egg donation system is insufficient to maintain sea turtle population in Guatemala over the long-term. In Hawaii, we calculated that roughly 50% of collectors comply with the one dozen egg donation, and this in an area of the Guatemalan coast that is relatively well patrolled. If we take into consideration that one dozen eggs is roughly 14% of a olive ridley nest (average of 84 eggs per nest [Ramboux, '82]) we are saying that only 7% of eggs laid on the Pacific coast are being saved. In addition, if we further take into consideration that most hatcheries only collect eggs during the heaviest months of the nesting season, leaving the light months (Nov-May) completely to the collectors, and that many parts of the Guatemalan coast are not covered by hatcheries at all, we could drop this figure to 5% or less. Obviously this is only a rough estimate, but it appears that at best 5% of the olive ridley sea turtle eggs laid on the Guatemalan pacific coast are being saved, buried in hatcheries, incubated and hatchlings released to replenish the nesting population.

NEST TEMPERATURE

In sea turtles, like most reptiles, sexual orientation is determined by the temperature of the nest during incubation. Because it is very difficult to determine the sex of hatchlings, most biologists recommend measuring nest temperature in order to determine whether hatcheries are producing a favorable 50/50 sex ratio.

Another objective of the present research was to re-evaluate the hatchery management methodology set out in the "Guía de Manejo de Tortugarios" (Higginson, Orantes... '84) which recommends that olive ridley

nests should be buried at 32-45cms with palm roofs of 50% shade. This methodology, with some slight modifications, is still that used by hatcheries in Guatemala.

According to data collected at the Hawaii Hatchery in 1997, the methodology set out in the Guia is correct, maintaining an approximate temperature of 31 degrees Centigrade, though there were broad temperature swings depending on the quantity of rain, clouds or sun.

HATCHLING SUCCESS

There is a tendency among hatchery workers and managers in Guatemala to exaggerate the hatchling success rates in Guatemalan hatcheries; the most commonly cited figure being 90-95%. It is true that if eggs are received at the hatchery and buried within 2 or 3 hours of nesting, hatchling success rates can be this high. However, the reality of the Donation System under which hatcheries in Guatemala work is that most eggs are donated to the hatchery in the early morning, after being fairly well manipulated all night long in plastic bags and having been laid anywhere between 1 and 12 hours previous. Under these conditions, we typically see hatchling success rates of 80-90%.

In Hawaii in 1997, we recorded an average hatchling success rate of 81%, while AGEXPRONT, in its three hatcheries recorded a figure of 86% for its three hatcheries (Roessales, 1997). Amigos del Bosque reported an average hatchling success rate of 87.5% for its hatcheries at Ocos and Tilapa between the years 1984 and 1997 (de Leon, 1997)

Ramboux (‘82) reported that eggs buried within 3 hours of nesting had a 97% hatchling success rate, while those that were 7 hours old had one of less than 60%.

In is important to point out that generally in Guatemala when nests are excavated to count the number of empty shell and determine how many sea turtles hatched, hatchlings that are still in the nests are “helped” to the surface and are counted as successfully hatched. That is to say, only undeveloped, unhatched eggs are counted as unhatched in order to determine hatchling success rates.

According to the scarce data available for San Francisco del Mar, it appears that the hatchling success rate on the Caribbean side of the country is 83%, although that figure includes hawksbill, loggerhead and green turtles combined.

RELATIONSHIP BETWEEN FRESHNESS OF EGGS, AMBIENT TEMPERATURE, INCUBATION PERIOD AND HATCHLING SUCCESS

There is a belief among hatchery workers in Guatemala that for every hour of delay between the time an egg is laid and it is buried in the hatchery, it’s incubation period will be extended one day. In other words, if a fresh egg is buried immediately, it will take 45 days to hatch; if it is one hour old, it will take 46 days, and so on.

However, according to our experience in Hawaii, that is not the case. If we consider that eggs received at the hatchery come from various different collectors and can be from 1 to 12 hours old, it is surprising the uniformity in the incubation period between nests, day-by-day, week-by-week.

The factor that appears to influence incubation period most directly is the ambient temperature during the 45-53 days of incubation. In Hawaii, we saw broad fluctuation in incubation periods over weeks and months, indicating that the ambient temperature more than the freshness of the eggs was a determining factor. There is an obvious need to look more closely at the correlation between incubation period and ambient temperature. (Please see “Suggestions for Future Research”)

We also saw that although the average incubation period at the three AGEXPRONT hatcheries was 46.3 days, that for the Hawaii hatchery was 49.6 days, indicating possibly that we need to look more closely at reducing the amount of shade over the nests or somehow raising the nest temperature.

