Crocodiles

An Action Plan for their Conservation

Compiled by
John Thorbjarnarson
Edited by
Harry Messel, F. Wayne King, and James Perran Ross
IUCN/SSC Crocodile Specialist Group

IUCN Species Survival Commission: A Global Network for Species Survival

Habitats and their living natural resources are under increasing pressures everywhere from humankind. Species, the basic biotic units, are consequently increasingly threatened with extinction. To protect and conserve biodiversity from species level to ecosystem requires management based on understanding of not just biological sciences, but also knowledge of local cultures, environmental economics, and governmental structures and dynamics.

Among international responses to deal with this complexity is the Species Survival Commission (SSC), a commission of IUCN—The World Conservation Union. Founded in 1949, the SSC network has 4,000 volunteer member scientists, field researchers, governmental officials, and conservation leaders in 155 countries. They provide technical and scientific counsel for biodiversity conservation projects throughout the world, serving as resources to governments, international conventions, and conservation organizations.

SSC works principally through its nearly 100 Specialist Groups, most of which represent particular plant or animal groups. SSC Specialist Groups focus on species either threatened with extinction or of special importance to human welfare. A few groups are disciplinary—veterinary medicine, captive breeding, reintroductions, international trade, and wildlife utilization.

Each taxonomic group is charged to assess the conservation status of the chosen species and their habitats, to develop an Action Plan that specifies conservation priorities, and finally to promote the implementation of the required activities outlined in the Plan. Developing an Action Plan may take several months; full implementation of an action agenda may span decades. Action Plans have been completed by 14 Specialist Groups.

The Species Survival Commission is the largest of six volunteer commissions of IUCN—The World Conservation Union. Founded in 1948, IUCN enrolls sovereign states, governmental agencies, research institutions, and non-governmental organizations to conserve the world's natural heritage. Besides developing general conservation policy, such as The World Conservation Strategy, IUCN manages conservation projects worldwide, including projects on tropical forests, wetlands, marine ecosystems, the Sahel, and sustainable development.

For more information on the Species Survival Commission and IUCN—The World Conservation Union, contact IUCN, Avenue du Mont-Blanc, CH-1196 Gland, Switzerland. Telephone (22)649 114; Telefax (22)642 926.

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Cover photo: Common caiman, *Caiman crocodilus*, in Venezuela (Photo by R. Godshalk).

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Contents

Foreword

When the Crocodile Specialist Group (CSG) convened its 1st Working Meeting in 1971, all 23 species of the world's crocodilians were endangered, depleted, or declining in numbers. Excessive exploitation was rampant, regulated harvest almost non-existent, and illegal international trade in crocodilian products was the rule. Some species were on the very edge of extinction, e.g., the Orinoco, Siamese, and Philippine crocodiles, the gharial, and the Apaporis River caiman. The situation has changed dramatically in the intervening 20 years. Today 11 species remain endangered, seven species critically so, but just under one-third (seven species) are abundant enough to sustain a regulated harvest, and nearly a quarter (five species) have populations that are stable or increasing. Much of this improvement is directly attributable to the myriad efforts of the Crocodile Specialist Group and its members scattered round the world. CSG members working for government agencies and non-governmental organizations (NGOs) were directly responsible for developing and implementing programs for the conservation and management of the crocodilians of Australia, India, Indonesia, Nepal, Ivory Coast, Madagascar, Papua New Guinea, South Africa, United States, Venezuela, and Zimbabwe. Others have advised on programs in 37 other countries around the world. While these actions were being pursued on the national fronts, members were actively involved with the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), both as members of national delegations to the CITES meetings and as advisors to the CITES Secretariat on technical matters. Through these efforts, management of crocodilian populations for conservation and sustainable utilization has improved and illegal trade has decreased.

The conservation status of crocodilians was so volatile that the CSG had to come together in a Working Meeting every second year to assess changes that had occurred and to set new priorities for action. Even so, much of what the Group accomplished was the result of opportunistic undertakings. Recognizing the need for a systematic approach, in 1976 at its 3rd Working Meeting (Maningrida, Australia), the CSG established an "Action Programme" that focused on 10 species, a dozen nations, three high-priority projects, and a half dozen lesser projects.

In 1978, the CSG prepared its first Action Plan for crocodilian conservation, the *Comprehensive Action Programme for the Conservation of Crocodiles*, as part of the "Seas Must Live" campaign of IUCN/WWF. It contained 18 projects for the conservation of estuarine and insular species of crocodilians. None of the projects was ever funded as part of the campaign, but four or five were undertaken with outside funding.

At its 1984 (Caracas, Venezuela) and 1986 (Quito, Ecuador) meetings, the CSG accepted the responsibility of producing a new Action Plan for the conservation of all crocodilians. Unfortunately, relatively few proposals were sent in, as volunteers who were busy fulfilling the responsibilities of their jobs back home found it difficult to write original proposals for inclusion in the plan. To complete the Action Plan in a reasonable period of time it would have to be written by an individual who would then insert the proposals that had been submitted and circulate the complete document to the members for review. Following its 1988 meeting (Lae, Papua New Guinea), the CSG received funds from Mainland Holdings Ltd. Crocodile Farm, and matching funds from TRAFFIC U.S.A./ World Wildlife Fund-U.S.A., which enabled it to hire John Thorbjarnarson, a graduate student in the crocodile conservation program at the University of Florida, U.S.A., to complete the Action Plan.

John was assigned the task of producing an Action Plan composed of three components: species accounts, country accounts, and a biogeographic overview. He started the task in 1989 by again requesting current proposals for crocodilian conservation from the CSG members and correspondents scattered round the world. He also drew together all the pertinent scientific and conservation literature on the status, management, biology, and trade in crocodilians worldwide. Relevant sections were reviewed by CSG Vice Chairmen and members with special expertise in each region or species. By April 1990, he had produced a second draft of the species and country accounts which was available for review by participants at the 10th Working Meeting of the CSG (Gainesville, Florida, U.S.A.). Based on comments received from wildlife biologists, ecologists, government agents, crocodile farmers, hide buyers and dealers, reptile skin tanners, and CITES representatives at the meeting, the draft was extensively rewritten and a third, much more information-rich draft was circulated to the chairman, deputy chairman, and executive officer for review in October 1990. This Action Plan is the result of that final review.

Having followed the production of this Action Plan through every stage, I can state that John—now Dr. Thorbjarnarson, having in the interim completed his Ph.D. studies on "The Ecology and Behavior of the Spectacled Caiman (*Caiman crocodilus*) in the Central Venezuelan Llanos"—wrote most of it from data gleaned from the scientific literature and from personal insight and experience. The remainder came as input from CSG colleagues and reviewers. However, the policies and statements presented have been extensively reviewed by various members of the Group and represent the current position of the CSG on these topics and priorities. This is the Action Plan of the CSG. John Thorbjarnarson is its writer and compiler and Professors Messel, King, and Dr. Ross the editors. Photographs came from various sources, primarily CSG members.

The Action Plan identifies the species which are most endangered, the states with the least known populations, and the actions that are needed to conserve various taxa and populations. It describes in general terms what is known about the biology of the various species and programs that have been successful in returning some populations to abundance and in managing them for sustainable use. The Action Plan should prove to be a useful tool in conserving crocodilians.

CSG members and people interested in crocodilian conservation can help us keep the Action Plan up-to-date by sending comments on the status, distribution, and problems facing various crocodilians to the Executive Officer, Crocodile

Specialist Group, Florida Museum of Natural History, Gainesville, FL 32611, U.S.A. These comments will help us revise the Action Plan from time to time. Such periodic reviews will reveal both how the conservation situation has changed and how the Action Plan is being used. It is our hope that the next review finds the crocodilians of every country better known and all 23 species of crocodilians returned to abundance and none endangered.

Professor Harry Messel
Chairman
IUCN/SSC Crocodile Specialist Group

Acknowledgments

Professor F. Wayne King, Deputy Chairman of the IUCN/SSC Crocodile Specialist Group (CSG), provided the impetus for this action plan, and has been tireless in his support of the project since its inception at the 7th CSG Working Meeting in Caracas, Venezuela in 1984. I would also like to thank Professor King, Professor Harry Messel, Chairman of the CSG, and James Perran Ross, CSG Executive Officer, for reviewing the action plan and correcting many mistakes. Any errors that remain, however, are my own. Thanks also go to the many members of the Crocodile Specialist Group who sent information or corrected earlier drafts of the action plan. I gratefully acknowledge the support of Mainland Holdings Ltd. Crocodile Farm (Papua New Guinea) and TRAFFIC U.S.A./World Wildlife Fund-U.S.A. for providing support during the preparation of this document, and WWF-International and the IUCN/SSC Peter Scott Action Plan Fund (established by a donation from the Sultanate of Oman) for supporting publication.

John Thorbjarnarson
Compiler

Executive Summary

This document describes the conservation status of the 23 species of the Order Crocodylia found worldwide. Because of the commercial value of their hides, crocodilians have been hunted extensively throughout the world's tropical and subtropical regions for over a century. Overhunting, combined with the more recent problem of habitat loss, has resulted in a number of species being pushed to the brink of extinction. Conservation efforts, concentrating on protection of animals and habitat, began in many countries in the 1960s and 1970s. Some countries have initiated conservation programs based on the sustainable-yield utilization (SYU) of non-endangered species, and in recent years the use of SYU programs based on ranching or farming of crocodilians has increased tremendously.

Although considerable effort has gone into crocodilian conservation over the last 30 years, it has tended to concentrate on a rather small group of species. Little or no research or conservation action has been carried out on many of the most endangered species of crocodilians. Of the 23 species considered in this action plan, eleven of them are endangered.

The seven most critical species in terms of need for conservation are, in order of decreasing priority: the Siamese crocodile (*Crocodylus siamensis*), the Philippine crocodile (*Crocodylus mindorensis*), the Chinese alligator (*Alligator sinensis*), the Cuban crocodile (*Crocodylus rhombifer*), the tomistoma (*Tomistoma schlegelii*), the Orinoco crocodile (*Crocodylus intermedius*), and the gharial (*Gavialis gangeticus*). Four other species are endangered, the broad-snouted caiman (*Caiman latirostris*), the black caiman (*Melanosuchus niger*), the American crocodile (*Crocodylus acutus*), and Morelet's crocodile (*Crocodylus moreletii*). Because so little is known about many of these species, emphasis is placed on conducting population surveys to quantify the current population status as a first step towards initiating conservation programs.

Of the remaining species, nearly all are under threat or have depleted populations in some parts of their range. Seven species have populations that are sufficiently numerous and widespread to support sustainable harvest in some countries where they occur, although most of them still require protection and careful management. These are *Alligator mississippiensis* (American alligator), *Crocodylus johnsoni* (Australian freshwater crocodile), *Crocodylus niloticus* (Nile crocodile), *Crocodylus porosus* (saltwater crocodile) *Crocodylus novaeguineae* (New Guinea crocodile), *Caiman crocodilus* (common or spectacled caiman), and *Caiman yacare* (yacare). These are the main species in international trade, and control and regulation of this trade, and restriction of trade to the products of farms, ranches, and sustainable harvest programs is necessary to ensure their long-term survival. Significant illegal trade occurs from Central and South America (*Caiman crocodilus, Caiman yacare*) and in southeast Asia (*Crocodylus porosus, Crocodylus novaeguineae*, and other species, including trans-shipped *Caiman* spp.).

Priority actions for crocodilian conservation are:

- Surveys of poorly known species to assess distribution and status.
- Protection of critical habitats for wild populations.
- Training programs to improve national management expertise for crocodilians.
- Prevention of illegal hunting and illegal trade.
- Captive breeding for gene pool preservation and restocking natural habitats.
- Establishment of sustainable use programs to provide incentives for conservation of wild populations and habitats.

Table 1. Critically endangered crocodilians and the countries where they occur. Species are listed in decreasing priority order. Countries are listed in order of highest priority for action.

Siamese crocodile	Thailand, Indonesia, Malaysia, Cambodia, Vietnam, Laos
Philippine crocodile	Philippines
Chinese alligator	China
Cuban crocodile	Cuba
Tomistoma	Thailand, Indonesia, Malaysia
Orinoco crocodile	Venezuela, Colombia
Gharial	India, Nepal, Pakistan, Bangladesh, Bhutan, Myanmar

In addition to applying these conservation actions to particular endangered species, the action plan identifies geographic regions where the status of crocodilians is so poorly known that it is difficult to plan action. The most critical of these regions are:

1. West and central Africa (Angola, Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Equatorial Guinea, Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo, and Zaire)
2. Southeast Asia (Bangladesh, Bhutan, Cambodia, China, Laos, Malaysia, Myanmar (Burma), Thailand, Vietnam)
3. Western Pacific islands (New Britain, New Hebrides, Vanuatu). Detailed quantitative surveys are required in these countries as a preliminary step to conservation action. Preliminary surveys in Palau and the Solomon Islands have been completed.

The action plan presents a general introduction to the conservation of crocodilians. The overall situation of each species, summarizing and compiling the country information, is given in the species accounts, indicating the immediate conservation problems and high priority projects needed. The status of each species for every country where it occurs is given in the country accounts. Contacts for each country and each project are indicated, with addresses in Appendix I. Appendix II summarizes the status of each species in every country in which it occurs.

Objectives and Organization of the Action Plan

The objectives of this action plan are to:

1. Summarize information on the current status of wild crocodilian populations;
2. Summarize information on the current management programs;
3. Prioritize species in terms of the need for conservation action; and
4. Develop a list of priority conservation projects for each species.

This action plan is organized into three principal sections: an Introductory Overview chapter, Country Accounts, and Species Accounts. The raw information on the status of crocodilian populations, and current management practices is presented in the Country Accounts. The Species Accounts provide a brief description of the natural history of each species, a compilation of the information found in the Country Accounts, and a list of the priority projects to address the conservation needs of that species. Each species is evaluated on the availability of survey data, the need for population recovery, and the potential for sustainable use management. Based on what we know about the status of wild populations, the species are ranked into four priority conservation categories: highest, high, moderate, and low. The current listings of each species indicated by the Convention in International Trade in Endangered Species (CITES) Appendix and by the current IUCN Red List (Groombridge 1982, IUCN 1990) are also given for comparison. Full citation to all references is given in Literature Cited, and Appendix 2 summarizes the status information for each species.

The priorities listed here (see Table 4, p. 11) do not exactly overlap the IUCN Red List (1990) designations, in part because this account is based on more recent information, and in part because of the varied situations of some species in different parts of their range. It is extremely difficult to integrate the numerous different facets of a widespread species situation into a single measure of endangerment, and the relative ranking of species varies according to the criteria used. Here we have focused on the priorities for action based on the criteria we have described.

Information on population status and management programs was gleaned from published sources, unpublished reports, and by direct communications with CSG members and correspondents. The priority conservation programs were projects recommended by CSG members, either specifically for this action plan or as recommendations in published or unpublished reports, or were projects deemed to be of particular importance by the compiler and editors. Not all conservation recommendations could be incorporated as specific projects; rather the intent was to address the principal areas of conservation concern and outline, in a very broad sense, what needs to be accomplished. These projects represent an inventory of conservation needs, and the details of project personnel, budget, and timetables are left for future elaboration. In each case, a list of people to contact for each project, country, or species is given. Full names and addresses of contacts are given in Appendix 1.

The action plan follows King and Burke (1989) in recognizing 23 crocodilian species, although where there is taxonomic confusion or revision in progress this is indicated in the Species Account. We have generally used the scientific binomial names for crocodilians rather than common names. The scientific names are unique, unambiguous, and internationally recognized, while each species has a plethora of common and colloquial names that can cause great confusion. We have inserted common English names to orient the lay reader. A full review of nomenclature of crocodilians is given in King and Burke (1989) and an exhaustive listing of common names in many languages is given in Dollinger (1981, 1985).

Introduction and Conservation Priorities

Crocodilians (crocodiles, alligators, caimans, and gharials) are prominent and widespread occupants of tropical aquatic habitats. The group is ancient, with hundreds of fossil forms and three major radiations. Crocodilians are implicated in positive effects in their environments as "keystone species" that maintain ecosystem structure and function by their activities. These include selective predation on fish species, recycling nutrients, and maintenance of wet refugia in droughts. Crocodilians have some unique aspects of natural history that create special challenges for their conservation. They are the largest predators in their habitats and can threaten humans and their livestock. Many species are exploited for their valuable skin, which supports an international trade worth over U.S. $200 million annually. They are also heavily impacted by habitat loss and pollution of aquatic habitats. Loss of any crocodilian species represents a significant loss of biodiversity, economic potential, and ecosystem stability. This action plan summarizes current status and priority actions needed to conserve crocodilians.

The crocodilians are classified as belonging to three families and eight genera (see Table 2). There is a wide diversity of size, habitat, food preference, reproductive behavior, and many other aspects of biology among the 23 crocodilian species. However, all species have the following basic similarities. All crocodilians are very effective aquatic predators. Although crocodiles are reptiles, they can often maintain their body temperature within narrow limits by behavior, basking in the sun when cool, seeking shade when hot. They are metabolically efficient, and have fast reflexes and effective locomotor ability on land, where they walk on erect legs, and in the water, where they swim rapidly, driven by their powerful tails. Crocodilians have complex behaviors including social interactions, dominance hierarchies, vocalization, coordinated feeding, and well-developed maternal behavior. Females deposit from 10 to over 40 hard-shelled eggs into a nest which is either a hole dug into the ground or a pile of vegetation gathered by the female. Most females remain near their nest during incubation and may protect it from predators. Upon hatching, vocalizations made by the hatchlings induce the female to help the hatchlings emerge, and she may even carry the tiny babies to the water in her mouth. The hatchlings remain together near the mother for several months, deriving protection from her proximity. As they grow and become more widely dispersed and independent, a large number of the offspring perish, some eaten by other crocodilians. The survivors grow and reach maturity after a period of 5-15 years, depending on the species. Females generally grow more slowly and reach maturity at a smaller size than males, who continue growing and usually exceed females in maximum size. Crocodilians can be long-lived in the wild, and there are records of particular individuals resident for decades at some locations. Adult males of several species emit loud vocalizations in association with the breeding season. Details of crocodilian biology as it pertains to their management and conservation can be found in Webb et al. 1987. These biological characteristics give the potential of great resiliency to some crocodilian populations, enabling them to recover from population depletion and sustain relatively high harvest rates. However, persistent killing of adults can lead to rapid population depletion, particularly if combined with habitat loss.

Crocodilians are threatened by many human activities. Commercial overexploitation and indiscriminate killing have resulted in many species suffering drastic declines in numbers and, when combined with severe habitat loss, have brought several species to the brink of extinction. Around the world, conservation interest has led to the development of a number of recovery programs designed to improve the status of wild populations. A number of these programs, such as the work on gharial in India and Nepal, have met with a degree of success. Today, with the heightened interest in conservation through

Table 2. Classification of Crocodilians, after King and Burke 1989.

Order Crocodylia

Family Alligatoridae
- Genus *Alligator* (true alligators-2 species)
- *Caiman* (caimans-3 species)
- *Melanosuchus* (black caiman-1 species)
- *Paleosuchus* (dwarf caimans-2 species)

Family Crocodylidae
- Subfamily Crocodylinae
- Genus *Crocodylus* (true crocodiles-12 species)
- *Osteolaemus* (dwarf crocodile-1 species)
- Subfamily Tomistominae
- Genus *Tomistoma* (Tomistoma-1 species)

Family Gavialidae
- Genus *Gavialis* (gharial-1 species)

Common caiman, *Caiman crocodilus*, attending nest. Many crocodilians form nests of a mound of vegetation (Photo by R. Godshalk).

sustainable-yield management, the number of people involved in crocodilian conservation projects has grown tremendously. The Crocodile Specialist Group, which started out as a small group composed principally of scientists, now comprises some 300 individuals with interests ranging from pure research to commercial propagation, tanning, and trade monitoring. Despite the heightened interest in crocodilian conservation, conservation priorities have not previously been established for all species and populations. The prioritization of conservation projects is of particular importance now, given the increase in resources available for crocodilian conservation.

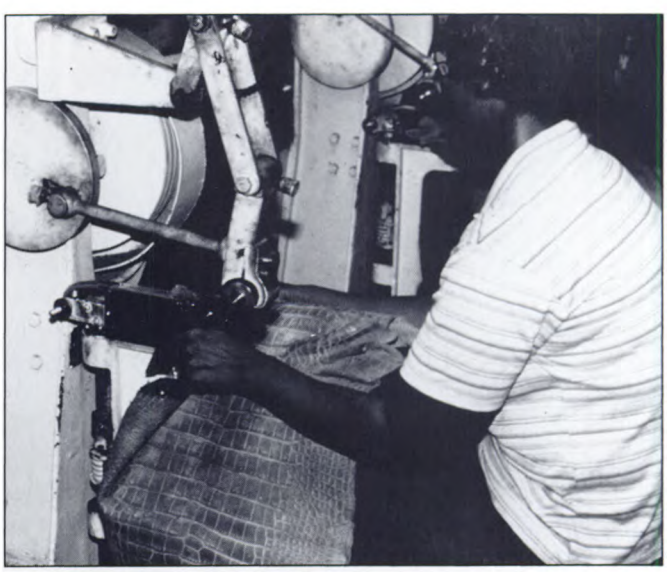
Human Exploitation of Crocodilians

Crocodilians have been exploited by people since time immemorial as a source of food or medicinal products, or killed when viewed as a threat to the human residents or their livestock. However, it was not until the 19th and 20th centuries that widespread human exploitation of crocodilians was fueled by commercial demand. Perhaps the first crocodilian to be widely commercially exploited was the American alligator. Initially, the commercial utilization of alligators was based on production of oil to grease the machinery of steam engines and cotton mills (Joanen and McNease 1987). Hunting of alligators for their hides was sporadic during the 19th century, but demand for skins increased greatly during the 1870s when alligator hide products became fashionable. In fact, the demand for hides during this period exceeded the production of alligator skins and led to the importation of skins from Mexico and Central America (Stevenson 1904), presumably from *Crocodylus acutus* and *C. moreletii*. The exploitation of alligators and Central American crocodiles continued throughout the early 20th century, and beginning around 1930, commercial hunting began in northern South America for Orinoco and American crocodiles (Medem 1981, 1983). When these species became rare due to overexploitation, the bulk of the commercial hunting switched to the less valuable black caiman during the 1940s.

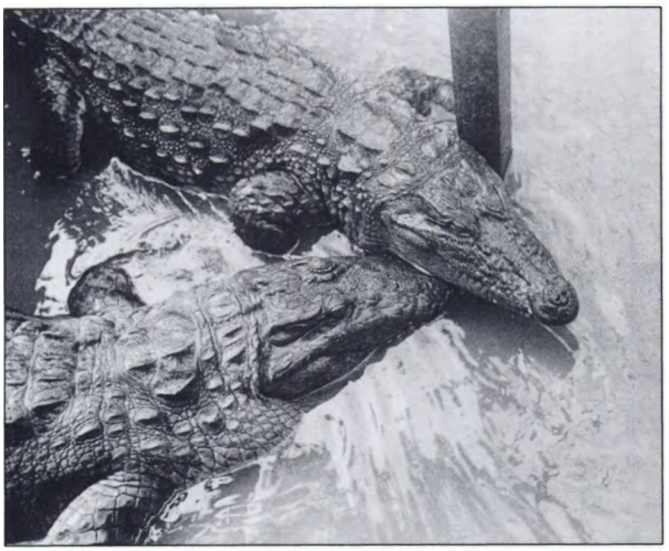
Some commercial hunting took place in Africa in the 1930s, and widespread eradication programs for Nile crocodiles were also implemented in the early part of this century (Cott 1961). Likewise, hunting of some Asian crocodiles took place during the 1930s (Westermann 1939, Hoogerwerf 1970). Nevertheless, the commercial exploitation of African and Asian crocodilians did not begin in earnest until after the Second World War (Fuchs et al. 1989). Hunting in the Old World tropics quickly became rampant and decimated accessible populations over vast areas. Worldwide, the peak in crocodilian hide commerce came in the late 1950s and early 1960s when 5-10 million hides a year were in trade (King 1978, Inskipp and Wells 1979).

With the depletion of wild populations of the "classic" crocodilian species, the commercial reptile leather industry turned more and more towards the exploitation of the spectacled and yacare caimans (King 1978, Hemley and Caldwell 1986). Caiman had not been previously utilized commercially because of the presence of extensive dermal ossifications (osteoderms) in the ventral scales, allowing the use of only a lateral flank of skin. During the 1960s and 1970s, caiman hunting became increasingly widespread. Today, the worldwide crocodilian trade, accounting for some 1.5 million skins per year, is comprised principally of caiman from South America.

The history of the crocodilian leather industry has been one of exploitation of the resource for short-term economic gain. The intensive hunting pressure generated by the demand for crocodilian skins decimated populations worldwide, and in many areas commercially valuable species are only found at critically low numbers, principally as a result of past overexploitation. While some species have recovered due to effective protection, recovery for many species has been slow or nonexistent, obviated by factors such as habitat destruction, continued commercial or non-commercial killing, or ecological factors such as interactions with other more abundant crocodilians. Today, of the 23 species of crocodilians, 17 have some or all of their populations included on CITES Appendix I. The depletion of crocodilian populations represents a significant loss of economic potential for local communities. For example, a recent survey in the Solomon Islands (Messel and King 1990)



Crocodile leather, buffing glaze finish, Fouke Co., Greenville, SC, U.S.A. (Photo by F.W. King).



Courting mugger, *Crocodylus palustris*, Tikarpada, Orissa, India. Crocodilians show complex social behavior. Courting may involve roaring (by males), postural changes, positioning, and snout rubbing, shown here (Photo by L.A.K. Singh).

revealed that excessive exploitation in recent years has depleted crocodiles to such a low level that complete protection for a decade or more is necessary to allow population recovery. If the Solomons had been surveyed 15 years ago it might have been possible to conserve the crocodiles by developing sustainable use of this valuable resource without depleting it.

Crocodilian Conservation Programs

The World Conservation Strategy defines three specific objectives for the conservation of living resources: (1) to maintain essential ecological processes and life support systems, (2) to preserve genetic diversity, and (3) to ensure that the utilization of species and ecosystems is only done on a sustainable basis (IUCN 1980). The last two of these objectives are of direct concern to the Crocodile Specialist Group, and broadly define the two basic types of crocodilian conservation programs in effect worldwide; recovery programs designed to reduce the threat of extinction to endangered species, and sustainable-yield utilization programs that capitalize on the economic value of crocodilians as a means of promoting conservation.

A growing realization that many crocodilians were becoming, or already were, endangered species emerged in the 1960s, and was first called to the attention of the scientific community by Cott (1961). The worldwide concern for the conservation of crocodilians was reflected in the creation of the Crocodile Specialist Group of IUCN's Species Survival Commission in 1971. Conservation efforts were undertaken by a host of countries worldwide during the 1960s and early 1970s (Cott and Pooley 1972). Most conservation programs at this time centered on the passage of legislation prohibiting the killing of crocodilians, or the creation of protected areas for wildlife conservation. However, outside of the more developed countries, where financial and institutional resources were adequate to enforce the legislation, few of these conservation programs played any major role in the conservation of crocodilians.

Beginning in the 1970s, a more active approach to crocodilian conservation was initiated in India. A national commitment was made to preserve the three native species of crocodilians, and a program set up involving the protection of habitat and a restocking campaign initiated. Crocodilian rearing centers were established around the country, stocked with eggs collected from wild nests. The young were reared at these centers until they had reached a size where they could be released. This program, initially supported by the United Nation's Food and Agriculture Organization, has been an overall success, and a similar project has since been established in Nepal for the endangered gharial. Restocking and reintroduction programs are also now being initiated in other countries (e.g., Venezuela).

However, in some countries (e.g., Papua New Guinea, Zimbabwe) a very different approach to crocodilian conservation was being attempted as early as the late 1960s. This approach was based on the exploitation of crocodilians in a rational, or sustainable-yield, fashion. Sustainable Yield Utilization (SYU) is defined as utilization of a resource that meets the needs of the present without compromising the ability of future generations to meet their own needs. It means using a resource at a rate within its capacity for renewal (IUCN 1990). In the context of crocodilian use, SYU refers to exploitation of a crocodilian species in a way that contributes to the conservation of the species and its habitat in the wild. Instead of managing a harvest based on short-term economic gain, as had been done by the reptile leather industry, harvests were planned to provide economic and conservation benefits in perpetuity (see below). The reality of the situation in the developing world is that wildlife is competing with mankind for limited resources. Denying wildlife a commercial value denies it the opportunity to compete successfully with alternative land use practices such as agriculture (Webb 1990). The key ingredient for the success of sustainable-yield utilization (SYU) programs lies in the economic benefits that accrue to local peoples from the conservation of wild populations. By making crocodilians a valuable economic resource, we are effectively broadening the constituency for conservation.

Although the use of sustainable-yield management for wildlife conservation programs is today a somewhat controversial issue, there is no doubt that when carefully planned and implemented, these programs can be successful. The value of SYU management programs lies in the ability to provide economic incentives for conservation action. These incentives come on a number of levels:

1. National level. The export of crocodilian products is often an important source of foreign exchange, especially for developing countries (King 1978). This provides economic incentives for governments to enforce the regulations regarding utilization effectively. The proper functioning of the SYU program is also in the best interest of the local reptile leather industry and can lead to the formation of cooperatives or associations that provide a self-policing function and report illegal activities.
2. Landowners. When SYU programs involve private lands, the economic value of crocodilians is an important incentive for landowners to protect their resident crocodilian populations and wetland habitats.

3. Local residents. The economic value of crocodilians is an important tool to modify local patterns of human utilization of the crocodilian resource. An effective SYU program can channel utilization away from activities considered harmful to the populations (e.g., hunting of breeding animals, nest robbing for consumption of the eggs), to ones that promote sustainable utilization (e.g., egg or hatchling collection for ranching).

The model programs in Papua New Guinea, Australia, Zimbabwe, and the United States have all taken an integrated approach to crocodilian conservation that has relied extensively on commercial utilization. Although the programs in these countries are very different (see descriptions in the country accounts), there are a number of common denominators: (1) the presence of a population monitoring program, (2) a research component providing details on the life history of the species involved, and (3) adequate enforcement capabilities. Today, sustainable-yield management programs are in operation or are being planned in a large number of countries worldwide (Luxmoore et al. 1985). Sustainable-yield management programs vary widely, but those that result in direct conservation benefits may be classified into two principal types: cropping and ranching.

Cropping Programs

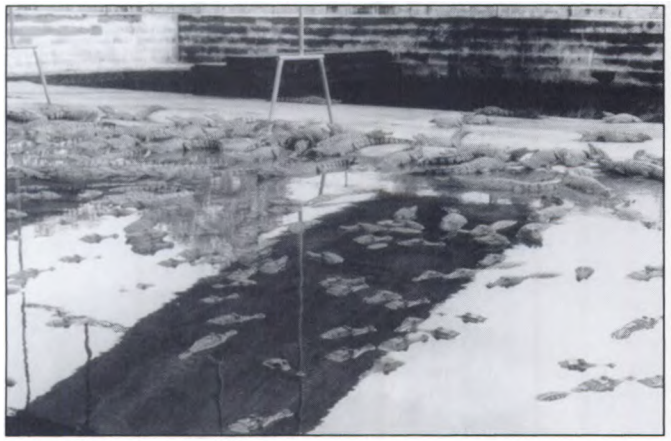
Cropping is the direct harvesting of commercial-sized animals from the wild. Cropping has traditionally been the system used for harvest of animals for their hides, and because the techniques are often identical to the ones used for subsistence hunting, this type of management frequently has the most cultural relevance to indigenous peoples, an important conservation consideration. Additionally, cropping provides direct economic benefits to local people involved in the harvest. However, cropping may involve the harvesting of some breeding-sized animals, so from a management point of view cropping programs are usually discouraged. Nevertheless, among certain small species, successful cropping programs have been designed based on a harvest of only the largest adult males (e.g., the spectacled caiman in Venezuela). Cropping programs have also been developed in the United States (where healthy alligator populations exist), and cropping still forms the largest component of the program in Papua New Guinea and Indonesia (where size limit restrictions apply).

Dennis David inspects dry salted caiman meat from the wild harvest in the Venezuelan llanos (Photo by F.W. King).

Crocodile eggs are carefully packed for transport to central incubator facilities at the farm. In Papua New Guinea, a hen's egg and a cash reward are given to local villagers for every crocodile egg collected (Photo by B. Vernon).

Ranching Programs

Ranching is a modified cropping program involving the captive rearing of crocodilians collected from the wild as eggs or juveniles. In captivity, the animals are reared to a commercial size (usually 1-2 m), depending on the species and the market being supplied), slaughtered, and the skins and meat sold commercially. Because eggs and juveniles have a very high natural mortality rate, removing them from the wild has less impact on the wild population than does the removal of breeding-sized individuals. The effects of a ranching program on the status of wild populations can be further ameliorated by mandating that a certain fraction of the slaughter-sized animals be returned back to the wild (e.g., Louisiana's alligator ranching program). In recent years, the field of crocodilian husbandry has grown tremendously in an effort to maximize growth rates and minimize mortality. Ranching maintains a direct link



New Guinea crocodiles, *Crocodylus novaeguineae*, at Mainland Holdings Pty. Ltd., Lae, Papua New Guinea. Successful sustainable use requires adequate surveys of the wild population, capitalization, and husbandry technique (Photo by B. Vernon).

between the health of wild populations and the ability to obtain rearing stock. By paying local people for the collection of young crocodiles (e.g., Papua New Guinea) ranching also links crocodilian conservation with widespread economic benefits. However, ranching programs based on the collection of eggs from the wild are more difficult to link directly to economic benefits for rural communities. The collection of eggs from nests is a delicate matter and if not done properly, results in the death of the embryo. For this reason, egg-harvest ranching programs (e.g., Zimbabwe) are typically done by ranch personnel, limiting the potential direct benefits to local communities.

Farming, which refers to the closed-cycle breeding of crocodilians in captivity, is another form of crocodilian utilization. Adult breeding animals are maintained in captivity, eggs laid by the captive females are collected and incubated artificially, and the young are reared to slaughtering size. The breeding of animals in captivity, and husbandry techniques that maximize growth rates, have received considerable attention associated with the growth of the crocodilian farming industry. Farming offers a number of advantages from a commercial standpoint, including the ability to exploit CITES Appendix I species (see *Implementation of sustainable yield management*, below). Also, farming permits more manipulation of the stock population. Selective breeding can be done to improve the genetic quality of the offspring. Furthermore, because eggs can be collected early during the incubation period, incubation techniques can be applied to control the sex of the offspring (by controlling temperature).

However, because farming isolates the management from the wild populations, these types of programs usually have no direct conservation benefits. At worst, the collection of animals from the wild to stock farms results in a drain on wild populations (Hutton 1989a, King et al. 1990, King and Cerrato 1990). Farming can be used to the benefit of wild crocodilian populations if the farms are required to release a certain fraction of the production back into the wild (e.g., in Colombia), but this still does not foster the important economic dependence on the maintenance of healthy wild populations. Farming also requires a large investment in the construction of the physical facilities and costs of maintaining and feeding breeding animals and the young being reared for commercial production.

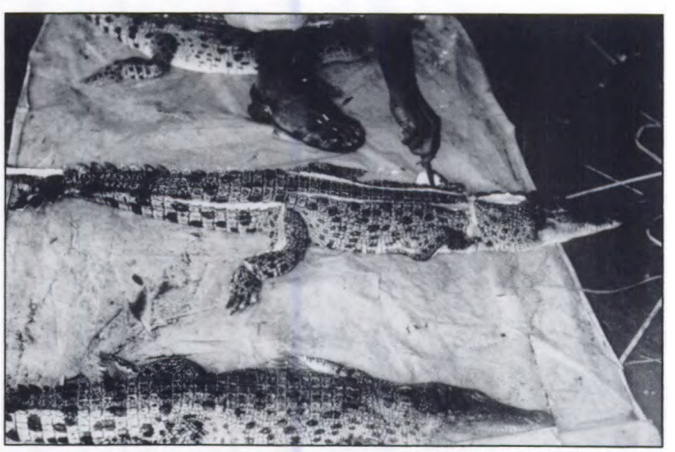
Implementation of Sustainable Yield Management Programs

The development of commercial utilization programs must comply with the laws of the country where the activity is being undertaken. The national management authorities regulate the development of SYU projects. However, most SYU programs involve international trade in raw skins, tanned hides, or products manufactured from the hides. This international trade is impacted by CITES, the Convention on International Trade in Endangered Species of Wild Fauna and Flora. CITES regulations, with certain exceptions, only permit commercial trade for species listed in Appendix II. Species listed in the more restrictive Appendix I are not allowed to be traded primarily for commercial purposes.

However, commercial trade of Appendix I species is permitted from farms. Under the CITES Article VII.4 (as subsequently clarified in Res. Conf. 2.12), Appendix I species propagated in captivity are treated under the provisions of Appendix II (subject to certification by the management authority of the country where the propagation was conducted, Article VII.5). The first commercial farm for an Appendix I species must also be approved by a full vote of the CITES Parties.

Other plans involving the international trade of commercially exploited species require that the species in question be listed in Appendix II, and for crocodilians this includes all ranching and cropping programs. Species involved in these programs can be divided into two categories, those that were never listed on Appendix I (*Caiman crocodilus*, *Crocodylus novaeguineae*, and *C. johnsoni*), and species that were listed on Appendix I and subsequently transferred to Appendix II either for the entire species (*Alligator mississippiensis*) or on a country-by-country basis (*Crocodylus niloticus*, *C. porosus*).

Since 1976, the addition of species to Appendix I and the transfer of species from Appendix I to Appendix II have been pursuant to CITES regulations referred to as the "Berne Criteria"



Skinning saltwater crocodiles during a government demonstration and training course for villagers on the Sepik River, Papua New Guinea. Size limits control harvest of wild crocodiles in Papua New Guinea (Photo by D. Jelden).

(Res. Conf. 1.1 and 1.2). This requires that proposals by producer nations to have their populations of Appendix I crocodilians transferred to Appendix II be based on scientific evidence that the populations can sustain commercial utilization, including results of surveys indicating population recovery. The only Appendix I populations that were transferred to Appendix II under Res. Conf. 1.2 were those of *Alligator mississippiensis* (United States) and *Crocodylus porosus* (Australia).

Many countries found it difficult to meet the requirements of the Berne Criteria, and since 1976 two CITES resolutions have been passed facilitating the transfer of Appendix I species to Appendix II. The first pertained to nations with developing or existing SYU conservation programs based on ranching (Res. Conf. 3.15). In order to qualify for an Appendix II classification under Res. Conf. 3.15, the nation's management authority was required to submit a proposal describing the program and showing how it would have positive conservation benefits for wild populations. In practice this has required the country to have a well-developed management program in place. Today, countries where populations were transferred to Appendix II under Res. Conf. 3.15 are Botswana, Malawi, Mozambique, Zambia, and Zimbabwe (*C. niloticus*).

In 1985, another resolution (Res. Conf. 5.21) was passed allowing the temporary transfer of a population to Appendix II under an annual quota system. The resolution was based on the listing of certain taxa in Appendix I "that either never met the Berne Criteria for inclusion or have recovered since their inclusion," but for which recovery cannot be shown because status was not determined when included in the appendix. This resolution was adopted as a temporary mechanism for countries to begin SYU programs while developing proposals for full transfer to Appendix II via Res. Conf. 1.2 or Res. Conf. 3.15. Quotas under Res. Conf. 5.21 were originally designed to have a time limit of four years, but in practice this limit has been extended for a number of countries. Nations that presently (1991) have Res. Conf. 5.21 quotas include Ethiopia, Kenya, Madagascar, Somalia, Sudan, and Tanzania (*C. niloticus*), and Indonesia (*C. porosus*).

Sustainable Yield Utilization Projects versus Non-commercial Recovery Programs: Setting Priorities

The principal goal of the SSC Action Plans is to specify the actions needed to ensure that threatened species survive as self-sustaining members of their ecosystems. As has been described in the previous sections, two very different approaches to crocodilian conservation are in evidence today, those that use commercial incentives and those that do not. The commercial basis of sustainable yield utilization programs provides a powerful tool for conservation, but is not equally applicable to all species. The development of successful conservation programs based on SYU requires the presence of a series of checks and balances which together ensure that the utilization does not exceed sustainable levels. This, in turn, necessitates that the program regulations can be adequately enforced. Furthermore, to be acceptable to CITES regulations, SYU ranching and cropping programs involving Appendix I species must demonstrate a clear conservation benefit to wild populations. Although the development of SYU projects is of considerable importance for a number of crocodilians, and will take on an increasingly larger role in years to come, significantly more emphasis needs to be placed now on the implementation of recovery programs for the truly endangered crocodilians for which commercial utilization is not an immediate option and for some never will be.

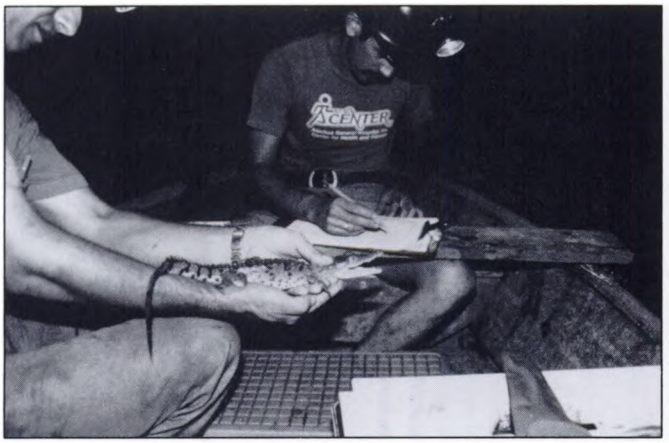
The implementation of SYU programs for truly endangered species, such as the Orinoco crocodile, would be viewed as a risky venture on economic grounds because of the unlikelihood of their approval by the CITES Parties. From a conservation viewpoint, the risk of program abuses leading to overexploitation far outweigh the potential benefits that would accrue from such programs at present. For these species, the first step is to implement management programs based on protection and natural or assisted population recovery. Once recovery is underway then the management program could be amended to incorporate SYU.

Of the 91 papers that have been published in the Proceedings of the 9th and 10th CSG meetings, a conservative estimate of 48 (53%) deal directly with operating or planned SYU programs, whereas only 10 (11%) concern one of the seven most endangered crocodilians (see below). Much of the funding that has been available in recent years for crocodilian conservation has come from the reptile leather industry and has been used principally to fund surveys or help implement management programs oriented towards SYU. Considerable effort has gone into survey work for species such as *Crocodylus niloticus*, *Crocodylus porosus*, *Caiman crocodilus*, and *Caiman yacare*, whereas species such as *Tomistoma schlegelii* and *Crocodylus siamensis* remain virtually unknown. At present only minimal funding has been available for conservation projects pertaining to the seven species most in need. The funding that has been available for work with these species has come primarily from international conservation organizations such as World Wildlife Fund-U.S., the World Wide Fund for Nature-International, and Wildlife Conservation International (New York Zoological Society).

The information compiled in this action plan has permitted an evaluation of the top species in terms of conservation priority. The seven species given the highest priority are (in order of descending priority): *Crocodylus siamensis*, *C. mindorensis*, *Alligator sinensis*, *Crocodylus rhombifer*, *Tomistoma schlegelii*, *Crocodylus intermedius*, and *Gavialis gangeticus*. A later section summarizes the conservation problems facing each of these species, lists some specific conservation actions, and outlines some general considerations for the development and implementation of recovery programs.

Conservation Programs: General Considerations

The main thrust of this action plan addresses species specific conservation problems. However, there are broader questions that must also be addressed that pertain to many, if not all, of the threatened species. These include issues such as training programs, scientific research, and habitat protection, but also involve specific points which may require policy decisions



Dante Videz (left) and Andres Seijas (right) record field data on an American crocodile hatchling, *Crocodylus acutus*, in Venezuela (Photo by F.W. King).

(e.g., captive breeding outside the species' range). This section provides a brief overview of some of these areas of concern. The purpose here is not to examine these issues exhaustively, and no attempt has been made here to list specific projects or to prioritize items.

Need for More Survey Work

It will become apparent from the information presented in this action plan that population surveys are urgently needed for a large percentage of the species. Despite the increase in crocodilian conservation programs worldwide, good or adequate population survey information is only available for five of the 23 species (Table 3), although for some species, such as *Crocodylus porosus* and *C. niloticus*, excellent survey data is available for isolated countries or parts thereof.

In geographical terms, two areas are particularly notable for the lack of information on the status of wild crocodilian populations; west and central Africa, and southeast Asia and the Indo-Malaysian archipelago. This is evident in Table 3 by the poor quality of data on *Crocodylus siamensis*, *Tomistoma schlegelii*, *Crocodylus porosus* (southeast Asia and the Indo-Malaysian Archipelago), and *Crocodylus cataphractus* and *Osteolaemus tetraspis* (west and central Africa). Survey data are lacking in many areas in South and Central America and the Caribbean, but not to the extent that they are in these regions of the Old World.

High Priority Survey Projects:

1. Status surveys in west and central Africa: Angola, Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Equatorial Guinea, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo, and Zaire.
2. Status surveys in southeast Asia: Bangladesh, Bhutan, Cambodia, China, Laos, Malaysia, Myanmar (Burma), Thailand, and Vietnam.
3. Status surveys in the west Pacific region: Philippines, Indonesia, Vanuatu, and the outlying islands of Papua New Guinea (New Britain, New Hebrides).

Surveys are needed not only for planning recovery programs, but also as the first step in the development of SYU programs as well. In recent years, funding for the latter has been forthcoming from a number of sources, and has resulted in good survey information from a number of countries. Nevertheless, for some species with high SYU potential and large geographical ranges, population status still remains virtually unknown over large areas. The classic example of this is the Nile crocodile. Despite a large amount of information on crocodile status in east and southern Africa, over the entire species' range the quality of survey data is rated Very Poor (Table 3) because virtually nothing is known about its status in west and central Africa. Much of the information available for east Africa has come through the development of SYU programs that include initial population censusing and population monitoring. The lack of such programs in west and central Africa appears to be a result of a number of factors including diminished institutional capacity, a limited tradition in wildlife research and

Table 3. Classification of crocodilian species according to the quality of population survey data available. Information summarized from the Species Accounts.

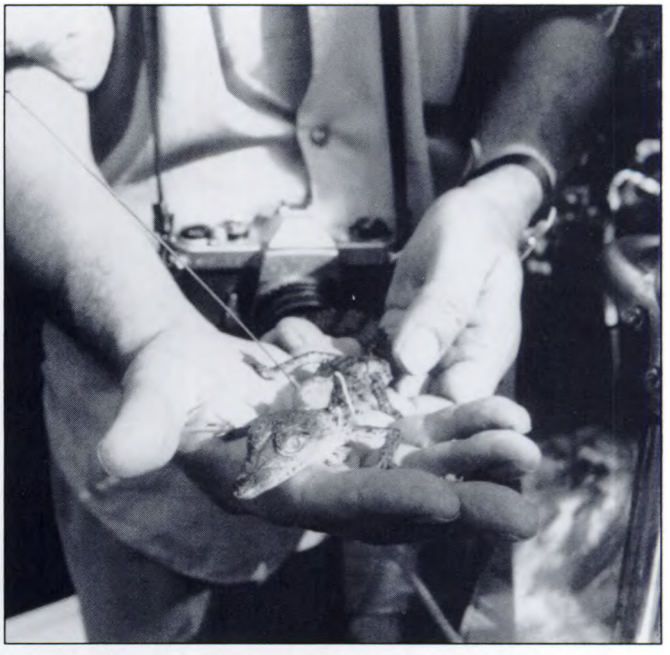
Survey Data Species	English Common Name
Extremely Poor	
Crocodylus siamensis	Siamese crocodile
Alligator sinensis	Chinese alligator
Crocodylus cataphractus	Slender-snouted crocodile
Osteolaemus tetraspis	Dwarf crocodile
Very Poor	
Crocodylus palustris	Mugger crocodile
Crocodylus niloticus	Nile crocodile
Crocodylus rhombifer	Cuban crocodile
Tomistoma schlegelii	Tomistoma
Gavialis gangeticus	Gharial
Crocodylus porosus	Saltwater crocodile
Caiman crocodilus	Common caiman
Poor	
Crocodylus acutus	American crocodile
Caiman latirostris	Broad-snouted caiman
Crocodylus intermedius	Orinoco crocodile
Crocodylus moreletii	Morelet's crocodile
Paleosuchus trigonatus	Smooth-fronted caiman
Paleosuchus palpebrosus	Dwarf caiman
Melanosuchus niger	Black caiman
Adequate	
Caiman yacare	Yacare
Crocodylus mindorensis	Philippine crocodile
Crocodylus novaeguineae	New Guinea crocodile
Good	
Alligator mississippiensis	American alligator
Crocodylus johnsoni	Australian freshwater crocodile

management, and the fact that crocodiles generally inhabit a more forested habitat and may naturally be more cryptic and occur at lower densities. Similarly, with estuarine crocodiles good survey information has been forthcoming from countries with SYU programs and traditions in wildlife research and management (e.g., Australia and Papua New Guinea), and other nations with an active interest in wildlife conservation (e.g., India, Sri Lanka), but very little information is available otherwise.

The situation is considerably worse for many of the endangered species for which no current SYU potential exists. The lack of funding for survey or other work on these species has been a major hurdle in developing conservation programs. Financial support from international organizations has been forthcoming, but conservation dollars are being stretched very thin by the immensity of the threats facing global biodiversity. Support of non-SYU survey and conservation programs by the reptile leather industry need not be viewed as purely altruistic, but rather as an investment in the future. The goal of non-SYU conservation programs is to establish viable populations and minimize the threat of extinction for that species or population. Once the criteria of a recovered population have been met, consideration could be given to initiating SYU programs. However, great care must be taken to avoid the pitfall of directly linking financial support of a non-SYU program to the eventual implementation of SYU management.

Habitat protection

Commercial overexploitation was the principal reason for the decline of most crocodilian populations in the past. However, today the burgeoning human population and development of the world's tropical regions has resulted in habitat destruction or modification playing an increasingly important role. How well we protect wetland habitats will to a large extent determine the success of future conservation work with crocodilians and other aquatic or semi-aquatic species. The development of SYU programs will provide important incentives to protect crocodilian habitat. However, areas also need to be set aside where consumptive exploitation does not occur. Establishment of national parks and marine reserves is of particular importance (Kakadu National Park in Australia for example; this World Heritage site contains the best *C. porosus* habitat in Australia). This will be of particular importance for the truly endangered species where SYU programs are not an option at present. However, merely declaring an area to be protected does not necessarily provide conservation benefits. Due to infrastructure and funding limitations, enforcement of protective regulations is virtually impossible in many areas and a large proportion of officially protected areas throughout the developing world is still subject to intense human exploitation. Increased resolve is necessary to protect these areas, and this requires international support. New and innovative approaches such as debt-for-nature swaps can play an important role in this respect. Wherever possible the negative impacts of local human populations should be ameliorated by implementing environmental education programs and/or non-consumptive wildlife utilization such as eco-tourism.



Hatchling *Crocodylus acutus* with radio-tracking package, Everglades, Florida, U.S.A. Continued long-term research on American crocodiles is needed (Photo by R. Godshalk).

Training Programs

The development and implementation of effective management programs in developing countries will depend to a large extent on the quality of the human resources available. Training courses are needed on two levels, the training of professionals who will take leadership roles in developing and administering management programs, and training at the technical level for those involved in the field implementation of the programs.

The CSG can play an important role in providing training through one of several ways:

1. Supporting research/management fellowships where participants visit and work in established crocodilian research/management programs for a period of time.
2. Helping to find financial support for students from developing nations to attend universities outside of their countries.
3. Offering international training courses where invited professionals from developing countries learn current research/management techniques.
4. Supporting in-country training courses offered by nationals, potentially with the involvement of international members of the CSG community.