Finally, we didn’t see a relationship between incubation period and hatchling success rate. These factors appeared to be independent: temperature influencing the first and freshness of eggs influencing the second.

GUATEMALAN SEA TURTLE POPULATION

Another main objective of this research was to attempt to estimate the population of nesting sea turtles in Guatemalan with the aim of determining whether that population is increasing or decreasing and, if the latter, develop an appropriate strategy for its recuperation. This data could also be used in regional comparisons and to formulate national or regional strategies for the conservation of sea turtles.

PACIFIC COAST

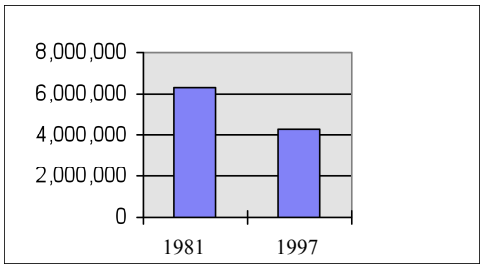
Methodology

The data presented in Cuadro II were collected by ARCAS between June and November, 1997, covering a total distance of 16kms between La Barra de Chapeton and Monterrico. Researchers conducted patrols just before sunrise on motorized ATVs to count the crawl tracks of olive ridley turtles that had nested the night before. During windy, rainy nights or when the high tide erased the tracks an accurate count could not be made and data for these nights were not included. Data was only included for nights when we were reasonably sure that we could get an accurate count of the number of turtles that had nested the night before.

According to this data, and extrapolating for the months of December through May, we calculate that in 1997 202 olive ridley nests were laid per kilometer in the 16kms between Monterrico and La Barra. With a littoral of roughly 254kms, this indicates that roughly 51,300 nests are laid on the Pacific coast of Guatemala per year and with an average nest of 84 eggs, this would result in a total production of 4,309,000 olive ridley eggs laid per year.

In 1981, Rosales and Ramboux conducted a similar crawl count study along a stretch of beach from El Chapeton to La Gabina, directly to the east of the ARCAS study area in the direction of the Salvadoran border. They counted 3,384 crawls (nests) in these 17kms during the months August to November. Cuadro III compares the number of crawls per kilometer in this study with that of the ARCAS study.

This data, although not entirely conclusive, is the most direct evidence available of a decline in the Pacific coast olive ridley nesting population. It indicates that In the last 16 years the number of nesting females in the El Chapeton-Monterrico area has declined by 34%. This figure is especially troubling if we take into consideration, as mentioned above, that 1997 was a year of "El Nino" when there were significantly more nesting turtles than in normal years. (Please see "Suggestions for Future Research") In 1981, there was an average of 1.87 nests/km in the El Chapeton to La Gabina area, while in 1997 that figure dropped to 1.24 in the La Barra - Monterrico area. Using these figures as a baseline and extrapolating for the months December to July, we estimate that the national production of olive ridley eggs in 1981 was 6,320,000* while in 1997 only 4,300,000 olive ridley eggs were laid on Guatemalan Pacific shores.



Estimated number of olive ridley eggs laid on the Guatemalan Pacific coast , Ramboux ´81 vs Muccio´97

ECONOMIC IMPACT

Depending on their availability, the price of olive ridley eggs in Guatemala fluctuates between 9 quetzals ($1.30) during the height of the nesting season and 35 quetzals ($5) during the low season. (Prices paid on the beach) Taking 22 quetzals per dozen or 1.80 quetzals per egg as an average, we can estimate that the total market in sea turtle eggs in Guatemala is worth at least 7,700,000 quetzals or $1,115,942 per year. This figure is probably significantly higher given the fact that we are not including the smaller leatherback egg market and are not factoring in the quite significant market in Mexican and Salvadoran eggs. In addition, we are only calculating the price paid on the beach, without including retail mark-up. Nevertheless, these figures give us a rough idea of the total "contribution" sea turtle eggs make to the Guatemalan economy. Rosales in 1985 calculated the national olive ridley market to be worth 1,508,025 quetzals.