Scientific Research

The CSG is composed of a large number of individuals, many of whom are biologists or wildlife managers and to whom the importance of scientific research for the design and implementation of management programs is well known. Basic research on the habitat use, reproductive ecology, and population dynamics has been incorporated into the design of management programs worldwide. Although many of the problems impacting crocodilian conservation are economic, political, or social

Skinning farm-raised alligators, *Alligator mississippiensis*, at Gator Jungle alligator farm, Florida, U.S.A. (Photo by F.W. King).

in nature, the support of conservation programs must be based on sound scientific information, and this requires continued research.

Nations implementing or planning management programs, especially those interested in SYU, should be strongly urged by the CSG to develop parallel research programs. Monitoring programs are most efficiently designed within the framework of an overall research program implemented to study the effects of harvesting on wild populations. Because research funds are usually in short supply, the preferred method of funding these programs has usually been directly from the proceeds of the SYU program. This ensures that as long as the wild resource is being utilized, funds will be available for monitoring and research. However, in order to guarantee that research programs are not unduly pressured by administrative concerns, the two branches of the programs should retain as much autonomy as possible. Because crocodilians are such long-lived animals, particular attention needs to be given to the establishment of long-term ecological studies. Some research projects have been underway for 10-15 or more years (e.g., Louisiana and Florida, U.S.A.; Northern Territories, Australia) and continue to yield important information on population dynamics. As part of long-term population monitoring programs, key ecological data should also be collected for the analysis of crocodilian population ecology.

Commercial Breeding of Species Outside of Their Natural Range

With the interest in commercial farming of crocodilian programs quickly becoming worldwide, the propagation of species outside of their natural range is becoming a potential conservation threat. Two potential problems are envisioned. First is the escape and subsequent establishment of breeding populations of exotic crocodilians. To date only one introduction has been linked to the escape from a farm (*C. moreletii* on the west coast of Mexico). However, the introduction of exotic species can have potentially dire effects on native crocodilians, and the suggestion that introduced *Caiman* played a role in the extirpation of *Crocodylus rhombifer* from the Lanier Swamp is an indication of this.

The second concern regarding the breeding of exotic species is the potential effect it would have on developing conservation programs based on SYU. For instance, the recent importation of *Crocodylus niloticus* by a commercial farm in Brazil (Luxmoore 1990) comes at a time when SYU ranching programs are being developed for *Caiman latirostris* and *C. yacare*. The commercial breeding of Nile crocodiles would be superior from an economic standpoint, but would reduce the economic incentives for developing conservation-oriented ranching programs. However, not all breeding of exotic species has negative conservation implications. Captive breeding by zoos is a good example. The Crocodile Specialist Group has recommended that crocodilian species should not be used for commercial farming operations outside their historical range where those operations are located within the range of other native species of crocodilians.

Commercial Hybridization of Species

The interbreeding of crocodiles (*Crocodylus* sp.) is not uncommon in captivity. In zoos and farms around the world known hybrids have included *acutus* x *rhombifer*, *acutus* x *intermedius*, *porosus* x *siamensis*, and *rhombifer* x *siamensis* (Honegger and Hunt 1990). Hybrids are reported to be superior for farming and ranching because they grow faster, have higher survival rates, and produce larger clutch sizes. The hybridization of *C. porosus* and *C. siamensis* has been actively undertaken at the Samutprakan farm in Thailand.

Uncontrolled interbreeding may result in the genetic loss of particular species. In the past this was a concern for *C. rhombifer* on farms in Cuba, and presently it remains a concern for *C. siamensis*. Hybridization for commercial purposes also raises concerns regarding how products originating from these animals would be classified under CITES. Clearly the hybridization of species has no conservation benefit whatsoever.

Sustainable Yield Utilization Programs

Broadening the conservation constituency. One of the key elements for the success of SYU management programs will be the degree to which they incorporate local people (McNeely 1990). Although crocodilian SYU programs can have conservation benefits, programs differ in their ability to provide local economic incentives. For instance, closed-cycle farming operations only provide economic benefits to the local community in the form of jobs for those who work on the farm. Ranching, on the other hand, can benefit a much larger spectrum of the local populace and provide a greater economic tie to the conservation of wild populations. The CSG must be cognizant of the relative conservation values of different SYU programs and where possible promote those that offer the greatest conservation benefits.

Reduce profitability of illegal trade. One of the greatest impediments to the successful operation of legal SYU programs is the continued presence of a large illegal trade in skins worldwide. In some instances illegal trade is promoted by the existence of a legal market which increases demand for skins.

Illegal skins are either imported by unscrupulous dealers in countries where CITES customs controls are lax or nonexistent, or are passed off as legal skins with falsified documents. The CSG is doing much to make illegal trade more difficult. By working with producer and consumer nations and emphasizing the benefits of dealing only with the increasing quantity of legal hides, the market for illegal skins can be reduced or shut off. To reduce importation of illegal skins into CITES member nations two approaches are needed: the improvement of forensic techniques permitting the accurate identification of species/subspecies and their dissemination to customs agents; and the implementation of standardized tagging techniques to permit the marking of skins through the tanning, and possibly even the manufacturing stage (e.g., Jelden 1990).

Long-term economic implications of SYU programs. The increasing reliance on SYU management programs will greatly increase the availability of crocodilian products on the world market. The long-term economic implications of the increased availability of skins is unclear, but could have important consequences for the future of conservation programs based on SYU. Economic studies of the current crocodilian hide market aimed at forecasting future trends could be a valuable tool for planning the future directions of SYU programs.

Table 4. Classification of crocodilian species according to the need for conservation action.

Priority Species	Distribution
Highest	
Crocodylus siamensis	Southeast Asia
Crocodylus mindorensis	Philippines
Alligator sinensis	China
Crocodylus rhombifer	Cuba
Tomistoma schlegelii	Southeast Asia
Crocodylus intermedius	South America
Gavialis gangeticus	Indian subcontinent
High	
Melanosuchus niger	South America
Crocodylus cataphractus	West and Central Africa
Crocodylus acutus	Central America and Caribbean
Crocodylus palustris	Indian subcontinent
Crocodylus porosus	Southeast Asia and Pacific
Moderate	
Caiman latirostris	South America
Caiman yacare	South America
Crocodylus moreletii	Central America
Crocodylus niloticus	Africa
Crocodylus novaeguineae	New Guinea
Osteolaemus tetraspis	West and Central Africa
Low	
Crocodylus johnsoni	Australia
Alligator mississippiensis	United States
Caiman crocodilus	South and Central America
Paleosuchus trigonatus	South America
Paleosuchus palpebrosus	South America

Species-specific Conservation Priorities

Highest Priority Species

Of the 23 extant species of crocodilians recognized in this action plan, seven are placed in the highest priority category for need of conservation action (Tables 1 and 4), based on the status of wild populations. These species have been ranked relative to one another based on the perceived severity of the threat facing each species, and current conservation efforts underway. Of these seven species, conservation programs have been initiated for six, that is all, except for the Siamese crocodile, *Crocodylus siamensis*. However, of these six species, truly effective conservation programs have only been established for the gharial, *Gavialis gangeticus*. Only a brief discussion of the seven highest priority species is given here. All 23 species are treated in more detail in the Species Accounts.

Included in this section is a list of the most important conservation projects for each of the seven highest priority species. These are the highest priority projects of the action plan and are presented in more detail in the appropriate Species Accounts. Because information on the status of wild populations is the first step towards developing effective management programs, surveys are emphasized for most of the species.

Siamese crocodile (*Crocodylus siamensis*). The Siamese crocodile was, until recently, known from only one small population in the wild in Thailand, but no recent sightings have been made. The possibility exists that wild populations remain in eastern Thailand, Cambodia, Laos, or Vietnam, but no surveys have been conducted in these areas. A small population was reported in Kalimantan, Indonesia, during a recent survey. This species is threatened by habitat destruction, and possibly by hide hunting. No management programs have been established for this species. A large captive population exists in a crocodile farm in Bangkok, but interbreeding with *C. porosus* is being encouraged by the proprietor. Captive breeding is also being carried out at a number of zoos in the United States and other countries.

High Priority Conservation Projects:

1. Status surveys in Thailand, Laos, Cambodia, Vietnam, and Myanmar (Burma).
2. Status surveys in the Greater Sunda Islands (Indonesia).
3. Ensure the presence of a stock of pure *C. siamensis* at the Samutprakan crocodile farm in Bangkok.
4. Protection of habitat in Thailand.

Philippine crocodile (*Crocodylus mindorensis*). This species is known to persist in only a few areas in the Philippine archipelago, where it is being threatened by habitat loss and indiscriminate killing. No effective protection exists in the wild, and the only conservation at present consists of two small-scale captive breeding efforts in the Philippines and one in the United States.

High Priority Conservation Projects:

1. Support for the Silliman University and CFI-Palawan breeding program in the Philippines.

Captive-bred Orinoco crocodiles, *Crocodylus intermedius*, are released into the Cano Guaritico National Wildlife Refuge in Venezuela (Photo by A.E. Siejas).

2. Development and implementation of a national crocodile management program in the Philippines.

Chinese alligator (*Alligator sinensis*). The Chinese alligator has been pushed to the brink of extinction by the tremendous human population pressures in the lower Yangtze River valley. Virtually no natural habitat remains and the few surviving wild individuals are forced to live in close proximity to dense human populations. The current government-sponsored conservation program has relied principally on captive breeding, and little attention has been given to the status of wild populations.

High Priority Conservation Projects:
1. Surveys of the status of wild populations.
2. Increase the conservation role of the captive rearing centers.
3. Enhanced protection of wild populations.

Cuban crocodile (*Crocodylus rhombifer*). The Cuban crocodile has the smallest distribution of any extant crocodilian. This species was known from only two wild populations, in the Zapata and Lanier Swamps, but recent evidence suggests that the latter population may have been extirpated. The introduction of *Caiman crocodilus* into the Lanier Swamp has been suggested as a significant factor in this extirpation. A large-scale captive breeding program has been established, including commercial utilization of skins and meat. Little attention has been given to the status of wild populations.

High Priority Conservation Projects:
1. Determine the status of the Cuban crocodile in the Zapata Swamp and in the Lanier Swamp, Isla de Juventud.
2. Develop and implement management programs in Cuba.

Tomistoma (*Tomistoma schlegelii*). The tomistoma is one of the least-known crocodilians, both in terms of ecology and status. Nevertheless, all current indications are that wild populations are extremely depleted. No management or research programs have been initiated.

High Priority Conservation Projects:
1. Status surveys in Thailand, Malaysia, and Indonesia.
2. Development and implementation of conservation and research programs in Indonesia and Malaysia.

Orinoco crocodile (*Crocodylus intermedius*). This species is found only in the Orinoco River drainage of Venezuela and Colombia. Populations are extremely depleted from past hide hunting, continued habitat modification, and indiscriminate killing. Ecological interactions with *Caiman crocodilus* may also be retarding natural recovery. Some crocodile habitat has been protected and a restocking program has been initiated in Venezuela.

High Priority Conservation Projects:
1. Population status survey in Colombia.
2. Reintroduction program at the Caño Guaritico National Wildlife Refuge, Venezuela.
3. Implementation of a crocodile management plan for Santos Luzardo National Park, Venezuela.

Gharial (*Gavialis gangeticus*). The gharial is restricted to only a few remaining wild populations in India and Nepal. Populations in Pakistan, Bangladesh, Burma, and Bhutan are either extinct or near extinction levels. A successful restocking program has been initiated in India and Nepal and populations in some areas are now recovering.

High Priority Conservation Projects:
1. Survey of status and distribution in Pakistan.
2. Survey of status and distribution in eastern India and Bangladesh.
3. Establishment of captive rearing center in Pakistan.
4. Establishment of captive rearing centers in Bangladesh and northeastern India.

Country Accounts

Introduction

This section presents accounts of each species found within a country for all the countries (a total of 94) which have a recent crocodilian fauna. The countries are presented alphabetically within three continental sections; Africa, Asia, and North and South America. Each account summarizes the information and presents a rating for the available survey data, wild population status, and current management programs for each species. The rating categories were broadly defined to be as unambiguous as possible, but a considerable amount of subjective interpretation of the data was involved, especially in the determination of population status. Contact persons for each country are given and full addresses can be found in Appendix 1.

Survey Data

The quality of survey data ranges from countries for which no crocodilian population surveys whatsoever have been attempted, to others for which extensive widespread data are available over a period of 10-15 years. These data have been ranked into four categories of increasing quality. The distinction between categories I and II was based on the fact that in some countries, while little or no survey data are currently available, survey work is being planned or underway and should yield status information in the near future.

I. **No survey planned.** Little or no information available; no surveys currently planned.
II. **Surveys planned.** Little or no information available; surveys currently underway or planned.
III. **Basic survey data.** Basic information on population size available for certain areas.
IV. **Widespread survey data.** Good information available on population size/trends on a widespread basis.

Wild Population Status

The status of wild populations is a particularly difficult parameter to define. In this action plan, status is defined in terms of the degree of population depletion that has been caused by human-related activities. This requires information on the current status (density, population size) of wild populations, and an implicit comparison to what the status would have been without the intervention of humans. However, given the almost universal lack of data on crocodilian populations prior to exploitation, the extent of the human-related depletion can only be surmised. Most human effects have resulted in the depletion of crocodilian populations, but in some areas habitat modification has actually increased the carrying capacity for certain species (e.g., the spectacled and yacare caimans). Status, as reflected in survey data producing estimates of total population size or density for a particular region, is also influenced by a number of other factors including habitat type, seasonal water level fluctuations, and the ecology and behavior of the particular species in question. The action plan attempts to categorize the species' status into four broad categories, plus another category when absolutely no information was available. These ratings were principally based on an interpretation of the available survey data, but in some cases where no actual data were available, classifications were made based on the opinion of local sources.

1. **Unknown.** No information available.
2. **Extirpated.** Populations extirpated.
3. **Severely depleted.** Populations severely depleted (endangered).
4. **Depleted.** Populations depleted (threatened-vulnerable).
5. **Not depleted.** Populations not significantly depleted.

Management Program

The type of management programs currently in place were divided into seven categories. Category C indicates countries where legal protection is the only management that has been implemented and does not include countries that have legal protection, plus some other form of management. Countries included under 'cropping' are those that have a legal mechanism permitting cropping, but do not necessarily have an active cropping program in effect. It was often difficult to distinguish these two so they were both included in category E.1 and further information included in the discussion in the country accounts.

A—No information available.
B—No management program.
C—Legislation protecting wild populations.
D—Active recuperation program (restocking/reintroduction).
E—Utilization program:
E.1—Cropping
E.2—Ranching
E.3—Farming

Country Accounts
Africa

Algeria

Nile crocodile

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: During the early 1900s, isolated populations were confirmed from a series of small lakes and ponds in the Tassili-n-Ajjer region of southeastern Algeria. These populations had been shot out by the French by 1934 (Guggisberg 1972).

Management and Conservation Programs: Current: No wild populations remain. Proposed: None.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 2-extirpated
Management Program: 1-no information

Angola

Slender-snouted crocodile
Nile crocodile
Dwarf crocodile

Slender-snouted crocodile (*Crocodylus cataphractus*)

Status of Wild Populations: No recent survey data are available. The species is reported to be endangered and present only in rivers in the north-northeastern region of the country bordering Zaire and Cabinda (Pooley 1982).

Management and Conservation Programs: Current: Protected by decree in 1969. Hunting and the export of skins are prohibited (Pooley 1982).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 3-severely depleted/endangered
Management Program: C-legislation

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: No recent survey data are available. In 1980, the species was widely distributed throughout the country and considered to be rare to vulnerable. Good numbers of crocodiles were reported to be in the lower Kunene, Cuanze, and the rivers to the east (Pooley 1982).

Management and Conservation Programs: Hunting and export of skins were prohibited by decree in 1969 (Pooley 1982).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 4-depleted/vulnerable
Management Program: C-legislation

Dwarf crocodile (*Osteolaemus tetraspis*)

Status of Wild Populations: No recent survey data are available and the status of this species is uncertain. Apparently it only occurs in the enclave of Cabinda north of the Congo river. In 1980 this species was classified as rare or indeterminate (Pooley 1982).

Management and Conservation Programs: Protected by decree since 1969. The hunting of crocodiles and the export of skins is prohibited (Pooley 1982).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: C-legislation

Contact: Nkosi Luta Kingengo

Benin

Slender-snouted crocodile
Nile crocodile
Dwarf crocodile

Slender-snouted crocodile (*Crocodylus cataphractus*)

Status of Wild Populations: No recent survey data are available, but it is listed as being present in the Oueme River by Pooley (1982) and Waitkuwait (1989).

Management and Conservation Programs: Fully protected under 1980 legislation (Klemm and Navid 1989).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: C-legislation

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: No recent survey data are available. It is present in the Pendjari National Park and the Bali waterhole (Pooley 1982).

Management and Conservation Programs: See *C. cataphractus* account above.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: C-legislation

Dwarf crocodile (*Osteolaemus tetraspis*)

Status of Wild Populations: No recent survey data are available. It is listed as being present in the Oueme, Mekrou, and Alibori rivers (Waitkuwait 1989).

Management and Conservation Programs: See *C. cataphractus* account above.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: C-legislation

Contact: Mr. Laurent Worou

Botswana

Nile crocodile

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: The present and historic distribution of the Nile crocodile in Botswana is limited to the few perennial rivers in this arid country. The largest populations are in the Okavango River, the Okavango Delta, and in the Limpopo, the Kwando, and Linyanti/Chobe rivers. Estimated crocodile population size in the Okavango is 5,704-6,608, and in the northern and eastern region of the country the total population is estimated at 1,185-2,780. The total population in the Limpopo River is estimated to be 2,552. Isolated and unsurveyed, populations also exist in Lake Liambezi and Savuti Channel. The country's total crocodile population size is projected to be 9,000-10,000 (CITES 1989, Simbotwe 1990).

A series of aerial surveys to count crocodile nests in the upper Okavango Delta was conducted between 1973 and 1979 (Graham 1976, Graham and Simbotwe 1988, Simbotwe 1990). Nesting increased by an average of 9.5% annually from 1975-1979. Aerial surveys were resumed in 1987 and indicated nesting levels were similar to the 1979 level (this despite the offtake of 175-300 adult females in the previous three years; Graham and Simbotwe 1988). However, the number of nests in 1989 was reported to be down (Simbotwe and Guillette, pers. comm.)

Management and Conservation Programs: Crocodiles in Botswana are regulated under the Fauna Conservation Act of 1961. They are considered a game animal and hunting is permitted by license. Crocodiles were extensively hunted in the Okavango region between 1959 and 1969, and again in 1973-1974 (Graham and Simbotwe 1988). For the period 1986-1989 permits were issued to collect 1,600 adult crocodiles and 12,000 eggs from the Okavango. The adult crocodiles were for use in captive breeding operations in Botswana, Namibia, and South Africa. Two captive breeding operations are currently registered with the CITES Secretariat: Wildlife Services Botswana and the Okavango Swamps Farm. These two farms still depend largely on eggs from the wild. Another farm (Tuli Block/Limpopo River Farm) has recently started operation along the Limpopo River (L. Guillette, pers. comm.).

Botswana maintained a reservation on the Nile crocodile until the population was transferred to CITES Appendix II in 1985 (pursuant to Resolution Conf. 5.21) and an annual quota of cropped crocodiles was established at 2,000. This quota was not realized due to administrative problems, so the quota was extended in 1987. To date no crocodile skins have been exported. However, since 1983, 4,487 live crocodiles have been exported to other crocodile farms in South Africa and Namibia. At the 1989 CITES conference, Botswana removed its reservation on the Appendix I listing of *C. niloticus*, clearing the way for the transfer of crocodile populations to Appendix II under Resolution Conf. 3.15 (ranching criteria).

Legal cropping continues but is limited to 50 per year for non-resident safari hunters.

Country Rating:
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: E.2-ranching, E.3-farming

Contact: Dr. Jon M. Hutton, John Seaman, Dr. M.P. Simbotwe, G.C. Craig

Burkina Faso

Slender-snouted crocodile
Nile crocodile
Dwarf crocodile

Slender-snouted crocodile (*Crocodylus cataphractus*)

Status of Wild Populations: No recent survey data are available. *C. cataphractus* was reported to be present in the Comoe, Black Volta, and Bougouriba rivers (Waitkuwait 1989). Pooley (1982) notes that populations have disappeared from most areas. Skin hunting and the collection of eggs for consumption were noted to be the biggest problems.

Management and Conservation Programs: Fully protected by legislation enacted in 1979 (Klemm and Navid 1989).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: C-legislation

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: No recent survey data are available. Listed as being present in the Black Volta, Red Volta, and White Volta (Pooley 1982).

Management and Conservation Programs: See *C. cataphractus* account above.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: C-legislation

Dwarf crocodile (*Osteolaemus tetraspis*)

Status of Wild Populations: No recent survey data are available. Waitkuwait (1989) lists it from the Comoe, Black Volta, and the Bougouriba rivers.

Management and Conservation Programs: Legislation pertaining to *C. cataphractus* and *C. niloticus* also presumably applies to this species as well.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: C-legislation

Contact: Mr. Souleymane Zeba

Burundi

Nile crocodile

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: No recent survey data are available. Reported to have been common at the mouth of the Rusizi River near the capital of Bujumbura, and present in Lake Tanganyika (Pooley 1982).

Management and Conservation Programs: Legally protected under a 1971 regulation (Klemm and Navid 1989).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: C-legislation

Cameroon

Slender-snouted crocodile
Nile crocodile
Dwarf crocodile

Slender-snouted crocodile (*Crocodylus cataphractus*)

Status of Wild Populations: The species was listed as endangered by the Fauna Conservation Department in 1980 (Pooley 1982). Abercrombie (1978) reported local informants saying this species was quite common in remote areas of the Cross river. Little skin trade was reported but the flesh was eaten. A quick survey by Behra (pers. comm.) in 1988 found extremely few animals.

Management and Conservation Programs: In the 1970s, crocodilians were unprotected outside of national parks (Pooley 1982). The hunting of crocodiles under license was authorized by legislation in 1983 (Klemm and Navid 1989).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: E.1-cropping

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: No recent survey data are available. This species is considered to be endangered by the Fauna Conservation Department in 1980 (Pooley 1982). Abercrombie (1978) states that commercially exploitable populations had not existed in over 10 years. Behra (pers. comm.) reported small populations occurred in the northern part of the country. Although the population was conditionally transferred to CITES Appendix II in 1985 (see below), no survey data was available.

Management and Conservation Programs: The hunting of crocodiles was authorized under license by legislation in 1983 (Klemm and Navid 1989). Cameroon's population was transferred to CITES Appendix II in 1985 and an annual export quota

of 20 was established for 1985-1986. This quota was raised to 100 at the 1987 CITES meeting, but no petition was presented at the 1989 meetings so the crocodile populations remained on Appendix II with a zero quota.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: E.1-cropping

Dwarf crocodile (*Osteolaemus tetraspis*)

Status of Wild Populations: No recent survey data are available.

Management and Conservation Programs: It is not known whether legislation pertaining to *C. cataphractus* and *C. niloticus* also applies to this species.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: A-none

Contact: Dr. Stephen Gartlan

Central African Republic

Slender-snouted crocodile
Nile crocodile
Dwarf crocodile

Slender-snouted crocodile (*Crocodylus cataphractus*)

Status of Wild Populations: Surveys were conducted by Behra (1987b) in five different areas in eastern CAR. Corrected densities of *C. cataphractus* ranged from 0.1-0.4/km. Extrapolations for eastern CAR suggest that the total population size is 600-1,800. Higher densities were noted in the Ougbangui River along the border with Zaire (4.1/km). Poaching by locals and Sudanese rebels is a problem.

Management and Conservation Programs: Legally protected in 1984 (Klemm and Navid 1989).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: C-legislation

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: Surveys conducted by Behra (1987b) at five riverine sites in eastern CAR show corrected densities of 1.1-1.9/km. The estimated population size for eastern CAR is 5,500-16,500. Higher densities were noted from the Oubangui River (7.6/km) along the border with Zaire. As with *C. cataphractus*, poaching continues to be a problem.

Management and Conservation Programs: See *C. cataphractus* account above.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: C-legislation

Dwarf crocodile (*Osteolaemus tetraspis*)

Status of Wild Populations: The surveys by Behra (1987b) found no *Osteolaemus*. An authority cited in Pooley (1982) reported this species to be plentiful in the dry Birao region.

Management and Conservation Programs: See *C. cataphractus* account above.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 1-unknown
Management Program: C-legislation

Contact: Olivier Behra, Floris Deodatus, Alistair Graham

Chad

Slender-snouted crocodile
Nile crocodile

Slender-snouted crocodile (*Crocodylus cataphractus*)

Status of Wild Populations: No recent survey data available. The presence of this species in Chad is mentioned by Cott and Pooley (1972). Pooley (1982) notes that this species is thought to occur in several tributaries of the Chari River. Its status in 1980 was considered to be endangered.

Management and Conservation Programs: Presumably regulations for *C. niloticus* (see below) also apply to this species.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 3-severely depleted/ endangered
Management Program: E.1-cropping

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: No recent survey data are available. Pooley (1982) reports that hunting had reduced the population by some 90% in the early 1970s, and that a 1979

report listed the species as ranging from rare to locally vulnerable. Isolated populations were reported from the northern region of the country in the Ennedi Mountains as late as 1960 (Wake and Kluge 1961).

Management and Conservation Programs: Prior to 1970, legislation regulating cropping of wild populations, skin dealers had to be licensed, and an export tax was levied on all skins. Hunting was forbidden in national parks and in the northern part of the country. The minimum legal size was established as 25 cm belly width, and egg collection was forbidden. The enforcement of these regulations was largely ineffective and difficult to control, especially after the advent of the civil war. Crocodile farming projects in the vicinity of Lake Chad were initiated in 1972 but were abandoned after 4-5 years (Pooley 1982).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 3-severely depleted/endangered
Management Program: E.1-cropping

Contact: Mr. Daboulaye Ban-Ymary

Congo

Slender-snouted crocodile
Nile crocodile
Dwarf crocodile

Slender-snouted crocodile (*Crocodylus cataphractus*)

Status of Wild Populations: This species was not considered to be endangered by authorities cited in Pooley (1982). Surveys by Behra (1987c) of seven sites found corrected densities of 0.3-6.5/km. Extrapolated population size for the northeastern section of the country surveyed was 10,000-30,000, and for the entire country was 15,000-45,000.