CARIBBEAN COAST

Due to a variety of logistical problems as well as political changes leading to the closing of DIGESEPE we were not able to collect reliable data on the nesting population on the Caribbean coast of Guatemala in 1997. However, Fernando Rosales, in a report to the W.A.T.S. Symposium in 1987 based on a study carried out along 10kms of coastline near San Francisco del Mar, estimated that the number of nests per species for the 50kms of Caribbean coastline was the following:

Species	Range of Number of Nests
Hawksbill (Ei)	380-760
Loggerhead (Cc)	45-90
Leatherback (Dc)	25-50

TOWARDS A GUATEMALAN NATIONAL SEA TURTLE RECOVERY STRATEGY

Any strategy for the conservation, recuperation and management of sea turtles should ideally strive towards the goal of sustainability, insuring that enough hatchlings are returning to the ocean to sustain the local population. In this regard, it is useful to compare present levels of "replenishment" with past conditions when humans were not interfering with the sea turtle's life cycle. The following is a comparison between a (perhaps fictitious) past when there was no human harvesting of eggs and the present when the harvesting rate of olive ridley eggs on the Pacific coast is nearly 100%.

PAST	**PRESENT**
51,300 nests/year	51,300 nests/year
x 84 eggs*	x 84 eggs
4,300,000 eggs laid	4,300,000 eggs laid
- 50% hatchling success rate**	+ 5% donated to hatcheries ***
	- 85% hatchling success rate
2,150,000 hatchlings returning to the sea	**182,750 hatchlings returning to the sea**

**Ramboux ('82) calculated an average of 84 eggs per nest*

***Briceno ('80) and Marquez, et al ('76) determined that the hatchling success rate of olive ridley nests laid in situ to be approximately 50%*

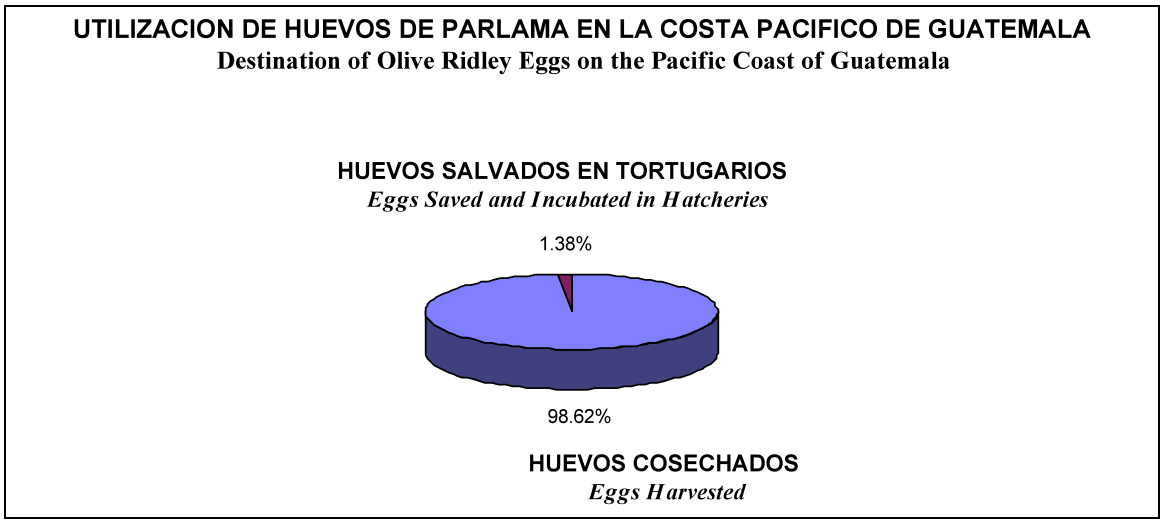
****See "Donations" above*

In other words, under "natural" conditions and accepting an already diminished nesting population, there would be 2,150,000 hatchlings returning to the ocean per year along the Pacific coast of Guatemala. However, if we consider the reality of current levels of harvesting and the imperfections of the Donation System in Guatemala, we calculate that only 182,750 hatchlings are produced or only 8% of the "natural" production rate.

However, this is only an estimate. If we look at the actual data collected by hatcheries for the number of eggs collected, the outlook becomes even bleaker. Although far from complete, the existing data on hatchery production in Guatemala presented in Cuadro I suggests that in no year were more than 60,000 eggs collected. The reason for the discrepancy between this figure and the figure of 182,750 mentioned above is undoubtedly due to the fact that parts of the Guatemalan coastline are not even covered by hatcheries, especially the areas to the west of Puerto San Jose towards the Mexican frontier.