Management and Conservation Programs: Pooley (1982) states that this species is protected in national parks. A 1983 decree permits hunting under license (Klemm and Navid 1989). In 1987, the Congo population was transferred to CITES Appendix II and an annual quota of 600 *C. cataphractus* skins to be exported was established. This quota was also approved for the period 1990-1992 at the 1989 CITES conference. All skins come from cropped wild individuals.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: E.1-cropping

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: Authorities cited in Pooley (1982) considered the overall population status to be poor, but that good populations still remained in the northern forested regions of the country. Behra (1987c) surveyed seven sites in the northern part of the Congo. Corrected population densities ranged from 0.45-3.7/km. The extrapolated population size for northeastern Congo was 2,800-8,600, and for the entire country was 4,000-13,000.

Management and Conservation Programs: The Nile crocodile is listed as being protected in national parks by Pooley (1982). A 1983 decree permits hunting under license (Klemm and Navid 1989). In 1985 the Congo population was reclassified as CITES Appendix II and an annual export permit of 1,000 cropped skins was established. This quota was reduced to 150 in 1987, and eliminated altogether in 1990.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: E.1-cropping

Dwarf crocodile (*Osteolaemus tetraspis*)

Status of Wild Populations: *Osteolaemus* is said to be plentiful in the northern part of the country (Pooley 1982), but surveys by Behra (1987c) in larger rivers failed to see any. Agnagna (1989) comments on nesting by this species in the Congo but presents no data on status. The Congo form of *Osteolaemus* was described as being taxonomically distinct from the West African form by Schmidt (1919). Since that time no work has been done on the taxonomic status of African dwarf crocodiles and future investigations of this topic are warranted.

Management and Conservation Programs: The dwarf crocodile is protected in national parks (Pooley 1982). A 1983 decree permits hunting under license (Klemm and Navid 1989). In 1987, the Congo population of *Osteolaemus* was transferred to Appendix II and a quota of 500 established. At the 1989 CITES conference, realizing that no market existed for *Osteolaemus* skins, the Congo had proposed the reclassification of this species into Appendix I and the elimination of the quota. Instead, the population was retained on Appendix II, and the Congo was given a zero quota (Hemley 1989).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 1-unknown
Management Program: C-Legislation

Contact: Olivier Behra, Marcellin Agnagna

Equatorial Guinea

Slender-snouted crocodile
Nile crocodile
Dwarf crocodile

Crocodylus cataphractus, Crocodylus niloticus, Osteolaemus tetraspis

Status of Wild Populations: No data are available concerning the status of crocodilians in Equatorial Guinea. Boulenger (1889) reported a specimen of *C. cataphractus* in the British Museum which originated from Fernando Po (Bioko).

Management and Conservation Programs: Unknown.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: A-no information

Contact: Dr. John E. Fa

Ethiopia

Nile crocodile

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: Crocodiles are widely distributed in lowland Ethiopia. Commercial hunting reduced crocodile numbers in areas accessible to hunters. In protected areas crocodile populations are said to have increased substantially over the last 20 years (CITES 1989, Doc. 7.42). The estimated population of crocodiles in Lake Chamo in 1987 was 4,175. During the same year, 316 crocodile nests were found around the lake. Aerial surveys of about 100 km of river within the Omo National Park revealed relatively high crocodile densities (259 crocodiles over 1.5 m total length on one bank only).

Habitat loss is a major problem in Ethiopia. Settlement of riverbank habitats is reducing the number of available nesting beaches. Hunting of crocodiles for their skins or meat is apparently not a major problem.

Management and Conservation Programs: Commercial hunting of crocodiles was prohibited in 1972 when this species was listed as a game animal. Hunting is by permit only. Crocodiles within the national parks are protected, and it is estimated that these account for 50% of the entire crocodile population.

In 1983, an FAO-sponsored crocodile ranching program began. A pilot ranch was established at Arba Minch, and ranching is based on the collection of eggs from Lake Chamo. In 1986, 5,521 eggs were collected from 126 nests producing a total of 4,928 hatchlings. Approximately half of these hatchlings were kept on the farm and the rest returned to the wild (CITES 1989).

Ethiopia was not a member of CITES in 1987, but attended the CITES general conference and announced a self-imposed quota of 500 skins. Following 1987, Ethiopia joined CITES and their populations of *C. niloticus* were conditionally transferred to Appendix II to allow an export quota for ranched skins (9,370 for 1990 and 8,870 for 1991-1992).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: E.2-ranching

Contact: Tadesse Hailu, Dr. Cris Hillman, Dr. Jon M. Hutton

Egypt

Nile crocodile

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: Historically present in the Nile river valley as far north as the delta (Anderson 1898). Extirpated from the country sometime during the early part of this century. Following the damming of the Nile by the Aswan Dam, crocodiles have been reported from Lake Nasser (Groombridge 1982), presumably having immigrated north from Sudan, but their status remains unknown. From December 1988 to March 1989, 50 to 60 juvenile crocodiles (35-40 cm long) were confiscated from pet shops and street vendors in Cairo and Aswan. In January, 1989, a 2.4 m crocodile was caught and killed in fishing nets in the Nasser High Dam (Bruessow, in litt. July 10, 1990).

Management and Conservation Programs: Fully protected by law (Decree 1059 of 1984; Klemm and Navid 1989).

Country Rating
Survey Data: II-surveys planned
Wild Population Status: 3-severely depleted
Management Program: C-legislation

Contact: Dr. Mohammed Nael, Daren M. Bruessow

Gabon

Slender-snouted crocodile
Nile crocodile
Dwarf crocodile

Slender-snouted crocodile (*Crocodylus cataphractus*)

Status of Wild Populations: A 1978 report listed this species as common in the lower coastal strip between Port Gentil and Mayumba (Pooley 1982). Behra (1987a) surveyed 3 sites in the Ogoue river drainage in northern Gabon and one coastal lagoon. At one site insufficient data were collected to estimate density. Two sites were lakes and corrected density was calculated to be 1.28/km² and 0.95/km². On the Ogoue River, corrected density

of *C. cataphractus* was 39.2/km. Behra notes that populations have been reduced, especially in readily accessible areas, but the Ogoue River population is quite large. Total *C. cataphractus* population size was estimated to be 30,000-90,000. Commercial exploitation during the 1960s was reported to be severe (Pooley 1982).

Management and Conservation Programs: Pooley (1982) reports that a 1966 decree protects crocodiles in national parks, in reserves, and in the entire country throughout the breeding season. Permits are issued annually for commercial harvesting. A temporary ban was placed on all hunting in 1981 (Klemm and Navid 1989), but the present legal status of crocodiles is uncertain.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: C-legislation

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: Abercrombie (1978) noted that populations of *C. niloticus* were severely depleted in Gabon. This statement is supported by the recent survey done by Behra (1987a), who failed to sight a single individual of this species.

Management and Conservation Programs: See *C. cataphractus* account above.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 3-severely depleted/endangered
Management Program: C-legislation

Dwarf crocodile (*Osteolaemus tetraspis*)

Status of Wild Populations: *Osteolaemus* were only seen at one of three sites for which survey data are available from Behra (1987a). At Sette Cama lagoon, a coastal lagoon, a corrected density of 1.58/km^2 was calculated.

Management and Conservation Programs: See *C. cataphractus* account above.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: C-legislation

Contact: Olivier Behra, Mr. Jean-Hubert Eyi-Mbeng

Gambia

Slender-snouted crocodile
Nile crocodile
Dwarf crocodile

Slender-snouted crocodile (*Crocodylus cataphractus*)

Status of Wild Populations: No recent survey data are available, but the species was considered in 1980 to be rare or endangered. Poaching continues and habitat destruction is also a problem (Pooley 1982).

Management and Conservation Programs: Fully protected by law (Wildlife Conservation Act, 1977; Pooley 1982, Klemm and Navid 1989).

Country Rating
Survey Data: I-no survey data
Wild Population Status: 3-severely depleted/endangered
Management Program: C-legislation

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: No recent survey data are available. Status of *C. niloticus* in the late 1970s was described as vulnerable. It is reported to be seen regularly in the Abuko National Park (Pooley 1982).

Management and Conservation Programs: See *C. cataphractus* account above.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 4-depleted/vulnerable
Management Program: C-legislation

Dwarf crocodile (*Osteolaemus tetraspis*)

Status of Wild Populations: No recent survey data are available. Listed in Pooley (1982) as endangered.

Management and Conservation Programs: *O. tetraspis* has been legally protected since 1977 (Pooley 1982). A proposal has been made to conduct an ecological study of this species throughout the country and to translocate animals into rehabilitated forest pools in the Abuko Nature Reserve (Jones and Day 1987).

Country Rating
Survey Data: II-surveys planned
Wild Population Status: 3-severely depleted/endangered
Management Program: C-legislation

Contact: E.F. Brewer

Ghana

Slender-snouted crocodile
Nile crocodile
Dwarf crocodile

Slender-snouted crocodile (*Crocodylus cataphractus*)

Status of Wild Populations: No recent survey data are available. Pooley (1982) reports that this species is found in low numbers in coastal lagoons, as well as in the Volta Lake and larger rivers in the forest zone. Listed as being found in the Black Volta, Tanoe, and Bia rivers by Waitkuwait (1989).

Management and Conservation Programs: Fully protected under the Wildlife Conservation Regulations of 1971 (Pooley 1982, Klemm and Navid 1989).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: C-legislation

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: No recent survey data are available. Populations were apparently very low in the early 1970s (Cott and Pooley 1972). The damming of the Volta River and the creation of Lake Volta has created a great deal of new habitat for the species but there are no data on present crocodile status in the lake.

Management and Conservation Programs: See *C. cataphractus* account above.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: C-legislation

Dwarf crocodile (*Osteolaemus tetraspis*)

Status of Wild Populations: No recent survey data are available. Pooley (1982) reports that in some areas they may be reasonably plentiful in small forest rivers. King (pers. comm.) reports that they were common in small streams and spoil ditches in and around Kumasi in 1975. Another informant in Pooley (1982) stated that the species is not very common, and is found principally in small streams and rivers and even in Lake Volta. Illegal hunting for meat occurs. The dwarf crocodile is listed as being found in the Black Volta, Tanoe, Bia, and Offin rivers by Waitkuwait (1989).

Management and Conservation Programs: See *C. cataphractus* account above.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: C-legislation

Contact: Gerald A. Punguse

Guinea

Slender-snouted crocodile
Nile crocodile
Dwarf crocodile

Crocodylus cataphractus, *Crocodylus niloticus*, *Osteolaemus tetraspis*

Status of Wild Populations: No survey data are available for crocodilians in Guinea. Waitkuwait (1989) lists *C. cataphractus* and *O. tetraspis* from tributaries of the Niger but presents no data on their status.

Management and Conservation Programs: No information is available regarding the management of crocodilian populations in Guinea.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: A-no information

Contact: Mr. Macky Ly

Guinea-Bissau

Slender-snouted crocodile
Nile crocodile
Dwarf crocodile

Crocodylus cataphractus, *Crocodylus niloticus*, *Osteolaemus tetraspis*

Status of Wild Populations: No survey data are available for crocodilians in Guinea-Bissau.

Management and Conservation Programs: The taking of crocodiles for sport is prohibited by law (Reglamento da caca, 1980), but commercial hunting is apparently not included in this law (Klemm and Navid 1989).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: B-none

Contact: Mr. Pierre Campredon

Israel

(The zoogeographic affinities of Israel, particularly with regard to crocodilians, justify its consideration here.)

Nile crocodile

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: Extirpated. Noted by Anderson (1898) to have been present in what is now Israel. Inhabited the Kishon (Qishon), Zerak, and Jordan rivers.

Management and Conservation Programs: No wild populations exist. In 1985, two crocodile farms were in operation. Both farms had *C. niloticus* stock and one was breeding an exotic species (*Alligator mississippiensis*; Luxmoore et al. 1985).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 2-extirpated
Management Program: E.3-farming

Contact: Guy Ben-Moshe, Emanuel Solnik, Prof. Yehudah L. Werner

Ivory Coast

Slender-snouted crocodile
Nile crocodile
Dwarf crocodile

Slender-snouted crocodile (*Crocodylus cataphractus*)

Status of Wild Populations: Surveys were conducted from 1981-1983 in three areas in the Ivory Coast (Waitkuwait 1988). In the Comoe River in Comoe National Park, a total crocodilian density of 1.77/km (over 133.2 km) was found with 0.11 *C. cataphractus* per km and 0.83/km unidentified crocodilians. In the Hana River in Tai National Park overall density was 0.93/km, with 0.50/km *cataphractus* and 0.40/km unidentified (21.0 km surveyed). Surveys in coastal lagoons found very low crocodile density: 0.003/km *cataphractus*, 0.09/km unidentified, and 0.15/km total (360 km surveyed).

Pooley (1982) comments that this species is considered to be out of danger. However, surveys in the early 1980s for the establishment of commercial crocodile ranches found populations to be very depleted (Luxmoore et al. 1985).

Management and Conservation Programs: Commercial hunting is regulated by the Arrete reglement la chasse des crocodiles (1967), with a minimum legal belly width of 25 cm. An overall hunting ban was established in 1974 (Klemm and Navid 1989). The establishment of commercial ranches was not considered feasible due to the low numbers of wild crocodiles; instead, a farming operation was recommended (Luxmoore et al.1985), but this was not developed.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: C-legislation

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: Surveys during 1981-1983 by Waitkuwait (1988) found a minimum density of 0.83/km in the Comoe River (Comoe National Park) (plus another 0.83/km unidentified crocodilians), but no *C. niloticus* in the Hana River in Tai National Park. Density in coastal lagoons was very low (0.05/km, plus 0.09/km unidentified).

Pooley (1982) felt that crocodile populations had declined due to habitat loss and illegal hunting. Surveys in the early 1980s for the establishment of commercial crocodile ranches found populations to be very depleted (Luxmoore et al. 1985).

Management and Conservation Programs: See *C. cataphractus* account above.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: C-legislation

Dwarf crocodile (*Osteolaemus tetraspis*)

Status of Wild Populations: Surveys by Waitkuwait (1988) in 1981-1983 found very low densities of this species in two national parks, and in some coastal lagoons (0.006-0.02/km). Pooley (1982) commented that the species was rare and that declines are attributed to poaching and habitat loss.

Management and Conservation Programs: *O. tetraspis* has been legally protected since 1979 (Pooley 1982).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: C-legislation

Contact: Dr. W. Ekke Waitkuwait

Kenya

Nile crocodile

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: Surveys of *C. niloticus* populations were conducted in 1988 by Hutton (1989c). Five areas were surveyed by fixed-wing aircraft including: the Tana, Ewaso Ngiro, and Sabaki/Galana rivers, and lakes Turkana and Baringo. It was concluded that population levels have declined since the late 1960s, and that this decline was principally attributable to an increase in Kenya's human population, and the recent effects of a severe drought. Human exploitation of the Tana River population was intense. Observable population sizes and densities (not absolute figures) were estimated to be: Lake Baringo-88.6, Lake Turkana-2,376, Ewaso Ngiro River-0.90-0.07/km (90 km surveyed), Tana River-0.00-4.83/km

(140 km surveyed), Sabaki/Galana River-0.0-1.5/km (120 km surveyed) (Hutton 1989c).

Management and Conservation Programs: Crocodiles are protected under the Wildlife (Conservation and Management) Act which requires a permit for exploitation. Limited permits were issued to Baobab Farm for egg collection. Since 1984, the uncontrolled collection of eggs, hatchlings, and even adult crocodiles from the Tana River by Mamba Village Crocodile Farm has caused a great deal of concern. Currently Baobab Farm is operating as a crocodile farm and Mamba Village as a ranching operation (Hutton 1989a). Kenya has received a 5,000 hide export quota under CITES, increasing to 6,000 in 1991 (Hemley 1989).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: E.1-cropping, E.2-ranching, E.3-farming

Contact: R.D. Haller, Dr. Jon M. Hutton, Ariel Zilber

Liberia

Slender-snouted crocodile
Nile crocodile
Dwarf crocodile

Slender-snouted crocodile (*Crocodylus cataphractus*)

Status of Wild Populations: No recent survey data are available. *C. cataphractus* was reported to be abundant in the St. Paul, St. John, and Maa-fa rivers in the late 1960s. More recent reports suggest that this species was common in the mangroves surrounding the capital of Monrovia, where little hunting was taking place. Poaching and habitat destruction were considered to be problems. Waitkuwait (1989) states that this species can be found in the Mano, Loffa, St. Paul, Mani, Cess, Sangwin, and Douabe rivers.

Management and Conservation Programs: Fully protected by Decision of the President, 1978 (Klemm and Navid 1989).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: C-legislation

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: No recent survey data are available. The account in Pooley (1982) suggests that the species is endangered but also reports that it is common in the mangroves surrounding the capital of Monrovia. Hide hunting, sale of hatchlings, and habitat destruction were listed as conservation problems.

Management and Conservation Programs: Fully protected by Decision of the President, 1978 (Klemm and Navid 1989).

Country Rating
Survey Data: II-surveys planned
Wild Population Status: 1-unknown
Management Program: C-legislation

Dwarf crocodile (*Osteolaemus tetraspis*)

Status of Wild Populations: No recent survey data are available. Along with the other two species, *O. tetraspis* was reported to be common in the mangroves surrounding the capital of Monrovia. A historical reference mentions this species using holes dug into forested riverbanks (Pooley 1982). Waitkuwait (1989) states that this species can be found in the Mano, Loffa, St. Paul, Mani, Cess, Sangwin, and Douabe rivers.

Management and Conservation Programs: Fully protected by Decision of the President, 1978 (Klemm and Navid 1989).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: C-legislation

Contact: Alexander Peal

Madagascar

Nile crocodile

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: Aerial and nocturnal counts of 36 rivers and lakes were conducted in 1987-1988 by Behra and Hutton (1989). Crocodiles were found to be widespread, especially along the island's west coast, but densities were very low. The highest observed density based on aerial survey was 0.27/km (Mangoky River; 180 km surveyed), which is well below the densities observed in Zimbabwe or Zambia (Hutton 1989a).

Overhunting is considered to pose a serious threat to crocodile populations in Madagascar. Also, the rapid growth of the human population and extensive rice cultivation indicates that large amounts of crocodile habitat are being lost (Behra and Hutton 1989).

Management and Conservation Programs: Prior to 1988, crocodiles were considered vermin and no effort was made to control hunting. By decree in 1988, crocodiles were reclassified as game animals, and hunting is regulated by permit. The

official hunting season is 1 May through the first Sunday in October. However, in October, 1988 hunting was reported to be continuing unabated (Hutton 1989a).

In 1985, Madagascar asked for and received an annual quota of 1,000 crocodiles under Resolution Conf. 5.21. Only 155 skins were exported in 1985, but this increased to 600 skins in 1986. The 1987 quota was also 1,000, but an additional 2,651 stockpiled skins were authorized for export by CITES as a step to encourage the government to develop a sustainable use management policy. One thousand skins were exported in 1988. During the period 1985-1989 it is estimated that 17,500 crocodiles were killed in Madagascar, mostly for local sale of goods to tourists (CITES 1989).

In 1989, Madagascar requested to keep its crocodile population on Appendix II under the provisions of Resolution Conf. 3.15 (ranching criteria). This request was turned down but the crocodile population was kept on Appendix II pursuant to Resolution Conf. 5.21, with a zero quota for 1990, and an annual quota of 2,000 ranched skins for 1991-1992.

Madagascar has proposed an ambitious ranching program, and this is being supported through an FAO crocodile management project. However, at present only one ranch is in operation in Madagascar. Furthermore, the wild populations have been cropped so severely that there are no known areas where a large-scale egg collection program can be initiated (Behra and Hutton 1989).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 3-severely depleted/endangered
Management Program: E.1-cropping, E.2-ranching

Contact: Raymond Rakotonindrina, Olivier Behra, J. Christophe Peyre

Malawi

Nile crocodile

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: Surveys were conducted in the mid-1980s by Uhlric (1984), Tello (1985a), and Mphande (1987). Overall results indicate that crocodiles are widely distributed, with Mphande (1987) finding crocodiles at 10 of the 11 sites visited. Large crocodile populations are found in the Liwonde National Park and Elephant Marsh (Hutton 1989a). The highest sample densities were 4.64/km (over 25 km), and 7.09/km (over 32 km) in the Liwonde National Park (Uhlric 1984, Mphande 1987). Mphande (1987) estimated the total Malawian crocodile population size to be 8,000-15,000.

Management and Conservation Programs: Crocodiles are protected by law and may not be hunted without permission from the government. Malawi has had a controlled cropping program for crocodiles since 1948, when quotas were established in Lake Malawi and the Shire River. Malawi's crocodile population was transferred to CITES Appendix II in 1985 (Resolution Conf. 5.21) and an export quota of 500 was established. The quota for cropped skins was increased to 700 in 1987 (for the period 1987-1989), and an additional ranched skin quota was given (1987-200, 1988-300, 1988-600). At the 1989 CITES conference, the Malawi crocodile population was transferred to Appendix II under the ranching criteria so no CITES-imposed limits on ranched hides are in effect. This was done with the understanding that Malawi would reduce its wild cropping program. However, at the 1989 CITES conference Malawi indicated that a limited amount of cropping would continue, including the removal of nuisance animals. Crocodile predation on humans accounts for some 10-15 deaths a year (Hutton 1989a).

One crocodile ranch, the Dwanga Crocodile Ranch, is currently in operation. Beginning in 1984 this ranch was given an annual quota of 2,000 eggs, which was reduced in 1986 to 1,600 eggs. Another ranch was reportedly being established in Mangochi. The Dwanga Crocodile Ranch has had high hatchling and low mortality rates and is aiming at a production of 1,600 skins per year. The ranch has also established a small breeding population of crocodiles for farming purposes (CITES 1989). The Malawi government requires the release of 5% of the ranched crocodiles into the wild, and 50 juveniles were released in 1987 (Hutton 1989a).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: E.1-cropping, E.2-ranching, E.3-farming

Contact: R.H.V. Bell, J.N.B. Mphande, Henri Nsanjama, Daren Bruessow, P. Strover

Mali

Slender-snouted crocodile
Nile crocodile
Dwarf crocodile

Slender-snouted crocodile (*Crocodylus cataphractus*)

Status of Wild Populations: No recent survey data are available. Hide hunting was uncontrolled prior to 1969. Habitat destruction for the creation of rice fields has also been reported as a major problem (Pooley 1982). Reported by Waitkuwait (1989) to be present in the Baoule, Bagoe, and Kankelaba rivers, but no survey data are presented.

Management and Conservation Programs: See account for *C. niloticus* below.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: C-legislation

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: No recent survey data are available.

Management and Conservation Programs: A licensed cropping program was initiated in 1969. Hunters would pay a fee for a permit which allowed them to trap three crocodiles per year. No information is available on size restrictions. A large percentage of the budget for wildlife conservation in Mali was reported to come from these hunter fees. Populations in national parks and nature reserves are reportedly protected. Partial protection is given to crocodiles in classified forestry areas (Pooley 1982). However, recent reports indicate that an overall hunting ban was established by Decree 325 PGRM (Klemm and Navid 1989).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: C-legislation

Dwarf crocodile (*Osteolaemus tetraspis*)

Status of Wild Populations: No recent survey data are available. This species is not listed by Pooley (1982) for Mali. It is reported by Waitkuwait (1989) to be present in the Baoule, Bagoe, and Kankelaba rivers, but no survey data are presented.

Management and Conservation Programs: The ban on crocodile hunting presumably applies to this species as well.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: C-legislation

Contact: Ms. Loriana Riccarelli Dembele

Mauritania

Slender-snouted crocodile

Slender-snouted crocodile (*Crocodylus cataphractus*)

Status of Wild Populations: Groombridge (1982) reports *C. cataphractus* from Mauritania. No additional information is available. Groombridge also reports that the Nile crocodile was formerly found in Mauritania but is now extirpated.

Management and Conservation Programs: No information.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: A-none

Contact: Mr. I. Thiaw

Mozambique

Nile crocodile

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: Several surveys were conducted in Mozambique during the 1980s, but the results in some areas appear contradictory. Whitaker (1981) did aerial surveys of the Zambezi delta and calculated a mean density of 0.26/km, which provided a population estimate of 620-1,313 (CITES 1989). Nocturnal spotlight counts by Tello (1985b) found an average density of 14.85/km, and an estimated population size of approximately 35,000.

Chande et al. (1989) conducted spotlight and aerial surveys of the upper Lake Cabora Bassa reservoir (Zumbo/Messenguezi Basins) before and after a cull (1987 and 1988) and found densities of 17.7-34.4/km (1987-spotlight count over 30 km of river), and 9.2-22.9/km (1988-spotlight (30 km) and aerial counts (116 km)). Total crocodile population size in the area was estimated to be 3,197-6,207.

Surveys in other parts of the country, as well as reports from Forestry/Wildlife personnel suggest that crocodiles are widespread in Mozambique.

Management and Conservation Programs: Since 1978, crocodiles can only be killed in defense of human life and property, or with a government hunting license. Crocodiles are completely protected in four national parks. Prior to 1985 cropping was restricted to sport hunting. However, under CITES Resolution Conf. 5.21, Mozambique was given a quota of 1,000 in 1985, which was not used (only two skins were exported in 1986). In 1987 the quota was extended, and in that year 1,000 crocodiles were cropped from Lake Cabora Bassa.

Attempts at crocodile ranching began in the early 1980s but were unsuccessful. In October, 1987, 1,800 eggs were collected from 96 nests, but subsequently died due to administrative delays. In December, 1987, a further 1,050 eggs were collected and the hatchlings transferred to rearing pens in Zimbabwe until sufficient facilities could be constructed in Mozambique (Chande et al. 1989). Subsequently, a crocodile ranch has begun operation on Bazaruto Island, and collection of 5,000 eggs was planned for 1988.