Accepting this outside figure of 60,000 eggs collected, that would result in an annual production of hatchlings of just 51,000, or only 2.3% of the "natural" replenishment.

The 60,000 eggs collected and incubated in Guatemalan hatcheries represents only 1.3% of the total annual number of eggs laid on the Guatemalan Pacific coast of 4,300,000. In other words, only 1.3% of all olive ridley eggs laid in Guatemala are saved! Again, though largely estimates, these figures indicate that sea turtle conservation efforts in Guatemala are sorely lacking and don't offer much hope for the continued existence of sea turtles in Guatemalan waters.



RECOMMENDATIONS

During the Regional Sea Turtle Conservation Workshop held at the Pacific Naval Base in November, 1996, participants developed a list of priorities for the strengthening of sea turtle conservation efforts in Guatemala. All the participants agreed that currents efforts are not sufficient. Based on these recommendations and taking into consideration the findings of this research, the following is a list of possible measures to be taken to improve sea turtle conservation efforts in Guatemala:

- *Improve hatchery management techniques;*
- *Increase the number of donated eggs by enforcing compliance of the informal Donation System through the increase in the number of roadblocks and searches by the Naval Base and other responsible authorities;*
- *Combine forces among the various institutions involved in the conservation of sea turtles in Guatemala;*
- *Strengthen sea turtle conservation efforts possibly through an increase in the donation from one dozen eggs to two dozen eggs or by establishing a period of moratorium on the collecting and trafficking of egg;*
- *Standardize data collection and hatchery management methods;*
- *Design a national strategy for the conservation of sea turtles;*
- *Increase educational activities;*
- *Develop the capacity of local organizations*

Based on the present research, it is obvious that the most urgently needed of these measures is to somehow increase the number of eggs collected and incubated in hatcheries. In July, 1998, a workshop sponsored by CONAP and BANAPAC was held to bring together hatchery workers and managers in order to better coordinate conservation efforts for the '98 nesting season. During that workshop, it was decided to increase the hatchery donation from one dozen to 20% of the nest. In other words, if a collector harvested a nest of 100 eggs, he was obliged to give 20 eggs as a donation to a hatchery rather than the 12 eggs donated before. Unfortunately, due to a lack of coordination, enforcement and education of local egg collectors and buyers, this 20% donation never took hold and people quickly reverted to the old system of one dozen eggs. Assuming that the new system had worked and that collectors began donating 20% of their nests and assuming that compliance remained at 50% as with the one dozen system, that would have resulted in a collection of 420,000 eggs with 357,000 hatchlings produced. This, though an obvious improvement, would still only mean that 10% of eggs would be "saved" and that the hatchling replenishment rate would only be 16% that of "natural" conditions.

One of the recommendations most often mentioned in the Regional Workshop was the establishment of a one-month moratorium on egg collecting and commercialization. It was argued that such a measure would be relatively easy to enforce as the possession of any quantity of eggs - with or without a voucher - would be illegal and subject to confiscation. It was also seen as a new measure, a break from the Donation System, and that it would lead to a dramatic increase in the number of eggs collected. However, a moratorium would also imply a higher level of involvement and coordination on the part of the government, something that has not been seen to date. It would also imply a greater emphasis on education, awareness-raising and community participation.

In the July 1998 workshop mentioned above, an additional measure was suggested: the registration and licensing of "authorized" hatcheries, collectors and buyers. This would not only lead to a better control over the commercialization of sea turtle eggs, it would also possibly prompt the formation of cooperatives of collectors and buyers that together with government authorities could lead to a collaborative effort to seek a truly sustainable level of use of this natural resource.

More than anything though, if we accept the figure of 1.3% as the number of olive ridley eggs laid on Guatemalan coasts that are being saved, and considering the demographic pressures and the level of poverty in the area, we really must begin to look at taking more drastic measures, enlisting the government's active participation to implement policies on a national level for the conservation of sea turtles in Guatemala. In order to successfully implement a one-month moratorium, for example, local hatcheries and conservation organizations would need the active participation and backing of the government; something that to date has not occurred.

According to our analysis, the hatchery management techniques laid out in the "Guia Para El Manejo de Tortugarios" are basically sound, although many of the hatcheries we visited need to refine their methodology and eliminate practices such as holding hatchlings in tanks before releasing them. There is a need to carry out more detailed research on the appropriateness of hatchery techniques, including, funding-permitting, a study to determine the sex ratio being produced, but for the time being and given the resources we have to work with, the methodology appears to be sound.