At the 1989 CITES conference, Mozambique requested and received a transfer of its Nile crocodile populations to Appendix II pursuant to Resolution Conf. 3.15 (ranching criteria). Mozambique also indicated that it would continue a limited amount of cropping, including the killing of nuisance crocodiles (Hemley 1989).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 5-not depleted
Management Program: C-legislation, E.2-ranching, E.1-cropping

Contact: R. Zohlo, I. Games

Namibia

Nile crocodile

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: No recent survey data are available. Present in the Kunene River in the northwest, and the floodplains of the Zambezi, Chobe, and Linyanti in the Caprivi area in northeastern Namibia where the populations of this species in 1980 were not considered to be endangered. Also present in the Okavango, where it was classified as endangered in 1980 (Pooley 1982).

Management and Conservation Programs: Crocodiles are legally protected in the Kavango area (partially), and in Kaokoland (fully) and Caprivi (fully) regions (Pooley 1982). Three farms were operational prior to 1989, but two closed down and only one currently remains (H. Kelly, in litt. June 11, 1990). This farm is located in Otijiwarongo, and contains 50 animals over 2 m long and 79 between 1.8 and 2 m. Breeding crocodiles were purchased from Botswana.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: C-legislation, E.3-farming

Contact: Dr. Eugene Joubert

Niger

Nile crocodile

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: No recent survey data are available. Distribution apparently restricted to the Niger River and some of its tributaries. Reported by one source in 1980 to be widespread but uncommon in reserves, this species is considered to be an endangered species by another source (Pooley 1982).

Management and Conservation Programs: A permanent hunting ban was established by decree in 1972 (Klemm and Navid 1989).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 3-severely depleted/endangered
Management Program: C-legislation

Contact: Mr. Anada Tiega

Nigeria

Slender-snouted crocodile
Nile crocodile
Dwarf crocodile

Slender-snouted crocodile (*Crocodylus cataphractus*)

Status of Wild Populations: No recent survey data are available. *C. cataphractus* is present in the Barkono River Gorge in the Yankari Game Reserve, where it was listed as not common. It is also listed in the Gaji and Yankari rivers (Pooley 1982).

Management and Conservation Programs: In the 1970s, this species was not protected under the Wild Animal Laws of Nigeria, but was officially protected in all game reserves (Pooley 1982). It is now officially protected under the Endangered Species Decree of 1985 (Klemm and Navid 1989).

Country Rating:
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: C-legislation

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: No recent survey data are available, although it was listed by Pooley (1982) as widespread but rare. Its decline has been attributed to hide hunting. Crocodiles are also kept in villages as objects of interest, for purported magical properties (Cott and Pooley 1972), or as status symbols or investments (for future sale of the hide) (Morgan-Davies 1980). Extremely poor quality artisanal leather goods made from *C. niloticus* hides were sold to tourists from Europe and North America in fair quantities all through the 1970s (F.W. King, pers. comm.).

Management and Conservation Programs: Although Nile crocodiles were not protected in the 1970s under the Wild Animal Laws of Nigeria, they were officially protected in all game reserves (Pooley 1982). They are now officially protected under the Endangered Species Decree of 1985 (Klemm and Navid 1989). A pilot restocking program was initiated by the Kyarimi Park Zoo in 1976 with the release of 15 crocodiles in the Gasaka Game Reserve. In 1979, 20 captive-bred juveniles were released in the Yim River in the Gumunti Game Reserve, and plans were made to release an additional 50 juveniles in the Pandam Game Preserve in 1980 (Morgan-Davies 1980).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: C-legislation only

Dwarf crocodile (*Osteolaemus tetraspis*)

Status of Wild Populations: No recent survey data are available. Dwarf crocodiles were reported to be rare in Western State in the early 1970s. The species was also reported from forested rivers and streams in East Central State (Pooley 1982).

Management and Conservation Programs: See *C. cataphractus* account above.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: C-legislation

Contact: Dr. Pius Anadu

Republic of South Africa

Nile crocodile

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: Pooley (1982) summarizes the known information on status and distribution up to 1980. In the Transvaal, crocodiles are found in all perennial rivers in Kruger National Park. Outside the park, populations are present in the Komati, Olifants, Blyde, Sabie, Letaba, Crocodile, and Limpopo rivers. Crocodile status outside Kruger National Park in 1980 was listed as vulnerable (Pooley 1982). A survey by Jacobsen (1984) revealed that crocodiles in the Transvaal outside Kruger National Park are widespread, but found in low densities. Aerial surveys located populations in seven rivers. The surveys, covering 2,146 km, found a mean density of 0.27 crocodiles/km. The highest observed density was on the lower Olifants River (1.13/km; 112 km surveyed). Based on an extrapolation from these data, the total population size in the Transvaal was estimated to be 4,000 individuals, of which 3,000 occur in Kruger National Park.

The Nile crocodile was at one time widely distributed throughout Natal province, and was especially numerous in the rivers of Natal province, such as the Tugela and Umfolozi rivers, and at St. Lucia. Currently, crocodiles are sparsely distributed throughout northern Natal from the Mozambique border south to the Tugela River. The major populations are found in the Ndumu Game Reserve and the Lake St. Lucia System. Based on aerial counts, the estimated crocodile population in Natal is about 4,500. Some information on population trends indicates that the crocodile populations in St. Lucia and Ndumu are relatively stable, whereas in other areas such as Lakes Sibaya and Mzingazi, reports indicate that populations are declining. In some areas there is evidence of organized poaching of crocodiles for traditional medicinal purposes (Blake 1990).

Management and Conservation Programs: Crocodiles in South Africa are protected under provincial, but not federal legislation. In Natal crocodiles are protected under the Nature Conservation Ordinance as amended in 1980. This legislation regulates the keeping of animals in captivity and allows for killing crocodiles in defense of human lives or property. In Natal, crocodiles were protected under the Reptile Protection Ordinance of 1968. Crocodiles in the Transvaal are protected under the Transvaal Nature Conservation Ordinance of 1983 (Klemm and Navid 1989). Property owners may hunt crocodiles on their own land without permits (Pooley 1982).

In Natal Province, some consideration has been given to restocking certain areas such as the Lake St. Lucia system, Pongolapoort Dam, and Lake Sibaya, but no action has been taken pending a feasibility study (D. Blake, pers. comm.)

The commercial management of crocodiles in South Africa is based on farming. A total of 28 farms were in existence in 1990, and captive breeding has been accomplished on 16 of these (H. Kelly, pers. comm.). Most reproductive stock has been obtained from other countries, particularly Zimbabwe and Botswana. Some problem crocodiles have been captured and sold to farmers by the Natal Parks Board (D. Blake, pers. comm.). In March, 1989, the total stock at six farms in Natal numbered 6,367, including 380 breeding animals.

Plans are being made to petition for reclassification of the South African crocodile population to Appendix II of CITES for the development of a ranching program (H. Kelly, pers. comm.). In 1988 the Natal Parks Board introduced a plan to collect eggs from vulnerable nests in the St. Lucia system. During the 1988-1989 season, eggs were collected from seven of the 123 nests located.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: E.3-farming

Contacts: David K. Blake, Dr. George R. Hughes, A.C. Pooley, M. Darazs, Andrew Ericksen, Jan-Gerd Kuhlmann, Johan Marais, Howard Kelly, Peter Watson

Rwanda

Nile crocodile

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: There are no recent survey data and the status of crocodiles in Rwanda is unknown.

Management and Conservation Programs: Hunting is permitted under license (Klemm and Navid 1989). A pilot crocodile farm was reported to have started in 1984 (Luxmoore et al. 1985).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: E.1-cropping, E.3-farming

Contact: Dr. Nicole Montfort

Senegal

Slender-snouted crocodile
Nile crocodile
Dwarf crocodile

Slender-snouted crocodile (*Crocodylus cataphractus*)

Status of Wild Populations: No recent survey data are available. Crocodile populations were reported to have collapsed in the 1970s. Illegal hunting has been the primary cause (Pooley 1982).

Management and Conservation Programs: All three species of crocodiles were protected in national parks, nature reserves, and forest reserves in 1971. Legislation totally protecting crocodiles was enacted in 1967 (Klemm and Navid 1989) and 1973 (Pooley 1982). Enforcement of these regulations has been largely ineffective.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 3-severely depleted/ endangered
Management Program: C-legislation

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: No recent survey data are available. Crocodile populations were reported to have collapsed in the 1970s. Illegal hunting has been the primary cause (Pooley 1982).

Management and Conservation Programs: See *C. cataphractus* account above.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 3-severely depleted/endangered
Management Program: C-legislation

Dwarf crocodile (*Osteolaemus tetraspis*)

Status of Wild Populations: No recent data are available, although the species is reported to be common in Parc National Niokolo Koba, and the Gambia River. Numbers were very low in the Parc National Delta du Saloum. Hide hunting was reportedly widespread in the 1970s (Pooley 1982).

Management and Conservation Programs: Legislation pertaining to *C. cataphractus* and *C. niloticus* presumably applies to this species also.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 4-depleted/vulnerable
Management Program: C-legislation

Contact: Mr. Assane Fall

Seychelles

Nile crocodile

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: Crocodiles were extirpated from the Seychelles by the last century. Nile crocodiles were reported to have been common in brackish coastal marshes as well as some inland swamps and streams of La Digue, Silhouette, and Mahé. The last crocodiles were killed prior to 1819 (Guggisberg 1972).

Management and Conservation Programs: None.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 2-extirpated
Management Program: B-none

Sierra Leone

Slender-snouted crocodile
Nile crocodile
Dwarf crocodile

Slender-snouted crocodile (*Crocodylus cataphractus*)

Status of Wild Populations: No recent survey data are available. The presence of this species in Sierra Leone has not been confirmed. Lowes (1970; in Pooley 1982) states that three species occur in the country, but are rarely seen. Cansdale (1955) reported the presence of *C. cataphractus* in Sierra Leone, but commented that it was much less abundant than *C. niloticus*, and was found in some saline mangrove habitats. It is listed as being present in the Moa and the Morro rivers by Waitkuwait (1989).

Management and Conservation Programs: The hunting of crocodiles is apparently authorized under license (Wildlife Conservation Act, 1972; Klemm and Navid 1989). A bag limit of 10 per person was established (Pooley 1982).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: E.1-cropping

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: No recent survey data are available. The account by Pooley (1982) suggests that a significant population decline has taken place because of commercial hunting and habitat loss.

Management and Conservation Programs: See *C. cataphractus* account above.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: E.1-unknown

Dwarf crocodile (*Osteolaemus tetraspis*)

Status of Wild Populations: No recent survey data are available. *O. tetraspis* is apparently found in a wildlife preserve being established near Mamunta in the country's northern province (Pooley 1982). It is listed as being present in the Jong River at Magburaka by Waitkuwait (1989).

Management and Conservation Programs: It is uncertain whether legislation pertaining to *C. cataphractus* and *C. niloticus* applies to this species.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: A-no information

Contact: Mr. Mohamed Bereteh

Somalia

Nile crocodile

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: Nile crocodiles are found in two river systems in southern Somalia: the Jubba and the Shabelle. A report of unknown validity suggests that crocodile population size in the Jubba is 45,000-150,000, and 30,000-70,000 in the Shabelle (Watson and Nimmo 1987). However, a very large correction factor was applied to the number of counted crocodiles to derive these estimates. Crocodiles are being killed frequently in both river valleys, including by the government (Fisheries Ministry) to protect fishermen (CITES 1989).

Management and Conservation Programs: Crocodiles are legally protected by Forestry Conservation Law No. 15 of 1989. The killing of crocodiles, collection of eggs, and rearing of young is prohibited. The government is considering establishing the Shabelle Swamp National Park (CITES 1989). For the first time in 1989 the Somalia population of *C. niloticus* was transferred to CITES Appendix II, with an annual quota (1990-1992) of 500 skins to be obtained through the cropping of problem animals.

Country Rating
Survey Data: II-surveys planned
Wild Population Status: 1-unknown
Management Program: E.1-cropping

Contact: John B. Sale, Dr. Abdillahi Ahmend Karani

Sudan

Nile crocodile

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: According to Pooley (1982) numbers were severely depleted by illegal hunting. Elobeid (1990) reported that an FAO survey in 1975 estimated Sudan's population numbered 1 million crocodiles.

Management and Conservation Programs: Partial legal protection conferred in 1970. Permits for killing crocodiles issued by the Dept. of Game and Fisheries (Pooley 1982). Sudan is a member of CITES, but until recently held a reservation on Nile crocodiles. This reservation was dropped effective 26 April 1990 (Anon. 1990). Sudan was given a 1989 quota of 5,040 skins at the 1989 CITES meeting in order to sell stockpiled skins. A quota of 5,000 was also established for 1990.

Country Rating
Survey Data: II-surveys planned
Wild Population Status: 4-depleted/vulnerable
Management Program: C-legislation, E.1-cropping

Contact: Major Ahmed Mohammed Elobied

Swaziland

Nile crocodile

Nile crocodile (*Crocodilus niloticus*)

Status of Wild Populations: The Nile crocodile is reported present in this small independent country that lies between South Africa and Mozambique (Groombridge 1982).

Management and Conservation Programs: No information.

Country Rating:
Survey Data: I-no surveys
Wild Population Status: 1-unknown
Management Program: A-unknown

Contact: A.C. Pooley

Tanzania

Slender-snouted crocodile
Nile crocodile

Slender-snouted crocodile (*Crocodylus cataphractus*)

Status of Wild Populations: No recent survey data are

available. In Tanzania this species occurs only in Lake Tanganyika and the Luichi and Malagarasi rivers. The species was considered to be vulnerable or threatened in 1980 (Pooley 1982).

Management and Conservation Programs: Crocodiles under 2 m long are legally protected under the Wildlife Conservation Act of 1974, which requires written permission from the Director of Wildlife for hunting (Pooley 1982).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: C-legislation

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: Nile crocodiles are reported to be widespread in Tanzania (CITES 1989). Recent surveys have been conducted of Lake Rukwa (Hiriji 1985), and in the Selous Game Reserve (Hutton and Katalihwa 1989, Games and Severre 1989). Total population size in Lake Rukwa was estimated to be approximately 5,000. Crocodiles are found at low to moderate densities (0.22-1.56/km; 479 km surveyed) in all the rivers in the vicinity of the Selous Game Reserve.

Management and Conservation Programs: The species is protected under the Wildlife Conservation Management Act No. 12, but the country has no policy or management plan (CITES 1989). Under CITES Res. Conf. 5.21 in 1985 the Tanzanian populations of *C. niloticus* were transferred to Appendix II to permit the export of skins under the quota system. The 1985-1986 annual quota was 1,000, and this was raised to 2,000 in 1987, and again to 3,500 in 1989. Exported skins are obtained from cropping wild populations outside national parks and game reserves. Most of the skins exported in 1986 came from Lake Rukwa (CITES 1989). At the 1989 CITES meetings, Tanzania sought an increase in their quota, but presented no population survey data. However, plans are being made to develop a ranching program and the following quotas were approved: 1990, 1,100 skins (1,000 wild, 100 trophies), 1991, 5,100 skins (4,000 ranched, 1,000 wild, and 100 trophies), and 1992, 6,100 skins (6,000 ranched, 100 trophies).

A crocodile farm opened in Tanzania in 1981 but closed down in 1985 because of the lack of an inexpensive food source (Luxmoore et al. 1985).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: E.1-cropping, E.2-ranching

Contact: Emmanuel Severre, Dr. Jon M. Hutton

Togo

Slender-snouted crocodile
Nile crocodile
Dwarf crocodile

Slender-snouted crocodile (*Crocodylus cataphractus*)

Status of Wild Populations: No recent survey data are available. Pooley (1982) reported that there was a marked population decline in the early 1970s.

Management and Conservation Programs: Crocodiles are considered to be predatory species and may be killed without control in farming or inhabited areas. Use of firearms to kill crocodiles is regulated by license (Decree 79-139 of 1979), as is the hunting of crocodiles in game management areas (Klemm and Navid 1989).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: E.1-cropping

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: No recent survey data are available. A population estimate of 1,000 is mentioned by Pooley (1982) for the northern part of the country in 1970. The population was reportedly declining in the 1960s and 1970s.

Management and Conservation Programs: Togo proposed the transfer of *C. niloticus* to CITES Appendix II in 1987, but provided no population data. Legal status of *C. niloticus* is as described above for *C. cataphractus*.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: E.1-cropping

Dwarf crocodile (*Osteolaemus tetraspis*)

Status of Wild Populations: No recent survey data are available. Listed as being present in the Mono and Oti rivers and Mare at Kini Kope (Waitkuwait 1989).

Management and Conservation Programs: See *C. cataphractus* account above.

Country Rating
Survey Data: I-no survey planned

Wild Population Status: 1-unknown
Management Program: E.1-cropping

Contact: Mr. Agbenuna Dogbe-Tomi

Uganda

Nile crocodile
Dwarf crocodile

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: No recent survey data are available. Intensive hunting and eradication efforts severely reduced population levels during the 1940s through the 1960s. Good populations existed prior to the early 1970s in the Kabalega Falls National Park (formerly Murchison Falls; Parker and Watson 1970, Cott and Pooley 1972). An outbreak of civil war led to much poaching throughout the country, but remnant populations were still found at Kabalega Falls and the Kidepo Valley National Park (Pooley 1982).

Management and Conservation Programs: Klemm and Navid (1989) report that licensed hunting was permitted under the Fish and Crocodiles Act of 1951. Pooley (1982) reported that hunting was banned in 1979.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: C-legislation

Dwarf crocodile (*Osteoleamus tetraspis*)

A single individual was reported from Uganda (Groombridge 1982). No other information is known.

Contact: Dr. Eric Edroma

Zaire

Slender-snouted crocodile
Nile crocodile
Dwarf crocodile

Slender-snouted crocodile (*Crocodylus cataphractus*)

Status of Wild Populations: No recent survey data are available from Zaire. Behra (1987b) surveyed the Ubangui River, which borders with the Congo and the Central African Republic. Corrected densities in this river ranged from 0.3-2.4/km along the Congo border, and 4.1/km along the CAR border.

Management and Conservation Programs: Hunting is permitted under license (Klemm and Navid 1989).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: E.1-cropping

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: No recent survey data are available from within Zaire. Local authorities stated in 1980 that the species was rare in estuaries but locally common and well protected in some areas (Pooley 1982). Behra (1987b) surveyed the Ubangui River which borders with the Congo and the Central African Republic. Corrected densities in this river ranged from 1.4-3.7/km along the Congo border, and 7.6/km along the CAR border. A new population of approximately 40-45 crocodiles (all under 2.5 m) was discovered in the Semliki River and in Lake Edward (Virunga National Park) about 100 km above the Semliki falls. Historically, crocodiles were unknown from this area. The population is reported to be stable (Verschuren et al. 1989).

Management and Conservation Programs: Nile crocodiles are protected by a 1968 ordinance that prohibits commerce in crocodiles without permission. Hunting licenses are issued by the Department of Agriculture, which collects a set fee per skin (Pooley 1982).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: E.1-cropping

Dwarf crocodile (*Osteolaemus tetraspis*)

Status of Wild Populations: No recent survey data are available.

Management and Conservation Programs: It is not known if legislation pertaining to *C. cataphractus* and *C. niloticus* also applies to this species.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: A-no information

Contact: Dr. Mankoto ma Mbaelele

Zambia

Slender-snouted crocodile
Nile crocodile

Slender-snouted crocodile (*Crocodylus cataphractus*)

Status of Wild Populations: No recent survey data are available. The species is present in the Luapula and Kalungwishi rivers, and in lakes Mweru, Mweru Wantipa, and Tanganyika (Pooley 1982, Hutton 1989a). Population levels in Lake Tanganyika are apparently very low (CITES 1989).

Management and Conservation Programs: The hunting of crocodiles in Zambia was regulated by license under the National Parks and Wildlife Act of 1968 (Klemm and Navid 1989). All crocodile hunting was banned in 1987 by presidential decree.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: C-legislation only

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: Extensive surveys have been conducted in several parts of Zambia. Crocodiles are reported to be widespread throughout the country, but densities are greatly reduced in settled areas. The Luangwa River has been surveyed six times between 1972 and 1986, and these surveys indicate a stable, high-density population (13.7/km in 1972 and 14.8/km in 1986). Howard (1989) estimated the population of crocodiles along 246 km of the Luangwa numbered 3,587. Total crocodile population size in Lake Mweru Wantipa in 1980 was estimated to be 4,466, but both *C. niloticus* and *C. cataphractus* were included. Since that time, heavy hunting pressure (legal and illegal) and egg collection has resulted in a substantial decline in population size (Hutton 1989a).

A night survey of Lake Tanganyika in Sumbu National Park found a density of 2.0/km (mostly adults), and located 56 nests along 68 km of shoreline. Crocodile numbers are low and most nests are destroyed outside protected areas on the lake. An aerial survey of 40 km of the Zambezi river in 1988 spotted 173 crocodiles along the protected Zimbabwe shore but only three along the settled Zambian side (Hutton 1989a).

Night counts along six km of the Kafue River in 1981 estimated a mean density of 16.33/km (CITES 1989).

Management and Conservation Programs: Considered to be a game animal under the National Parks and Wildlife Act. Hunting of Nile crocodiles requires a license and the possession of hides requires a certificate of ownership. Approximately 1,000 crocodiles were legally cropped in Lake Mweru Wantipa in 1980, but cropping was discontinued until 1985, when the Zambian population was conditionally transferred to CITES Appendix II and a quota of 2,000 was established. In 1987, following the successful application for an annual quota of 2,000 crocodiles, the hunting of crocodiles was banned by the President of Zambia (Hutton 1989a). Sport (safari) hunting is still being considered as a viable management alternative. At the 1989 CITES conference, Zambia indicated that it would continue with a limited amount of cropping, including the removal of nuisance crocodiles (Hemley 1989).

Zambia currently has seven crocodile ranches, but ranching success has been very mixed (Hutton 1989a). At the 1989 CITES conference the Zambian crocodile population was transferred to Appendix II under the ranching criteria, so no CITES imposed limitations of exports are in effect. The 1989 egg quota is 18,000 and is divided among the ranches as follows: Kasaba Bay Crocodile 2,500/yr. (Lake Tanganyika), Lake Tropicals Limited 2,000/yr. (Lake Mweru Wantipa), Luwanga Crocodile Ranch 5,500/yr. (Luangwa, Lunga, and Kabompo rivers), Kariba Crocodile and Fish Ranch 2,000/yr. (Kafue River and lower Zambezi), Sumbu Crocodile Ranch 2,000/yr. (Lake Kariba), Kalimba Crocodile Ranch 2,000/yr. (Luangwa, Lukusashi, and Lunsenfwa rivers), Siansowa Crocodile Ranch 2,000/yr. (Lake Kariba). All ranches are required to release 5-10% of the crocodiles that reach a length of 50 cm.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: E.2-ranching, E.1-cropping

Contact: Dr. M.P. Simbotwe, Keith Asherwood, Peter Taylor, Dr. Jon M. Hutton

Zimbabwe

Nile crocodile

Nile crocodile (*Crocodylus niloticus*)

Status of Wild Populations: Crocodiles are found in two distinct areas in Zimbabwe. The largest population occurs in the northern region of the country in the Zambezi River, part of which has been dammed to form Lake Kariba. A smaller crocodile population is located in the lowveld region of southeastern Zimbabwe. Crocodile populations have increased substantially in suitable areas since the early 1960s (Child 1987, Hutton 1987).

The total crocodile population in Zimbabwe in 1982 was estimated to be 50,000, with approximately 40,000 being found in the Zambezi River and Lake Kariba (Taylor et al. 1982). Taylor (1987) calculated a crude density of 5.59 crocodiles/km of shoreline for Lake Kariba for the period 1982-1985, resulting in a crude population estimate of approximately 11,000 crocodiles for the entire lake. Using correction factors the total population was calculated to be nearly 32,000, but Taylor (1987) concludes that the actual population size is somewhere between these two figures. No counts have been made to estimate the size of the crocodile population in the Zambezi River below Lake Kariba as this population is not exploited (Hutton 1987). The crocodile population in the lowveld region of southeastern Zimbabwe is possibly less than 4,000 (Hutton 1987).

Management and Conservation Programs: Zimbabwe's

population of Nile crocodiles was transferred to CITES Appendix II pursuant to Resolution Conf. 3.15 (ranching criteria) in 1983. Management of crocodiles in Zimbabwe is based on non-consumptive use (tourist value), a small trophy hunting program, a large-scale ranching program based on the annual collection of eggs from the wild, and a smaller-scale farming program using problem animals caught from the wild as breeders. Crocodiles are fully protected in all national parks and in the Ngezi Recreational Area, but the collection of eggs for ranching programs is permitted in all Safari Areas and other areas under the control of the Department of National Parks and Wild Life Management (Child 1987). Presently, 14 crocodile ranches are in operation. Each ranch is assigned a yearly quota of eggs and a specified area for egg collection. Most of the ranches are located in the north and collect from the Lake Kariba area, but some small ranches have started in the lowveld also. Eggs are collected as early as possible during incubation, and are incubated in vermiculite in Styrofoam boxes inside insulated buildings at approximately 32° C. Original regulations required ranches to return 10% of the crocodiles reared to 1 m long back into the wild, but this proportion was later reduced to 5%. A total of 910 animals were released into the wild, but in recent years this has not been done as crocodile populations were increasing naturally.

The total adult breeding stock reported in 1984 was 278. Farmed eggs accounted for at least 20% of the eggs obtained during the period 1979-1983. Hatching success of farmed and ranched eggs has generally been high (70-80%; Child 1987).