SUGGESTIONS FOR FUTURE RESEARCH

1. DATA COLLECTION

A. CRAWL COUNTS

It is very important to continue crawl count surveys along the coast of Guatemala in order to determine the health of the Guatemala sea turtle population; whether it is increasing or, as suggested in this study, decreasing. This is especially important given the fact that 1997 was a year of El Nino and an unusually heavy nesting year and that in all probability the drop in the Guatemalan sea turtle population since 1981 is much more dramatic than indicated here.

This population census data is crucial evidence with which to present to national and regional policy-makers in order to convince them of the need to strengthen conservation measures.

It is also important to expand these crawl count surveys to other parts of the country and to the Caribbean coast and to conduct occasional aerial surveys in order to get a more accurate estimate of the actual Guatemalan sea turtle population.

B. STANDARDIZATION OF DATA COLLECTION

There is also an urgent need to standardize data collection at hatcheries and in crawl counts in order that this data can be used in national and regional comparisons. Sea turtles are migratory animals and any attempt at their conservation will need to take a regional focus.

2. USE OF TEDS

There is also a need to carry out a scientifically sound study on the degree of compliance in the use of TEDs on the part of the Guatemalan shrimping fleet. As mentioned above, yearly checks are conducted by representatives of the US Embassy, but they are usually only accompanied by industry representatives without the representation of conservation groups. In addition, to date there have been no open-sea spot searches of Guatemalan shrimpers as are carried out in the Gulf of Mexico with American shrimpers. As in other countries, a great deal of research must be carried out and refinements made to TEDs in order to adapt them to local conditions, ameliorate their negative impacts on shrimp catches and thus ensure their ready acceptance by the shrimp industry.

3. USE OF SEA TURTLES AS BAIT BY THE SHARK FISHING INDUSTRY

There are continued reports about shark fishermen, especially Mexicans fishing in Guatemalan waters, slaughtering sea turtles at sea and using the meat as bait to catch shark. There is an urgent need to investigate this practice, and if true, document it and have it stopped. It is part of a larger, global problem of the use of unsustainable and ultimately self-destructive fishing practices on the part of commercial fisheries.

4. RELATION BETWEEN FRESHNESS OF EGGS, AMBIENT TEMPERATURE, INCUBATION PERIOD AND HATCHLING SUCCESS

Considering the fact that under the Donation System operating in Guatemala the eggs received at hatcheries may be between 1 and 12 hours old, research needs to be carried out on the degree to which the freshness of these eggs affects other factors, such as incubation period and hatchling success rate and what role ambient temperature plays in this process. Getting a better idea of the relationship between these factors will allow hatchery workers to better regulate and manage their hatcheries.

ANEXO I

ACRONYMS

AGEXPRONT	=	Asociación Gremial de Exportadores de Productos no Tradicionales *Association of Producers of Non-traditional Exports*
ARCAS	=	Asociación Rescate y Conservación de Animales Silvestres *Wildlife Rescue and Conservation Association*
BANAPAC	=	Base Naval del Pacifico *Naval Base of the Pacific*
CONAP	=	Consejo Nacional de Areas Protegidas *National Council of Protected Areas*
DIGESEPE	=	Dirección General de Servicios Pecuarios (Ministerio de Agricultura) *National Fisheries Directorate* (Now UNEPA)
DIGEBOS	=	Dirección General de Bosques y Vida Silvestre (Now INAB), *National Forestry Directorate*
INAB	=	Instituto Nacional de Bosques *National Forestry Institute*
MAGA	=	Ministerio de Agricultura y Ganadería (Supervisory ministry of DIGESEPE, DIGEBOS and INAB) *Ministry of Agriculture*

INFORME NACIONAL SOBRE EL ESTADO DE LA CONSERVACION DE TORTUGAS MARINAS EN GUATEMALA

Agosto, 1998

Colum Muccio

Asociación Rescate y Conservación de Vida Silvestre
■ **ARCAS -**

con el apoyo generoso del
Columbus Zoo

ANEXO III

ANEXO IV

CUADRO IIA.

CUADRO IIB

CUADRO II

CUADRO III

CUADRO IV

NATIONAL SEA TURTLE CONSERVATION REPORT FOR GUATEMALA

August, 1998

Colum Muccio

Asociación Rescate y Conservación de Vida Silvestre
Wildlife Rescue and Conservation Association
- ARCAS -

with the generous support of the
Columbus Zoo