Crocodiles are reared primarily in concrete pens to a total length of approximately 1.5 m. Belly and hornback skins are salted and prepared for export raw (untanned). No market exists for the meat so the eviscerated carcasses are fed back to the crocodiles. Crocodile heads and feet are made into curios for sale to tourists (Child 1987).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 5-not depleted
Management Program: E.2-ranching, E.3-farming

Contact: I. Games, Dr. Jon M. Hutton, Dr. John P. Loveridge, Kevin van Jaarsveldt, Dr. Chris Foggin, Robert Gee

Country Accounts
Asia

Australia

Australian freshwater crocodile
Saltwater crocodile

Australian freshwater crocodile (*Crocodylus johnsoni*)

Status of Wild Populations: *Crocodylus johnsoni* is a medium-sized Australian endemic restricted primarily to freshwater habitats. Population densities vary significantly between areas, but the overall population size in the Northern Territory was estimated by Webb et al. (1987) to be in the 30,000-60,000 range. In Western Australia, freshwater crocodiles are restricted to the Kimberly region, but are reported to be abundant. Although there was widespread hunting in the past (Bustard 1970), some remote populations may never have been hunted (Burbidge 1987). Recent surveys commissioned by the Department of Conservation and Land Management resulted in estimates of 35,700 *C. johnsoni* in the Ord and Fitzroy Rivers and the large impoundments associated with them. The total population is thought to be in excess of 50,000 (G. Webb, in litt. May 29, 1990). The species has been termed "abundant" in Queensland, although no systematic surveys of the population have been undertaken (Taplin 1987).

Management and Conservation Programs: This species is protected throughout its distribution in northern Australia. Export of crocodiles or crocodilian products is prohibited under the Wildlife Protection (Regulation of Exports and Imports) Act of 1982. In the Northern Territory, 1,532 *C. johnsoni* hatchlings were harvested in 1980-1981 during initial field trials (Webb et al. 1987, Conservation Commission of the Northern Territory (CCNT) 1989). In 1982, 4,573 were harvested in a commercial-scale trial in eight management areas split between the crocodile farms. The extent of the annual harvest has varied from year to year, with a total of 19,506 hatchlings being harvested between 1980 and 1989 (Webb et al. 1987, CCNT 1989, Manolis and Webb 1990, Webb et al. 1990a).

A commercial egg collection program initiated in 1983 resulted in 1,563 eggs being harvested, and allowed a comparison of the merits of egg harvesting versus hatchling collection. In some areas egg harvesting is more efficient, and between 1983 and 1989, 8,532 eggs have been harvested from the management areas (CCNT 1989, Webb et al. 1990b) and an additional 787 eggs were taken for incubation experiments in 1989 (Webb et al. 1990b).

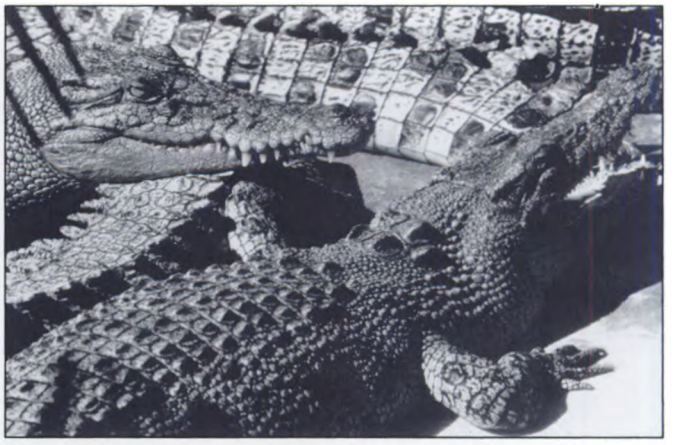
Technicians weigh a wild freshwater crocodile, *Crocodylus johnsoni*, at McKinley River, Northern Territory, Australia (Photo by G.J.W. Webb).

Population monitoring in the hatchling and egg collecting areas is being carried out by nocturnal spotlight counts and helicopter surveys during the annual dry season. To date, results indicate that populations have continued to increase regardless of the harvest (CCNT 1989, Webb et al. 1990b). The development of the management program for this species in the Northern Territory has been accompanied by, and is based on,

a large-scale research program, which has investigated many aspects of the ecology of this species (for summary see Webb et al. 1987).

Four crocodile farms in the Northern Territory and two in Queensland are currently rearing *C. johnsoni*. Most farms rely largely on wild-produced young, but at Crocodile Farms N.T. 25 nests were laid in 1987, 22 in 1988, and 23 in 1989 (Webb and Manolis 1990, Webb et al. 1990b). The total captive stock in the Northern Territory farms in 1983 was 6,777 (Luxmoore et al. 1985), and in 1989 was 9,183 (Webb et al. 1990b).

Country Rating
Survey Data: IV-widespread survey data
Wild Population Status: 5-not depleted
Management Program: E.2-ranching, E.3-farming



Saltwater crocodile, *Crocodylus porosus*, on a crocodile farm in the Northern Territory, Australia (Photo by G.J.W. Webb).

Saltwater crocodile (*Crocodylus porosus*)

Status of Wild Populations: One of the most extensive census programs for any species of wildlife was conducted for *C. porosus* by the University of Sydney, with assistance from State and Territory governments. The surveys were taken in the tidal waterways of northern Australia by Messel and co-workers. The results of these surveys have been published as a series of 20 monographs (Messel et al. 1978-1987). From 1975-1979 approximately 100 river systems were systematically surveyed in the Northern Territory, Western Australia, and Queensland (Messel et al. 1981-monograph 1). These areas were resurveyed during 1980-1987 (Messel and Vorlicek 1989b). The results of these surveys have provided considerable information not only on population status, but on behavior and ecology as well. The Conservation Commission of the Northern Territory began supporting ecological investigations in the late 1970s, and has continued an extensive survey-monitoring program since that time. Queensland National Parks and Wildlife Service and the Western Australian Department of Conservation and Land Management have both continued some monitoring.

An extensive survey database now exists for *C. porosus* within Australia, especially in the Northern Territory. Within tidal riverine habitats in the Northern Territory, spotlight count data now span some 15 years. During the early 1980s some recovery was noted on certain river systems (e.g. Alligator River region and the Adelaide River system), and a 1984 non-hatchling population estimate for the Northern Territory was 12,000, up 2,000 from 1979. Populations from the Adelaide River westward to the Western Australia border were found to be stable or decreasing in number. Populations in the Gulf of Carpentaria (apart from the Roper and Towns rivers), were considered to be near extinction level (Messel et al. 1978-1987).

However, by the mid-1980s, a general recovery trend was evident. Webb et al. (1989) consider that population recovery began within the first 2-5 years after protection of the population in 1971. Although crocodile densities between river systems were highly variable, an analysis of data for the tidal river population as a whole, spanning 14 years (1975-1988), showed a mean annual increase of 8.3% per year for "all" crocodiles and 9.7% per year when only non-hatchlings were considered.

Total population size in the Northern Territory was variously estimated to be 12,000 non-hatchlings (Messel and Vorlicek 1989b) to at least 30,000 and "probably closer to 40,000" (hatchlings, non-hatchlings, and captive)(Webb et al. 1984). Much of this difference resulted from different interpretations of the number of crocodiles in unsurveyed habitats, and the inclusion of hatchlings and captive animals in the estimates of Webb et al. (1984).

Populations in Western Australia are steady or increasing in some rivers (Messel et al. 1987, Monograph 20). Messel and Vorlicek (1989b) estimated the 1979 non-hatchling population in the Kimberley region to be 2,500. In Queensland, crocodiles are still widespread and common, but population recovery since protection has not been as great as in the Northern Territory (Taplin 1990). Messel and Vorlicek (1989b) estimated the 1979 non-hatchling population to be 3,000 in northern Queensland. Although more recent survey data from Queensland are available (Taplin 1990), no revised estimate of total population has been offered. Habitat loss on the Queensland eastern coast is now a major concern.

Management and Conservation Programs: Full protection for the saltwater crocodile began in 1971 in Western Australia, 1972 in the Northern Territory, and 1974 in Queensland (Groombridge 1982). A national ban on import and export began in 1972 (Messel, pers. comm.). Extensive field and laboratory research into virtually all aspects of the biology of *C. porosus* have been conducted by Messel and co-workers of the University of Sydney, and more recently by the Conservation Commission of the Northern Territory. As a result, *C. porosus* is one of the best-known crocodilians from an ecological standpoint. Because of the effective protection of wild populations and the large-scale research and management program, the Australian population was moved from CITES Appendix I to Appendix II in 1985. The establishment of Kakadu National Park was a major conservation achievement for crocodiles.

Capture of saltwater crocodile, *Crocodylus porosus*, for research, Hardees Creek, Northern Territory, Australia. Continued monitoring and research provide the basis for controlling exploitation at a sustainable level in Australia (Photo by G.J.W. Webb).

This park contains the largest system of crocodile breeding rivers in northern Australia, and has been the site of the most significant population recovery (Messel et al. 1986, Monograph 19).

Until recently, management of *C. porosus* in Western Australia was based on the protection of wild populations and had no utilization component (Burbridge 1987). However, a permit for the establishment of one commercial ranching operation at Wyndham was recently issued. Aside from the presence of privately owned commercial farms, crocodile management in Queensland has no commercial component (Taplin 1987). To deal with the increasing number of complaints from the public, a problem crocodile program was initiated along the populated eastern coast (Taplin 1990). Messel et al. (Monographs 16 (1981), 20 (1987)) has strongly recommended the establishment of marine parks in both of these states.

After the reclassification of Australian *C. porosus* onto CITES Appendix II, a ranching program was begun in the Northern Territory. This program is based on the collection of eggs. Experimental harvests were conducted in 1983-1984 (994 eggs), 1984-1985 (3,517 eggs) and 1985-1986 (3,470 eggs). Follow-up spotlight surveys found no negative impacts on population size of juvenile crocodiles (Webb et al. 1989). Egg harvests in more recent years have been: 1986-1987 4,293 eggs, 1987-1988 4,509 eggs (Manolis and Webb 1990). The eggs are incubated by research staff of the Conservation Commission. Because no negative impacts on wild populations were noted, the egg collection program was expanded in the 1988-1989 season, with 6,497 eggs (total viable and non-viable) collected (Webb et al. 1990b). To date, collections have been experimental in nature and have been carried out by the Conservation Commission, with the sale of hatchlings to crocodile farms paying for the research. Plans now allow increased landowner participation in the egg collection program (Webb et al. 1987, Manolis and Webb 1990).

Problem or nuisance crocodiles are captured alive and distributed among commercial crocodile farms or relocated. In the two calendar years 1988 and 1989, 278 problem *C. porosus* were dealt with: 221 went to farms, 52 were were relocated in the wild, 4 died at capture, and 1 was shot.

Presently there are eight commercial *C. porosus* farms in Australia (four in the Northern Territory, three in Queensland, and one in Western Australia). Five are operating as ranches, obtaining wild stock as hatchlings (from egg collection) or adults (problem animals). However, captive breeding is occurring at several farms. At Crocodile Farms N.T., 41 *C. porosus* nests were laid during the 1986-1987 nesting season, of which 37 were in 1987-1988, and 61 in 1988-1989. The Edward River Farm (established 1973) in Queensland began as a conservation program, and originally most of its animals were released back into the wild. In 1979, ranching operations ceased and the farm became the first closed-cycle breeding operation in Australia. Commercial operation began in 1984 (Luxmoore et al. 1985).

The Conservation Commission of the Northern Territory has designed regulations for the preparation of crocodile meat and the monitoring of skin and meat commerce. The first skins were exported from the Northern Territory in 1987. Skins go mostly to the Japanese market, while meat is consumed domestically (Manolis and Webb 1990).

Country Rating
Survey Data: IV-widespread survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: E.2-ranching, E.3-farming

Contact: John Bache, Melvin Bolton, Harvey Cooper-Preston, Warren Entsch, Harry J. Freeman, Prof. Gordon Grigg, Robert W.G. Jenkins, Bill Freeland, Dr. Colin Limpus, John Lever, S. Charlie Manolis, Prof. Harry Messel, J.T. Victor Onions, Dr. John Shield, Dr. Grahame J.W. Webb

Skinning farmed crocodiles at Edwards River crocodile farm, Queensland, Australia. This model farm provides employment for local aboriginals (Photo by G.J.W. Webb).

***Crocodylus porosus* hatching, Northern Territory, Australia. Successful breeding and incubation of captive crocodiles is the basis of many farming and ranching programs (Photo by G.J.W. Webb).**

Bangladesh

Mugger
Saltwater crocodile
Gharial

Mugger (*Crocodylus palustris*)

Status of Wild Populations: No recent survey data are available. This species is thought to be virtually extirpated in the wild, but approximately 10 individuals remain in a pond in a shrine in the Khulna District (Whitaker 1982, 1986). Reproduction was reported in this pond (the Peer Khan Jahan Ali Pond in Bagerhat) by Rahman (1990), who reports the presence of an adult pair and four juveniles. Whitaker and Whitaker (1989b) list the total wild population in Bangladesh as five.

Management and Conservation Programs: Muggers are protected by the 1973 Wildlife Preservation Act (Klemm and Navid 1989). Rhaman (1990) reports a small breeding group (2 males, 1 female) in the Dhaka Zoo.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 3-severely depleted/endangered
Management Program: C-legislation

Saltwater crocodile (*Crocodylus porosus*)

Status of Wild Populations: Whitaker (1986) states that small numbers of this species survive in the mangrove forests of the Sundarbans. Akonda (in litt. May 4, 1990) cited a 1982 report by Khan with a total population figure of 200 for the Sundarbans, and that crocodiles have been reported from the coastal rivers of Barisal and Chittagong, including Chakaria Sundarbans. Rahman (1990) estimated a much smaller population of *C. porosus* in the Sunderbans (10 adult males, 22 adult females, and 8 juveniles).

Management and Conservation Programs: Protected by the 1973 Wildlife Preservation Act (Klemm and Navid 1989).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 3-severely depleted/endangered
Management Program: C-legislation

Gharial (*Gavialis gangeticus*)

Status of Wild Populations: Whitaker (1986) reports that small breeding populations of gharial remain in the Padma and Jamuna rivers in Rajahahi District. Rahman (in litt. Oct. 22, 1985) reported that on the basis of nocturnal counts, approximately 20 adult gharial remain in the Padma, and only a few survive in the Jamuna. Rahman (1990) lists the population of gharial in the Padma, Jamuna, and Brahmaputra rivers in Bangladesh as 2 adult males, 12 adult females, and 6 juveniles. Two breeding groups were reported on the Padma, and during the period 1982-1985, a total of 12 nests was found. Gharial drown in fishing nets, and eggs are dug up and destroyed (Rahman 1985).

Management and Conservation Programs: Gharial are protected by the 1973 Wildlife Preservation Act (Klemm and Navid 1989). Plans were being made in the mid-1980s to establish a protected enclosure for gharial breeding at the mouth of the Baral River, a tributary of the Padma (Rahman 1985), but this project apparently was never undertaken for lack of funding.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 3-severely depleted/endangered
Management Program: C-legislation

Contact: Md. Mokhlesur Rahman, Dr. Mod. A. Reza Khan

Bhutan

Gharial

Gharial (*Gavialis gangeticus*)

Status of Wild Populations: No recent survey data are available. The gharial was historically found in the Manas River, a tributary of the Brahmaputra, in Bhutan. A survey by Bustard (1980) suggests that this species has been extirpated, although a 1.5 m long individual was released in the Manas in 1977. The last adult was reportedly seen in 1964.

Management and Conservation Programs: No information is available.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 2-extirpated

Management Program: A-no information

Contact: Mr. Gopal Mahat

Brunei

Saltwater crocodile

Saltwater crocodile (*Crocodylus porosus*)

Status of Wild Populations: No recent survey data are available. King et al. (1979) reported that scattered specimens of *C. porosus* were seen in coastal mangrove and Nipa palm swamps. The Siamese crocodile, *C. siamensis*, was reported to be widespread in the Indonesian islands, including Borneo, by Ross (1986), but no substantiated records from Brunei exist.

Management and Conservation Programs: Legal status of crocodiles is uncertain, but they are apparently unprotected (Klemm and Navid 1989). The purchase of young crocodiles by operators of commercial rearing stations was reported by King et al. (1979).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: B-none

Cambodia

Saltwater crocodile
Siamese crocodile

Saltwater crocodile (*Crocodylus porosus*)

Status of Wild Populations: No recent survey data are available. Virtually nothing is known concerning crocodilians in this country.

Management and Conservation Programs: The legal status of this species is unknown. No management programs are known to be in operation.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: B-none

Siamese crocodile (*Crocodylus siamensis*)

Status of Wild Populations: No recent survey data are available. The species' current status in Cambodia is unknown, although extensive habitat exists around the Tonle Sap (great lake). According to Smith (1931) it was common in the early part of the century. Approximately 2,000-3,000 specimens of *C. siamensis* are reported to be exported live to crocodile farms in Thailand (R. Luxmoore, pers. comm.) indicating that some wild populations still exist. An IUCN conservation program in Cambodia is gathering information on distribution.

Management and Conservation Programs: Unknown.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: B-none

Contact: Mr. Chan Sarun, Dr. Rick Salter

China (People's Republic of)

Chinese alligator
Saltwater crocodile

Chinese alligator (*Alligator sinensis*)

Status of Wild Populations: The present distribution of this species is limited to the lower Yangtze River, principally in Xuancheng, Zhejiang, and Jiangau Provinces, which represents approximately one-tenth of its former distribution (Watanabe and Huang 1984). The total wild population size in the Xuancheng region was estimated to be only 300-500 and declining (Watanabe and Huang 1984). A 1983 count by research workers in several counties estimated total population size to be 500 (Chen 1990a).

Habitat destruction has been the most important factor contributing to the decline of Chinese alligator populations. However, alligators have also been widely killed as agricultural pests, for food, for hide or medicinal products, and in poisoning campaigns aimed at eradicating blood flukes (Chen 1990a). Climatic change may have played an important role in the extirpation of the alligator from the northern part of its historical range. Recent floods and droughts have also made certain habitats uninhabitable for alligators, and environmental pollution has had a negative effect on prey availability (Chen 1990a).

Most alligators are today found in agricultural communes in low-lying areas, or in isolated reservoirs in tree farm communes at elevations below 100 m. In both of these areas the alligators are coexisting with dense human populations, and this is partially facilitated by the alligators' extensive use of underground burrows. Populations of alligators in riverine habitats were reported to be virtually wiped out by extensive flooding in 1957 (Watanabe 1982). Human population pressures, habitat destruction, and the killing of wild animals take place despite the legal protection of the species (Watanabe and Huang 1984).

Of the estimated 500 wild alligators in 1983, 200 were captured (Chen 1990a) and an unknown fraction of these were placed in captivity. The collection of eggs from the wild also reveals a downward trend in population size (270 eggs collected in 1982, 278 eggs in 1983, 154 eggs in 1984, and 85 eggs in 1985), and few of these eggs were reported to hatch normally

(Chen 1990a). However, in Xuancheng, Nanling, and Jingxian counties, alligator reproduction has been observed and the wild populations are reported to be recovering.

Management and Conservation Programs: Alligators are an officially protected species in China (Klemm and Navid 1989). Agricultural communes in southern Anhui province have been declared to be alligator preserves, but this offers, at best, very limited protection (Watanabe and Huang 1984). Several captive rearing centers have been established; in 1983 a total of seven were operational (Luxmoore et al. 1985). Initially, some of these rearing programs were a drain on wild populations as farms were paying for alligators and alligator eggs (Watanabe and Huang 1984). The largest farm is the Xiadu alligator farm in southern Anhui province, which started operations in 1979 and by 1983 had a stock of more than 100 adult alligators. Initially, the only captive breeding being done was in zoos (Shanghai Zoo, Ningpo Zoo), and all of the farms were relying on eggs collected from the wild. More recently captive breeding has been achieved outside the zoos. At the Xiadu farm (Anhui Research Center of Alligator Reproduction) successful captive breeding was first attained in 1982, and by 1988 captive breeding of second generation captive alligators had been reported, and approximately 800-1,000 young were being hatched each year (Zhang 1989, Huang 1989). Egg production has increased dramatically since 1983: 1983-264 eggs, 1984-809 eggs, 1985-809 eggs, 1986-801 eggs, 1987-1,045 eggs, 1988-1,219 eggs (Chen 1990a). Although initially husbandry techniques were rather poor (Watanabe and Huang 1984), by 1983 the survival rate of young increased to 95%, nesting rate had increased to 67% (from 14%), and eggs had a 90% fertility rate (Zhang 1989). The total number of captive-produced alligators in 1987 was 975 (Chen 1990a).

The captive rearing programs are ostensibly conservation oriented, but as yet no restocking has taken place, and indeed no mention of future plans for alligator releases has been made in reviews of the alligator conservation program (e.g., Chen 1990a). Extreme human population pressures on the little remaining wild habitat make this a difficult undertaking.

Captive breeding and rearing of Chinese alligators in the United States is being coordinated through the Rockefeller Wildlife Refuge (Louisiana) and the New York Zoological Society (Behler and Brazaitis 1982). The present (May 1990) studbook population of animals outside of China numbers 123 animals. Of these, 84 (5 males, 19 females, and 60 juveniles) are present in 13 North American collections. This species has been repeatedly bred at the Bronx Zoo, Rockefeller Wildlife Refuge, and at the St. Augustine Alligator Farm in Florida, U.S.A. The New York Zoological Society is currently exploring the possibility of exchanging young produced in U.S. institutions for animals hatched on Chinese farms since the U.S. population is derived from only seven founders (J. Behler, pers. comm.).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 3-severely depleted/endangered
Management Program: E.3-farming

Saltwater crocodile (*Crocodylus porosus*)

Status of Wild Populations: The presence of this species in China is based on historical records. No current information is available on their status. Pope (1935) considered the crocodile already extirpated from China, but Whitaker (1982) suggests a remnant few may remain in Kwangtun province.

Management and Conservation Programs: Unknown.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: A-no information

Contact: Chen Bihui, Huang Chu-Chein, Li Yangwen, Wang Sung, Shih Ying-hsien, Zhang Zhengdong, John Behler

India

Mugger
Saltwater crocodile
Gharial

Mugger (*Crocodylus palustris*)

Status of Wild Populations: According to Whitaker (1987) *C. palustris* is widely distributed, but populations are mostly small and isolated. Total population size in India was estimated by Whitaker and Whitaker (1989b) to be 2,000-3,000. Two of the largest remaining populations are in the Gir Sanctuary (Hiran Lake, Gujarat State) with approximately 30 nesting females, and in the Amaravathi Reservoir in the Anamallais Sanctuary (Tamil Nadu State) with 16 nesting females. Prior to the beginning of the reintroduction program (see below), the total *C. palustris* population in Tamil Nadu was estimated by Whitaker and Daniel (1980) to be no more than 200. Large populations are also reported by Choudhury (pers. comm.) to be found in the Ranthambore and Jawa reservoirs in Rajasthan state. Populations in other states were considerably lower.

Management and Conservation Programs: All three species of crocodilians were protected in 1972 under the Wildlife Protection Act, which forbade hunting and exports. Ratification and implementation of this act was delayed for up to 10 years in some states (Whitaker 1987). Beginning in 1975 the government of India embarked on a milestone conservation program for its three species of crocodilians. With technical support from FAO (until 1982), the program focused on the collection of eggs from wild nests, and the rearing of the young in captivity. After attaining a size of approximately 1-1.5 m total length the animals are released into protected areas to speed population recovery. The initial recovery efforts for *C. palustris* were made by collecting eggs in the states of Guajarat and Tamil Nadu in cooperation with personnel from the Madras Crocodile Bank. Prior to 1984, 9,000 *C. palustris* eggs had been collected (Singh et al. 1986a). Captive breeding of this species

has also been accomplished at 25 different zoos and rearing centers throughout India (Choudhury, pers. comm.). According to Whitaker and Whitaker (1989b), by 1986 a total of 3,300+ juveniles had been produced through captive breeding and 4,775+ through the egg collection program. By 1984 approximately 600 juvenile *C. palustris* had been released (Singh et al. 1986a), and for 1990 this figure is 1,000+ (Choudhury, pers. comm.). Present captive stock numbers in excess of 15,000 (Whitaker 1990). Resightings of mugger released in the Similipal Preserve in Orissa have ranged from 12.1% in the Budhabalanga River to 34.7% in the West Deo River to 71.6% in the Khairi River (based on March 1990 reports; Rath et al. 1990).

Many of the mugger crocodiles used in release programs throughout India have originated from the southern state of Tamil Nadu. This activity was questioned on genetic grounds because it could result in the intermixing of geographically distinct forms. However, as the first priority of the program was to re-establish wild breeding populations, and in many areas wild populations no longer existed, it was felt that this release protocol was justified (Whitaker and Whitaker 1989a).

A total of 28 national parks, wildlife reserves, or crocodile sanctuaries have been designated in 11 states (Madhya Pradesh, Uttar Pradesh, Gujarat, Orissa, Tamil Nadu, Bihar, Andra Pradesh, Kerala, Karnataka, Rajasthan, and Maharastra) for the management of *C. palustris* (Singh et al. 1986b).

Restocking has declined in recent years, resulting in a large number of excess crocodiles being maintained at the captive rearing centers. The limited number of release sites as well as fears of human-crocodile conflicts have been the principal cause of the slow-down in releases (Whitaker and Whitaker 1989a, Singh et al. 1990). Interest is now developing for the commercial rearing of this species, but to date this has been opposed by the government.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: D-restocking/reintroduction

Saltwater crocodile (*Crocodylus porosus*)

Status of Wild Populations: This species was formerly present in areas of suitable habitat along the entire eastern coast and up the western coast to the vicinity of Cochin (Kerala State). Breeding populations of *C. porosus* are now restricted to the northeastern coastal region (Orissa and West Bengal States) and in the Andaman and Nicobar Islands. The largest known population, numbering approximately 450 individuals of all sizes, is located in the Bhitarkanika Sanctuary at the mouth of the Mahanadi River in Orissa State (Rath et al. 1990). During egg collection in 1990, 12 *C. porosus* nests were located in Bhitarkanika (Kar 1990b). In the Andaman and Little Andaman Islands, remnant populations are still located in the extreme north and west of North Andaman, and on a few adjacent offshore islands, and on the southern and western coasts of South Andaman. A population remains in the Jarawa Tribal Reserve but cannot be surveyed at present as local tribes controlling the area will not allow entry. Small but untouched populations still remain in parts of the Nicobars (Whitaker 1987).

Management and Conservation Programs: *C. porosus* is legally protected under the Wildlife Protection Act of 1972. A head-starting program similar to the one for *C. palustris* is in effect for *C. porosus*. Centers for *C. porosus* conservation were established in the Bhitarkanika National Park (Orissa), as well as in Port Blair (Andaman Islands), and adjacent to the Sunderbans Tiger Reserve. The principal functions of these centers was to locate *C. porosus* nests, collect eggs, and rear the young for restocking programs. By 1984, captive breeding had been attempted at five breeding centers, and had been successful at two: the Bhagabatur in West Bengal and the Madras Crocodile Bank in Tamil Nadu. As of 1984 a total of 2,500 *C. porosus* eggs had been handled, and 415 crocodiles released back into the wild (Singh et al. 1986a). This work has continued, and by 1989 a total of 3,000 eggs had been collected and 1,050 crocodiles released into the Bhitarkanika National Park (Kar 1989). Some of the released crocodiles began breeding during the 1989 nesting season (Kar 1990a). In 1990, four released *C. porosus* nested (Kar 1990b). Surveys in March 1990 revealed that 40.0% of the released crocodiles are still in the park.

More than 200 crocodiles of approximately 2 m length are to be released into the Kujang area, at the delta of the Mahanadi River (adjacent to the Bhitarkanika National Park) following the rainy season in 1990 (Kar 1990b). Four sites (three crocodile sanctuaries and one tiger reserve) have been designated as protected areas for the management of *C. porosus* (Singh et al. 1986b, Whitaker 1987).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 3-severely depleted/endangered
Management Program: D-restocking/reintroduction

Gharial (*Gavialis gangeticus*)

Status of Wild Populations: Prior to the initiation of conservation efforts in the mid-1970s world populations of gharial were extremely low. Total population in 1974 was estimated to be approximately 250. Since that time the release program in India has significantly increased overall population size to over 2,500, with 1,000+ alive in the wild (Whitaker and Whitaker 1989b). The largest gharial population in India is in the National Chambal Sanctuary along the Chambal River, which is 600 km long and runs through the states of Uttar Pradesh, Madhya Pradesh, and Rajastan. Surveys in the Chambal conducted by Rao (1988, 1990) indicate gharial density has increased from 1.08/km in 1983-1984 to 1.89/km in 1988. Increases in the number of nests have also been observed. The total number of individuals spotted during the 1987-1988 surveys was 804. Eggs are collected for the head-starting program but natural recruitment is also taking place (Rao 1988, 1990).

Smaller gharial populations remain in other parts of India including: Katerniyaghat (Uttar Pradesh), Sathkoshia Gorge

Gharial, *Gavialis gangeticus*, breeding stock at Madras Crocodile Bank, **India. Successful captive breeding and release programs have made the future of this species more secure (Photo by H. Andrews).**

(Mahanadi River, Orissa), Corbett National Park (Uttar Pradesh), and in small sections of the Son and Ken rivers in Madhya Pradesh (Whitaker and Whitaker 1989b). The population in the Mahanadi River is 25, which represents only 4.5% of the gharial released at this site (Rath et al. 1990).

Management and Conservation Programs: Gharial are legally protected under the 1972 Wildlife Protection Act. Egg collection for head-starting programs began in 1975 with the collection of eggs from a nest on the Girwa River in Uttar Pradesh. Subsequent efforts were made to locate nests and collect eggs in other parts of India, and some eggs were collected from the Rapiti-Narayani River in Nepal as well (Whitaker 1987). As of 1984 a total of 6,000 eggs had been collected and 1,164 juvenile gharials released back into the wild (Singh et al. 1986a).

By 1984, eight protected areas had been designated for gharial management: National Chambal Sanctuary, Corbett National Park, Jawaharsagar Sanctuary (Rajasthan), Katerniyaghat Sanctuary, Ken Sanctuary, Son Sanctuary, Satkoshia Gorge Sanctuary, and Papikonda Sanctuary (Andhra Pradesh).

Over 500 gharial were released in the Satkoshia Gorge Sanctuary, but the success of this program has been limited due to extensive human use of the river. New trial release sites have been identified in the Debrigad Sanctuary, and a portion of the adjacent Hirakud reservoir (Orissa). Additional release sites on the Braham River are also being sought (Singh, 1990).

Currently there are nine rearing centers for gharial in India. Captive breeding of gharial has been difficult and has been accomplished only at four sites: Nandankanan Biological Park (Orissa), Kukrail Crocodile Rehabilitation Centre (Uttar Pradesh), Banarghatta National Park (Karnataka), and the Madras Crocodile Bank (Tamil Nadu) (Singh et al. 1986b, Choudhury, pers. comm.).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 3-severely depleted/endangered
Management Program: D-restocking/reintroduction

Contact: D. Basu, B. C. Choudhury, Suchant Choudhury, Dr. J.C. Daniel, Chandra Sekhar Kar, Dr. Sudhakar Kar, Dr. R.J. Rao, R.L. Rath, Dr. Lala A.K. Singh, Romulus Whitaker

Indonesia

Saltwater crocodile
New Guinea crocodile
Siamese crocodile
Tomistoma

Saltwater crocodile (*Crocodylus porosus*)

Status of Wild Populations: Populations of *C. porosus* are widely scattered throughout many of the estimated 13,679 islands in Indonesia. Few data are available on population status in most areas, although comprehensive surveys in representative lowland habitats in Sumatra and Kalimantan were conducted by the Food and Agricultural Organization (FAO)-Directorate of Forest Protection and Nature Conservation (PHPA) crocodile project in 1990. The results are still in press (J. Cox pers. comm.). The most complete data are for the populations in Irian Jaya. Crocodile populations on Java were reported to be severely depleted (Groombridge 1982, Whitaker 1982), with *C. porosus* apparently persisting in low numbers in the Ujung Kulon National Park (W. Ramono pers. comm. to J. Cox). Crocodiles still remain in scattered small populations on Sulawesi, the Maluku Islands (Moluccas), the Lesser Sunda Islands (including Timor), and on Siberut. This species was reported to be becoming rare on Sumatra in the early 1980s, but was still present in most of the rivers along the east coast (Groombridge 1982). This species has possibly been extirpated on the island of Bali (J. Cox, pers. comm.). Population status on Kalimantan (Borneo) is unknown but the species was becoming very rare in the 1970s.

The status of crocodile populations in three principal areas on Irian Jaya was summarized by Frazier (1990) and Cox (1990). Overhunting has severely reduced the number of crocodiles in the Bintuni Bay area. Virtually all observed crocodile densities were under 2.0/km, with an overall density estimate of 0.43/km (183 seen over 428 km) for both *C. porosus* and *C. novaeguineae* (Cox 1990, Frazier 1990). Of these 68 were identified as *C. porosus* and 59 as *C. novaeguineae*). In the Mamberamo river system populations of *C. porosus* appear to be severely depleted in the delta region, and the mid-upper regions were probably never a stronghold for the species (J. Cox, pers. comm.) Spotlight surveys reveal very low crocodile densities (27 counted over 52.2 km; 0.52/km) and aerial nest counts found low levels of nesting. However, *C. porosus* still constitutes approximately 8% of crocodile skins and young harvested from the middle and upper Mamberano River (J. Cox, unpublished data). The population status in the Pulau Kimaam region is somewhat better, with population density values ranging from 0.18 to 4.7/km. However, in most areas observed densities were below 2.0/km (mean=1.40/km over 306.4 km of river habitat) and surveys repeated on the same rivers in 1989 have shown a further decline of some 58%. All observed

Saltwater crocodile, *Crocodylus porosus*, and New Guinea crocodile, *Crocodylus novaeguineae*, in a ranch in Irian Jaya, Indonesia (Photo by G.J.W. Webb).

crocodiles were *C. porosus*. Although hunting is still common in the area, the large amount of remote habitat and low human population density have combined to reduce the effects of hunting.

Management and Conservation Programs: *C. porosus* is officially protected by law in Indonesia by Decree of the Minister of Agriculture in 1980 (Klemm and Navid 1989). The management of *C. porosus* in Indonesia is based on a sustainable-utilization program, located principally in Irian Jaya. The program, run jointly by FAO and PHPA is aimed at establishing a crocodile ranching and farming industry in Irian Jaya similar to the system in Papua New Guinea. Program activities have included the monitoring of wild crocodile populations, providing technical support concerning husbandry techniques, and assistance in the development of the processing and marketing of the crocodile products. A major obstacle has been the widespread illegal hunting of breeding-sized crocodiles. Regional crocodile skin trade data indicate that the mean size of skins for both species has been dropping in recent years, suggesting that hunting is having a negative impact on the wild populations. Most of these illegal skins were being purchased by dealers from Singapore. In an effort to monitor and control the hunting, the sale of 10-18 inch belly-width skins was legalized in 1988. The killing of larger crocodiles and the use of baited hooks was prohibited (Cox 1990). The recent (October, 1990) removal by Singapore of its reservation on *C. porosus* offers renewed hope that the illegal trade networks from Indonesia can be shut down.

Presently there are more than 30 authorized crocodile rearing centers in Indonesia. The majority of these operations are located in Irian Jaya, but some are in Sumatra, west Java, Kalimantan, and Sulawesi. Estimated total stock at all rearing centers is 51,000, almost all of which have been ranched or purchased from local peoples. Four village demonstration ranches have been constructed with the assistance of the FAO-PHPA program. These village ranches serve as holding pens before the crocodiles are transported to one of the larger rearing operations. The village-level ranches serve as extension sites for teaching husbandry and education concerning the beneficial effects of the crocodile program. More emphasis is being placed on the village-level rearing and breeding of crocodiles than in Papua New Guinea. In addition, a government operated research farm in Sorong, Irian Jaya is conducting husbandry research (Cox 1990). A trial egg-collection program is also being developed with 500+ viable eggs of *C. novaeguineae* harvested in conjunction with the annual nest counts.

Crocodile population monitoring is concentrating on helicopter nest surveys in certain areas of the Mamberamo river system during the annual *C. novaeguineae* nesting season. Similar surveys for *C. porosus* nests were abandoned due the the low numbers of nests spotted. Night spotlight counts are also being conducted (Cox 1990). A restocking campaign for *C. porosus* is currently under consideration (CITES 1989); however, because effective policing of most release sites cannot yet be guaranteed, suggestions have recently been made to retain much of this stock to promote captive breeding (Cox 1990). Nevertheless, trial restocking will be attempted (J. Cox, pers. comm.).

Four protected areas have been established on Irian Jaya: the Mamberamo-Foja National Park (1.66 million ha), Rouffaer Strict Nature Reserve (531,000 ha), Bintuni Bay Nature Reserve (261,000 ha), and Kimaam Island Wildlife Reserve (720,000 ha). However, management plans have not yet been developed for any of these areas (Cox 1990).

Surveys of crocodile populations on Sumatra, Kalimantan, Sulawesi, and the Maluku Islands are being planned for 1990-1991 (CITES 1989).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: E.1-cropping, E.2-ranching

New Guinea crocodile (*Crocodylus novaeguineae*)

Status of Wild Populations: This species is restricted to the island of New Guinea. In Indonesia it is found only in Irian Jaya. Recent surveys have been conducted by Frazier (1990) as part of the FAO-PHPA crocodile management program. In the Mamberamo/Rouffaer/Idenburg river system relatively dense pockets of *C. novaeguineae* are still found, and aerial nest surveys indicate a healthy population comparable to that of the middle Sepik in Papua New Guinea (Frazier 1990). Aerial nest counts conducted in 1989 suggested that the population is stable or increasing (Cox 1989). On Pulau Kimaan Island, *C. novaeguineae* is common among the captive groups of small crocodiles held by villagers, but its natural presence in the wild is not yet confirmed. The population in the Bintuni Bay region was also reported to be healthy (in comparison to the *C. porosus* from the same area) (Frazier 1990).

Management and Conservation Programs: This species (and *C. porosus*) forms the basis of a large-scale management program on Irian Jaya (see *C. porosus* account above). This

species has also been reportedly introduced onto farms on Sulawesi and Batam Islands. Approximately 3,000 *C. novaeguineae* are held at P.T. Jagat Perkasa Karunia farm on Batam, and 500-1,000 on the farm of C.V. Sumbar Karya outside Ujung Padang, Sulawesi.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: E.1-cropping, E.2-ranching

Siamese crocodile (*Crocodylus siamensis*)

Status of Wild Populations: Few recent data are available. Ross (1986) has examined specimens from Java, Sumatra, Bangka Island, Borneo (Kalimantan) and Sulawesi. A considerable amount of inter-island variation occurs and these forms are distinct from the mainland *C. siamensis* (Ross 1986). Ross (1990) identifies a crocodile from Kalimantan as *Crocodylus raninus*, a species very distinct from all other insular Indonesian crocodile populations. According to Ross (in litt. June 23, 1990), the relationships of crocodiles in the Indonesian islands are not well understood, but it appears that *C. siamensis* was found on Java, where it may be extinct (Groombridge 1982). FAO-PHPA surveys of areas in Kalimantan, Sumatra, and Sulawesi were conducted in 1990-1991 to shed more light on the current status of this species complex in Indonesia. Preliminary surveys in August 1990 revealed a number of *siamensis*-like crocodiles on farms in Kalimantan that did not appear to be the *raninus* form. Further examination is in progress to establish the taxonomic identity and source of these animals.

Management and Conservation Programs: Protected under the Fauna Regulation of 1978 (Klemm and Navid 1989).

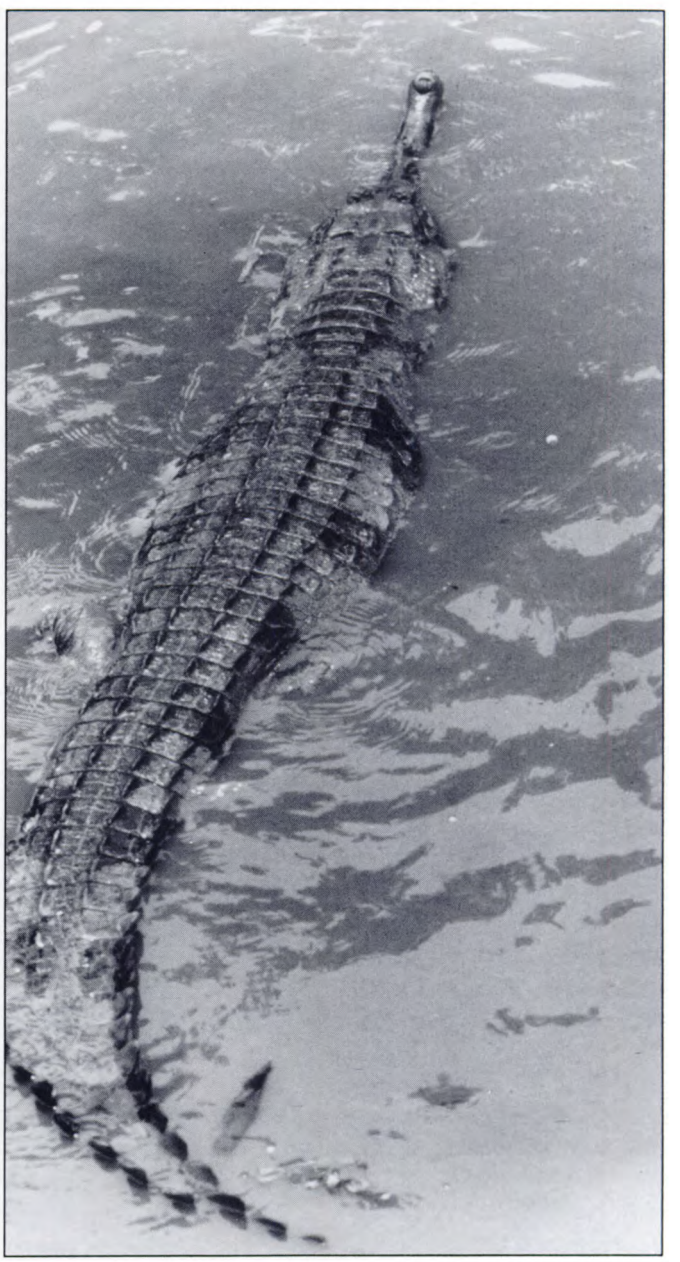
Country Rating
Survey Data: II-surveys planned
Wild Population Status: 1-unknown
Management Program: C-legislation

Tomistoma (*Tomistoma schlegelii*)

Status of Wild Populations: No recent survey data are published. Surveys of Kalimantan and Sumatra were conducted 1990 by FAO-PHPA project personnel. Three month surveys in Sumatra and in Kalimantan revealed nine river systems with significant densities of *Tomistoma*. The range of this species includes Kalimantan, Sumatra, and possibly Sulawesi. Population status in the early 1980s was termed not rare in some parts of east Sumatra including the Berbak Reserve, and possibly the Way Kambas Reserve. Reports from south Sumatra from the Lalan, Kuran, and Bahar rivers as well as swamps adjacent to the Medak and Merang rivers (Groombridge 1982) were confirmed in recent surveys (Cox pers. comm.). In Sumatra, *Tomistoma* has recently been reported to be locally common in suitable habitat (freshwater swamps/headwaters of river systems) by crocodile ranchers who have acquired 100+ in the past 2-3 years. These ranchers reported that they could get more if prices for skins were higher (J. Cox, pers. comm.). It is thought that even before exploitation by people became widespread that this species was only present in relatively low densities.

Populations reported from several areas in Kalimantan, including the Tanjung Puting Reserve and the Beran River (Groombridge 1982), have been recently confirmed (Scott Frazier pers. comm.). The reported presence of *Tomistoma* in the Marisa River in northern Sulawesi has not yet been confirmed.

Management and Conservation Programs: The tomistoma is legally protected in Indonesia under the Fauna Regulation of 1978 (Klemm and Navid 1989). Permits to acquire and rear young *Tomistoma* are being issued by the Indonesian Manage-



Captive tomistoma, *Tomistoma schlegelii*, on a crocodile farm, Kalimantan, Indonesia (Photo by G.J.W. Webb).

Tomistoma, *Tomistoma schlegelii*, at Surabaya Zoo, Java, Indonesia (Photo by F.W. King).

ment Authority to farmers in Sumatra and Kalimantan. Small groups are maintained in captivity in Sumatra, Kalimantan, and west Java, but as yet no captive breeding has taken place.

Country Rating
Survey Data: II-surveys planned
Wild Population Status: 3-severely depleted/endangered
Management Program: C-legislation

Contact: Jack Cox, Scott Frazier, Dr. Effendy A. Sumardja

Iran

Mugger

Mugger (*Crocodylus palustris*)

Status of Wild Populations: No recent survey data are available. Surveys in 1970 indicated that crocodiles were restricted to the Sarbaz River drainage in southeastern Iran. A total of 18 crocodiles were sighted, and population size was extrapolated to be greater than 50 (Groombridge 1982), although Anderson (1979) suggested this may be an overestimate. Whitaker and Whitaker (1989b) suggest that the wild population numbers 50-100. Crocodiles are found in two parts of the river: in the Kolani Marsh near the mouth, and in a stretch of river between Rask and Bahu Kalat. The population had reportedly been reduced by hide hunting (Groombridge 1982), although Whitaker (1982) considers habitat loss to be the biggest threat.

Management and Conservation Programs: Crocodiles were fully protected by Iranian law in 1972 under the Wildlife Protection Act (Klemm and Navid 1989).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: C-legislation

Laos

Siamese crocodile

Siamese crocodile (*Crocodylus siamensis*)

Status of Wild Populations: This species is only known in Laos from historical references. Smith (1931) states that this species extends northward to about latitude 16° N, with one specimen known from Kemarat, along the border between Laos and Thailand. There are recent photographs of captive *C. siamensis* at a small zoo in Vientiane. The animals were said to have been captured in Laos (Stuart, in litt. June 1991).

Management and Conservation Programs: Unknown.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: B-none

Contact: Xaisida Bounthong, Dr. Richard E. Salter

Malaysia

Saltwater crocodile
Siamese crocodile
Tomistoma

Saltwater crocodile (*Crocodylus porosus*)

Status of Wild Populations: The population status in West Malaysia is uncertain. A recent country-wide survey of Sarawak indicated that *C. porosus* populations are very depleted. Mean crocodile density over 1,043 km of night spotlight counts revealed a density of only 0.054/km, with few juveniles (Cox and Gombek 1985). A similar survey in Sabah (1,146 km surveyed) also found very low crocodile densities (mean 0.049/

km) (Whitaker 1984). From these data a corrected population density figure of 0.46 crocodiles/km was estimated, and these values were extrapolated to predict a total population size of about 2,600 in Sabah. More recent surveys of one river in Sabah (Klias river) found a population estimated to be about 90 individuals, suggesting that some recovery had taken place.

Management and Conservation Programs: *C. porosus* is legally protected in Sabah but not Sarawak (Groombridge 1982). Klemm and Navid (1989) report that crocodile may be taken under license. Crocodile farming and ranching operations have started all over Malaysia. In West Malaysia, seven farms were reported by Luxmoore et al. (1985) but apparently only one was breeding animals in captivity. In Sabah only one farm was reported. This was essentially a ranching operation but the government banned the collection of wild animals; captive breeding was then planned, but some illegal import from Kalimantan, Indonesia was reported (Luxmoore et al. 1985). In Sarawak, two farms are in operation. One was purchasing crocodiles from local fishermen, but the other was making serious efforts to develop a captive breeding program.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 3-severely depleted/endangered
Management Program: E.2-ranching, E.3-farming

Siamese crocodile (*Crocodylus siamensis*)

Status of Wild Populations: This species was reported by Ross (1986) to be widespread in the Indonesian islands, including Borneo, indicating it may have been found at one time in Sabah and Sarawak. Specimens were also reported from southernmost Thailand (Smith 1931), suggesting they were also found in Peninsular Malaysia.

Management and Conservation Programs: Legal status is assumed to be the same as for *C. porosus*. *C. siamensis* is not known to be found on any commercial farm in Malaysia.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 1-unknown
Management Program: C-legislation

Tomistoma (*Tomistoma schlegelii*)

Status of Wild Populations: No recent survey data are available for West Malaysia, but *Tomistoma* is reported to be extremely rare. The species is possibly still found in the Pahang river, but has apparently been extirpated from the Tasek Bera Swamps (Groombridge 1982). Terry Cullen (pers. comm., April 1990) reported *Tomistoma* to be rare on Peninsular Malaysia, where it is more commonly found in shallow swamps and backwaters as opposed to rivers. Whitaker (1984) visited Sarawak in 1983 and reported that *Tomistoma* was present in most of the inland rivers and permanent swamp areas, and reported that young were not infrequently encountered. However, a subsequent survey in Sarawak indicated population levels were very low. *Tomistoma* was only confirmed from one river system (the upper Ensengai Baki), but may still be found in some of the more remote and inaccessible areas (Cox and Gombek 1985).

Tomistoma was apparently never found in Sabah (Whitaker 1984).

Management and Conservation Programs: *Tomistoma* is reported to be protected in parts of West Malaysia including Selangor, Negri Sembilan, and Malacca (Honegger 1979), but not in Sarawak (Cox and Gombek 1985).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 3-severely depleted/endangered
Management Program: C-legislation

Contact: Patrick Andau, Mohd. Khan b. Momin Khan, Tunku Mohammed, Ken Scriven, Rob Stuebing, Romulus Whitaker

Myanmar (Burma)

Saltwater crocodile
Gharial

Saltwater crocodile (*Crocodylus porosus*)

Status of Wild Populations: No recent survey data are available. Only isolated populations are thought to remain. Based on a survey conducted by Caughley (in Groombridge 1982), the largest remaining population is in the Irrawaddy Delta and numbered about 4,000 in 1980, but was being depleted by heavy exploitation. Aung Moe (1990) reports the *C. porosus* population to be declining due to illegal hunting and nest and habitat destruction.

Management and Conservation Programs: No specific legal protection is afforded this species, but the issue of all game hunting licences has been banned since 1958 (Klemm and Navid 1989). A proposed United Nations Development Program crocodile project was never started due to lack of funds (Whitaker 1986). One crocodile farm was started in 1978 in Rangoon (The People's Pearl and Fisheries Corporation Crocodile Farm), run by the Burmese government (Luxmoore et al. 1985). According to a report by Caughley (1980), hatchling or yearling crocodiles were collected through a number of collection centers along the eastern side of the Irrawaddy Delta. This collection was apparently taking virtually all the recruitment in at least one region (Tawbaing area). The farm is reported to be modelled on the farms in Thailand and Singapore, and in 1980 it had a stock of 900 *C. porosus*. Captive breeding was hoped to make the farm self-sustaining by 1983, but a 1990 report indicated that total captive stock only numbered 550 (Aung Moe 1990). However, some captive breeding was reported to be taking place. The farm planned on creating a crocodile sanctuary on Meinmahla Kyun Island (in the Irrawaddy Delta),

where some of the crocodiles reared on the farm could be released to restock natural populations and provide for future sustainable-yield harvests (Luxmoore et al. 1985).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 3-severely depleted/endangered
Management Program: C-legislation,E.2-ranching

Gharial (*Gavialis gangeticus*)

Status of Wild Populations: No recent survey data are available. The historical presence of this species in Burma is confirmed by Barton (1929), who shot a large gharial in the Shweli River some 1,000 miles upstream from the delta of the Irrawaddy. The only other historical reference to gharial in Myanmar is from the Kaladan River near the border with Bangladesh. A survey in the early 1980s of the Kaladan River found no gharial, and local people indicated that the species had been extirpated (Groombridge 1982). Aung Moe (1990) reported that *Gavialis* have been reported from coastal areas, but no specimens had been collected.

Management and Conservation Programs: This species is protected by law (Whitaker 1989).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 2-extirpated
Management Program: C-legislation

Contact: B.K. Aung Moe, Ko Ko Gyi, Kyaw Nyun Lwin, Nyan Taw

Nepal

Mugger
Gharial

Mugger (*Crocodylus palustris*)

Status of Wild Populations: No recent survey data are available. Maskey (in Groombridge 1982) reported that the mugger crocodile was relatively common throughout Nepal in marshy lakes, ponds, and small rivers. It is found in scattered populations in some of the major rivers and in forested ponds (Whitaker 1982). The population in the Royal Chitwan National Park (Narayani/Rapti/Reu rivers) in 1978 was estimated to be 200 (Groombridge 1982). Whitaker and Whitaker (1989b) present a smaller figure of 30-50 for the entire country.

Management and Conservation Programs: The mugger is partially protected under the National Parks and Wildlife Protection Rules of 1974, but full protection may have been given since that time (Klemm and Navid 1989).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 3-severely depleted/endangered
Management Program: C-legislation

Gharial (*Gavialis gangeticus*)

Status of Wild Populations: Gharial were at one time widely distributed throughout the major river systems of Nepal. At present, gharials are known only from the Karnali, Babai, Kali, and Narayani rivers (Maskey 1989a). Total adult population size in Nepal was estimated by Maskey (1989a) to be 74. This number was elevated to 186 by Maskey in 1990. The largest single population is in the Narayani, numbering approximately 95 adults, concentrated in the areas around Velaunge and Bhosarghat, where they frequent areas with deep pools and high sand banks. The population in the Babai River, in western Nepal, numbers 7-10 wild individuals and is the only river not affected by dams (Maskey 1990). Populations have increased in recent years with the release of captive-reared juveniles (see below).

Management and Conservation Programs: Gharials are protected under the Wildlife Protection Act of 1973. In 1978, the Gharial Conservation Project was started at the park headquarters of Royal Chitawan National Park, Kasara, and was aimed at restocking gharials into the Narayani and other rivers in Nepal. This program is modelled after the gharial release program in India, and consists of collecting eggs from wild nests, rearing the young in captivity, and releasing them at a size of at least 1 m. Between 1981 and 1987, a total of 307 gharials were released in the rivers Narayani (183 gharials), Kali (35), Kosi (84), and Rapti (5) (Maskey 1989a). The captive rearing program has continued, and in 1989, 141 hatchlings were produced. In 1990, an additional 87 gharial (5 years old; 1.2-1.6 m long) were released including 25 in the Naranyani River, 32 in the Kali Ghandaki River, and 30 in the Babai River in western Nepal. By 1990, the total number of gharial released was 394. Approximately 40 released gharial still survive in the Naranyani (18% of the total number released) and some of those released in 1981 are now approaching reproductive age (Maskey 1990).

Maskey (1989a) conducted a radio-telemetry study of released gharials in the Narayani River in 1981-1982 and in 1987. Plans continue for long-term monitoring of the populations and the expansion of the program with the release of gharials into the Karnali River in western Nepal (Maskey 1989b).

Country Rating
Survey Data: IV-widespread survey data
Wild Population Status: 3-severely depleted/endangered
Management Program: D-restocking/reintroduction

Contact: Dr. Tirtha M. Maskey, Dr. Hemanta Mishra

Pakistan

Mugger
Gharial

Mugger (*Crocodylus palustris*)

Status of Wild Populations: No recent survey data are available but this species was considered to be endangered or very rare in the early 1980s (Groombridge 1982). An estimate of over 100 crocodiles was given for the Sind region, where 51 were counted in the Nara canal. Since that time populations of *C. palustris* have recovered, and the species is now considered safe in the Sind by Khan (1987). Crocodile recovery has been in association with a conservation project in the Deh Akro No. 2 Taluka Nawabshah. This project began in 1983, and current estimates place the crocodile population at about 2,000 (Ahmad 1990). In Baluchistan, widespread killing of crocodiles has threatened the majority of the local populations with extinction. Many crocodiles were reported to have been killed in the River Hingol during a period of low water in 1986-1987 (Khan 1989). Principal threats include killing for sale of the hide, killing by fishermen, as well the collecting of specimens for laboratories and museums (Khan 1988).

Management and Conservation Programs: Hunting and exporting of crocodiles or crocodile products is banned. Jurisdiction is at the state level and all states and the Islamabad Capital Territory offer legal protection to this species (Klemm and Navid 1989). Crocodiles are reportedly protected in Lal Suhanra National Park (Whitaker 1982). The government of the Sind has recently declared the Deh Akro No. 2 Taluka Nawabshah region, an area of 50,000 acres containing some 30 lakes, as a wildlife sanctuary for crocodiles. The government of India is planing to provide Pakistan with 200 young *C. palustris* to Pakistan to be used in a restocking program for sanctuaries in Pakistan (Rao 1989). Official approval of the exchange is awaiting a reply from Pakistan concerning the specific release sites to be used (B.C. Choudhury, pers. comm.).

A captive breeding operation in the Sind is reportedly underway. Plans are to rear crocodiles for three years before releasing them back into the wild.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 4-depleted/vulnerable
Management Program: C-legislation, D-restocking/reintroduction

Gharial (*Gavialis gangeticus*)

Status of Wild Populations: No recent survey data are available. This species was considered to be on the verge of extinction in Pakistan in the early 1980s. Populations were at one time abundant in the Sind, but were impacted by habitat destruction with the construction of dams used for irrigation, and were killed by fishermen. Population estimates at this time suggested that no more than 20-30 individuals remained (Groombridge 1982, Whitaker 1982). The main populations were found in the Indus River and the Nara Canal (Whitaker 1982). Khan (1987) reports that gharial were extinct in the Indus River in the province of Sind. Ahamad (in litt. April 16, 1990) recently reported the sighting of one female in the Sind but gave no further details. A survey is planned for January, 1991.

Management and Conservation Programs: Hunting and export are banned in Pakistan. The species is reported to be protected within the Indus River Dolphin Sanctuary (Whitaker 1982). Pakistan has plans to breed and rear gharial for a restocking program similar to the one in India (Khan 1989).

Country Rating
Survey Data: II-surveys planned
Wild Population Status: 3-severely depleted/endangered
Management Program: C-legislation

Contact: Ashiq Ahmad, W.A. Kermani, Abrar Husain Mirza, Abdul Latif Rao

Palau (Caroline Islands)

Saltwater crocodile

Saltwater crocodile (*Crocodylus porosus*)

Status of Wild Populations: Unwarranted confusion has surrounded the species of crocodile occuring on the Palau Islands; all the Palau crocodiles are *C. porosus* and no other species occurs on Palau (Messel and King 1991). Motoda (1937, 1938) stated that the Palau crocodiles were the same species as occurs in India, *C. porosus* or possibly *C. palustris*. Other early records refer to *C. porosus* until Kimura (1968) reported three species, *C. mindorensis* and *C. novaeguineae* in addition to *C. porosus*. Kimura (1968) reported that a crocodile farm operated prior to World War II on Arakabesang Island near Koror and was stocked with crocodiles from the Philippines, New Guinea, and local sources. Other sources (e.g. Thyssen 1988) have suggested that *C. porosus* have hybridized with *C. novaeguineae* on Palau to produce a third hybrid form. Populations of crocodiles numbering in the thousands were reported. Examination of numerous specimens in 1991 by Messel and King could not verify the presence of any species except *C. porosus*.

Surveys of all the major habitats in the Palau group in June 1991 revealed a total of 42 crocodiles in 112.4 km of survey. Messel and King (1991) conclude that *C. porosus* is nearing extinction in Palau with two very small populations remaining at Belilou Island and Ngerdok Lake on Babeldaob and a handful of scattered survivors elsewhere. No evidence of juveniles or recent breeding was seen.

Management and Conservation Programs: The endangered status of *C. porusus* in Palau is a direct result of a deliberate program of extermination pursued by the U.S. Administration in the late 1960s and 1970s. Several hundred were shot by hunters contracted to the local administration during the 1970s and 500-1,000 by a team of local hunters between 1979 and

1981, a period when this species was protected by the U.S. Endangered Species Act. These islands are a U.S. protectorate and subject to U.S. federal laws and CITES restrictions. Reports during 1990 indicate that illegal *C. porosus* skins and products are entering Guam from the Palau Islands (H. Messel, pers. comm.). Also, recent reports suggest that tourists are arriving in Guam from Palau with crocodilian articles (F.W. King, pers. comm., 1990).

A small number of locally caught *C. porosus*, presently held in a farm run by a local resident, could form the nucleus of a breeding group. Recommendations to develop captive breeding, public education, sustainable use programs, and eventually a restocking program have been made (Messel and King 1991).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 3-severely depleted/endangered
Management Program: B-none

Contact: Prof. F. Wayne King, Prof. Harry Messel, Joshua Eberdon, Mr. Demei Otobed

Papua New Guinea

New Guinea crocodile
Saltwater crocodile

New Guinea crocodile (*Crocodylus novaeguineae*)

Status of Wild Populations: The New Guinea crocodile is found throughout the lowlands of the Papua New Guinea mainland but is thought to be absent from the outlying islands of the Bismark archipelago (Genolagani and Wilmot 1991). Owing to the difficulty and inefficiency of monitoring crocodile population status in Papua New Guinea by spotlight counts, aerial nest counts have been used as an index of population trend. Surveys have been carried out in the middle Sepik River area since 1981. The results of the 1989 surveys indicate that over the nine year period an overall 21.9% increase in *C. novaeguineae* nesting has occurred (mean annual increase of 2.5%) (Cox 1989). More recent surveys and analysis covering the decade through 1990 indicate that the nesting index may have declined to 98.6%, an annual decrease of 0.1% per year (J. Cox pers. comm.)

During 1978-1980, Montague (1983) conducted nocturnal spotlight counts in the Fly River drainage in southern Papua New Guinea. Overall densities (for both *C. porosus* and *C. novaeguineae*) on unhunted sections of river averaged 1.6/km (504 km surveyed), and in hunted areas the mean was 0.83/km (476 km surveyed).

Management and Conservation Programs: This account is based principally on Hollands (1987). Beginning in the late 1960s the government of Papua New Guinea embarked on a milestone program to manage the utilization of crocodilians. Prior to this the uncontrolled hunting of crocodiles had led to a serious decline in wild stocks. In 1966, the Crocodile Trade Ordinance was passed, regulating crocodile skin trade for the first time, including a clause prohibiting the killing of large crocodiles (over 51 cm belly width) for commercial purposes. During the early 1970s a program was developed by the Papua New Guinea Wildlife Division designed to shift the utilization away from the hunting of large breeding animals, and develop a ranching program based on the collection of small crocodiles by local peoples. The original program intent was to establish a large number of village-level ranches that would rear crocodiles to a commercial size using appropriate technology and low cost local materials. The program was aimed at developing a sustainable utilization project that would offer the maximum benefits to rural peoples. In 1976, the Food and Agricultural Organization (FAO) began providing technical assistance to develop fully the village ranching programs, as well as help establish large-scale commercial ranches and a system for supplying them with crocodiles. In 1981, legislation was passed prohibiting the killing of small crocodiles (less than 18 cm belly width), so that these animals would instead be reared to a larger size and provide a more valuable skin.

The goal of hundreds of village-level ranches was never attained due to a number of technical and social problems (see Hollands 1987), and the program was modified to one of large-scale commercial rearing. Under the modified program the village ranches were simply used as holding pens for animals before they could be sold to large commercial ranches.

Currently, most of the crocodile industry in Papua New Guinea is still based on direct hunting for skins. These skins may only be purchased by licensed dealers, and only skins between 18 and 51 cm belly width are considered legal. Most of the skins traded are small, and this is discouraged by selective taxation.

Since 1981, ranched skins have provided an increasing fraction of the total number of skins exported. Presently there are two large commercial ranches in operation: Mainland Holdings in Lae (about 26,000 crocodiles), and Ilimo Farm (Port Moresby; about 3,000 crocodiles). Both commercial farms are associated with large-scale aviculture operations (chicken farms) which provide food in the form of offal. Besides the two large commercial farms, there are approximately eight private mini-ranches, which buy crocodiles from local peoples, rearing some to commercial size and selling the surplus to the large commercial ranches. The number of animals reared is usually restricted by the availability of local food resources for feeding the crocodiles (Luxmoore et al. 1985). Also, in the 1970s the Moitaka Crocodile Farm was established by the Papua New Guinea government as a demonstration farm for studying and improving husbandry techniques. Although it is no longer a commercial operation, it now serves as a center for education and research.

After a trial harvest of *C. porosus* eggs in 1985, regular harvests of *C. porosus* eggs are now being conducted. Harvests are controlled by the government as part of the annual nest surveys. A similar program for *C. novaeguineae* commenced in 1988. Nests in flood-prone or human-predation prone areas are located by helicopter and the eggs collected. Local villagers are paid the sum of 2 kina (U.S. $2.70) and given one chicken egg for every crocodile egg collected. Eggs are transported by charter flight to a large incubator at the Mainland Holdings

ranch in Lae. In 1988, a total of 1,329 *C. porosus* and 1,708 *C. novaeguineae* eggs were collected. The egg collection program is financed by the Mainland Holdings operation. Captive breeding of *C. porosus* is also being conducted at the two largest farms.

As part of the crocodile management program, research was initiated into a number of aspects of crocodile ecology, particularly nesting (Hall and Johnson 1987, Cox 1985). A monitoring program was also initiated in 1981 using helicopter nest surveys as an index of population size and trend.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: E.1-cropping, E.2-ranching

Saltwater crocodile (*Crocodylus porosus*)

Status of Wild Populations: The saltwater crocodile is found throughout the territory of Papua New Guinea including the larger islands of the Bismark archipelago and the many islands of Milne Bay (Genolagani and Wilmot 1991). Survey and management efforts are focused on the mainland areas and major drainages of the Fly and Sepick rivers. As with *C. novaeguineae*, population monitoring in the middle Sepik River area is done by means of helicopter nest counts. Between 1982 and 1989 a dramatic increase of 50.8% in annual nesting (6.0% per year) was reported, but the index declined significantly in the 1990 counts.

Nocturnal spotlight counts were conducted by Montague in the Fly River drainage from 1978-1980 (see *C. novaeguineae* account above).

Management and Conservation Programs: See account for *C. novaeguineae* above. Also, trial commercial farming (captive breeding) of *C. porosus* is being conducted at two farms (Mainland Holdings and Ilimo).

Country Rating
Survey Data: III-basic survey data

Saltwater crocodile, *Crocodylus porosus*, guarding its nest, Papua New Guinea. Crocodilians show well-developed maternal behavior (Photo by R. Whitaker).

Wild Population Status: 4-depleted/vulnerable
Management Program: E.1-cropping, E.2-ranching, E.3-farming

Contact: Jack Cox, John-Mark Genolagani, Greg Mitchell, Kamana Sinba, Dr. Mark A. Staton, John M. Wilmot, Brian Vernon

Philippines

Philippine crocodile
Saltwater crocodile

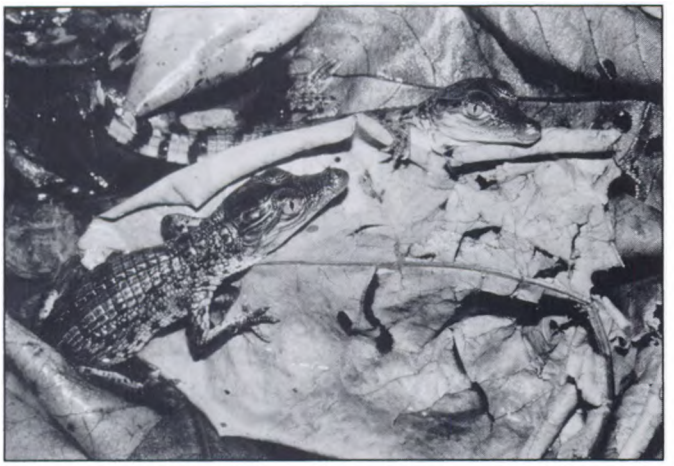
Philippine crocodile (*Crocodylus mindorensis*)

Status of Wild Populations: A survey was conducted by Ross in the early 1980s (Ross 1982, Ross and Alcala 1983). This species was at one time widely distributed throughout the Philippines, with the possible exception of Palawan. Current population levels are extremely low. Total wild population size in 1982 was estimated to be between 500 and 1,000 individuals. Remnant populations are still found in the vicinity of Lake Naujan on Mindoro, in the Pagatban River on Negros, and in three disjunct populations on Mindanao (Calarian Lake, near Nabunturan, Davao del Norte, and the Macasendey Marsh). Another wild population was thought to remain on the island of Samar. The species is thought to be most abundant on Mindanao (C.A. Ross, in litt. June 23, 1990).

Management and Conservation Programs: Crocodiles are protected under Philippine law (C.A. Ross, in litt. June 23, 1990). Crocodiles are also officially protected in three areas: Lake Naujan National Park (Mindoro), Lingausan Game Reserve (North Cotabato and Maguindanao provinces), and the province of Palawan. However, *C. mindorensis* is only known from the first of these areas, and crocodile killing has continued unabated in these areas. A captive breeding program began at the Silliman University Marine Laboratory in 1980. Successful breeding was accomplished in 1982. The goal of the operation is to release crocodiles back into the wild on the island of Negros. The total captive stock in 1984 was 25, including two breeding pairs (Ross 1982, Ross and Alcala 1983, Ross 1984).

In 1988, a new large-scale crocodile farm was inaugurated on Palawan. This is a joint operation between the Republic of the Philippines and the Japanese government. The farm is aiming at commercial production but also hopes to play an important conservation role for *C. mindorensis*. Stock is being collected from the wild and in 1989 numbered 157 individuals, of which approximately 20% were *C. mindorensis*. In 1989, the farm had six breeding pairs of *C. mindorensis*, and three females were showing signs of nesting. Most crocodiles (both species) came from Cotabato (Mindanao) or Palawan (*C. porosus*), but others originated from Agusan, Panay, and Mindoro. Another pair of *C. mindorensis* is housed in the Manila Zoological and Botanical Garden but has not yet produced fertile eggs (Diaz 1989).

Outside the Philippines, only a small number of captive *C. mindorensis* exist. Two pairs are located at the Brownsville Zoo (Texas, U.S.A.; Honegger and Hunt 1990), and breeding is



Crocodylus mindorensis, **Philippine crocodile hatchlings in laboratory tank, Marine Laboratory, Silliman University, Philippines (Photo courtesy of WWF-T.F. Luchavez).**

being attempted with one pair at the St. Augustine Alligator Farm (Ocala, Florida).

Ross (1984) concludes that there is little future for crocodiles in the existing or proposed wildlife sanctuaries, and that captive breeding is the only hope for the species until public sentiment and awareness of conservation permit effective protection and the implementation of reintroduction programs.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 3-severely depleted/endangered
Management Program: C-legislation only

Saltwater crocodile (*Crocodylus porosus*)

Status of Wild Populations: Surveys conducted by Ross (1982) in the early 1980s demonstrated that population levels are very low. Small, low-density isolated populations still occur scattered around the archipelago, particularly on Mindanao, but including Luzon, Mindoro, Palawan, and Samar. The best remaining population is found in the upper Agusan River valley (Agusan del Sur Province, Mindanao)(C.A. Ross, in litt. June 23, 1990).

Management and Conservation Programs: Reported not to be legally protected by Groombridge (1982) and (Klemm and Navid 1989). Three protected areas have been declared (see *C. mindorensis*) but little or no actual protection is afforded crocodiles in these areas (Ross 1982).

The RP-Japan Crocodile Farming Institute on Palawan is trying to establish a captive breeding operation for both species of crocodiles located in the Philippines. However, by 1988 the farm had only three breeding pairs of *C. porosus*. Some captive breeding of *C. porosus* has also taken place at the Manila Zoological and Biological Garden (where one pair is housed), but no live hatchlings have been produced yet (Diaz 1989).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 3-severely depleted/endangered
Management Program: B-none

Contact: Prof. A.C. Alcala, Dr. Gerardo V. Ortega

Singapore

Saltwater crocodile

Saltwater crocodile (*Crocodylus porosus*)

Status of Wild Populations: No known breeding population exists, but in recent years specimens have been captured on Singapore Island by Richard Tan (H. Messel, pers. comm.). Whether these represent escaped farm animals or crocodiles from Malaysia/Indonesia is not known.

Management and Conservation Programs: Despite the lack of wild populations on Singapore itself, Singapore is a major center of commerce in crocodilians and their byproducts. Luxmoore et al. (1985) reported that a large number of rearing operations exist, importing eggs and juvenile crocodiles from Indonesia, Malaysia, Papua New Guinea, Australia, and the Philippines. Most stock are *C. porosus*, but *Tomistoma schlegelii*, *C. novaeguineae*, and *Caiman crocodilus* are also being reared for both skins and meat. Tan Chye Hock (1990) reports that approximately 250 crocodile rearing operations exist in Singapore, the majority being small operations associated with poultry or livestock operations. Only 15 larger rearing centers (with a mean stock of 1,000 individuals) exist, and the majority of these are ranching operations. However, obtaining stock has become more difficult recently due to CITES restrictions. One farm, the Jurong Crocodile Paradise, has been breeding crocodiles in a closed-cycle operation since 1981. Total stock of the farm is 5,500, of which 1,900 were bred on the farm (Tan Chye Hock 1990).

Until recently, Singapore maintained reservations on the importation of *C. porosus* and *C. novaeguineae*, which fostered an illegal trade from Indonesia. These reservations were dropped on 31 August 1990.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 2-extirpated
Management Program: E.3-farming

Contact: Richard Tan Chye Hock

Solomon Islands

Saltwater crocodile

Saltwater crocodile (*Crocodylus porosus*)

Status of Wild Populations: A survey of a large part of the

crocodile habitat in the Solomon Islands was recently carried out by Messel and King (1990). Although most of the remaining suitable crocodile habitat was censused, only 177 non-hatchling crocodiles were counted (over 173 km=1.02/km). Most of the crocodiles spotted were at one of three freshwater lagoons: Lauvi Lagoon (Guadalcanal Province), 92 counted; Lake Tatae (Central Province), 27 counted; and the Ghahirahobo Island Lagoon (Isabel Province), 15 counted. Crocodiles were rarely sighted along rivers or creeks or in saltwater lagoons. Total population size in the Solomon Islands was estimated to be no more than 720.

Management and Conservation Programs: Current law prohibits the selling of crocodile skins with a belly width less than 50 cm. Cropping of wild populations has continued without much regulation, and this has resulted in severe depletion of the wild populations. All the hides are exported to Japanese tanners. Bolton (1988) had made recommendations for the development of a crocodile farming program in the Solomon Islands, but presently only 12 small crocodile farms exist, with the largest having only 54 animals. None of these farms were considered to be viable commercial operations by Messel and King (1990). In their report, Messel and King (1990) recommended a total export ban on skins for at least five years, and a permanent ban on skins larger than 45 cm belly width. Other recommendations included better protection and continued monitoring of wild populations.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 3-severely depleted/endangered
Management Program: E.1-cropping

Contact: G.D. Whewell

Sri Lanka

Mugger
Saltwater crocodile

Mugger (*Crocodylus palustris*)

Status of Wild Populations: The most recent surveys were conducted by Whitaker and Whitaker (1979). This species has been largely depleted throughout Sri Lanka, but sizeable populations remain, especially in Yala and Wilpattu National Parks and at Panama Wewa. The results of this survey estimate a total country-wide non-hatchling population of about 2,800 *C. palustris*, and suggest that Sri Lanka has the largest remaining wild populations of this species.

Management and Conservation Programs: *C. palustris* is protected under the Fauna and Flora Protection Ordinance of 1938, but may be hunted with a special license (Klemm and Navid 1989). However, little enforcement is evident outside of the national parks (Whitaker and Whitaker 1989b).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: C-legislation

Saltwater crocodile (*Crocodylus porosus*)

Status of Wild Populations: A survey was conducted in the late 1970s by Whitaker and Whitaker (1979). Overall, populations were found to be very depleted. The largest number of remaining *C. porosus* were found in or near the major rivers which drain along the island's southwest coast (about 25 breeding females and 125 total non-hatchlings). Whitaker and Whitaker (1979) estimated that in the rest of the island a total of 15 other adult females remained. Total non-hatchling population was estimated to be 250. Habitat loss is viewed as the principal reason for the continued population decline.

Management and Conservation Programs: This species is legally protected under the Fauna and Flora Preservation Ordinance of 1938. Single specimens may be taken under a special license (Klemm and Navid 1989).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 3-severely depleted/endangered
Management Program: C-legislation

Contact: Romulus Whitaker, Dr. Sarath Kotogama, Mr. Anslem de Silva

Thailand

Saltwater crocodile
Siamese crocodile
Tomistoma

Saltwater crocodile (*Crocodylus porosus*)

Status of Wild Populations: No recent survey data are available. Wild populations are believed to be extremely depleted. King et al. (1979) suggested that no more than 10 adult *C. porosus* were left in the wild in southern Thailand. According to Bain and Humphrey (1980) the last sighting of a wild *C. porosus* was in the area of Ko Tarutao in Changwat Satun in 1971.

Management and Conservation Programs: Crocodiles are afforded no legal protection in Thailand (Klemm and Navid 1989), and virtually no government control of imports or exports exists. Crocodile habitat is protected in the Tarutao Marine National Park (Bain and Humphrey 1980).

The Samutprakarn Crocodile Farm is one of the largest in the world. Established in 1950 with 20 wild-caught crocodiles, the 1985 stock numbered some 14,000 crocodilians, including 1,755 *C. porosus* (Suvanakorn and Youngprapakorn 1987),

though this is a considerable reduction from the reported farm stock in the late 1970s and early 1980s, which was in the 20,000-30,000 range (Luxmoore et al. 1985). The farm rears crocodiles for meat (sold locally) and skins, and is also a major tourist attraction. Sixty percent of the skins are processed and sold locally (principally to tourists) and the remainder are exported raw. The farm is entirely self-sufficient (i.e., no offtake from wild populations occurs) and most crocodiles are slaughtered at three years of age. Hybridization between *C. porosus* and *C. siamensis* has taken place, and in 1985 the farm reported having 710 hybrids. The commercial production of the *porosus* x *siamensis* hybrids represents a dangerous precedent from a conservation standpoint, especially for the severely threatened Siamese crocodile, which is extremely rare in the wild. Annual production of hatchlings (for both species) averaged 4,356 from 1976 to 1985 (Suvanakorn and Youngprapakorn 1987). Between 1980 and 1984 the mean number of *C. porosus* hatched was 1,082 (Luxmoore et al. 1985). Mean hatch rate was reported to be 40-50%.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 3-severely depleted/endangered
Management Program: E.3-farming

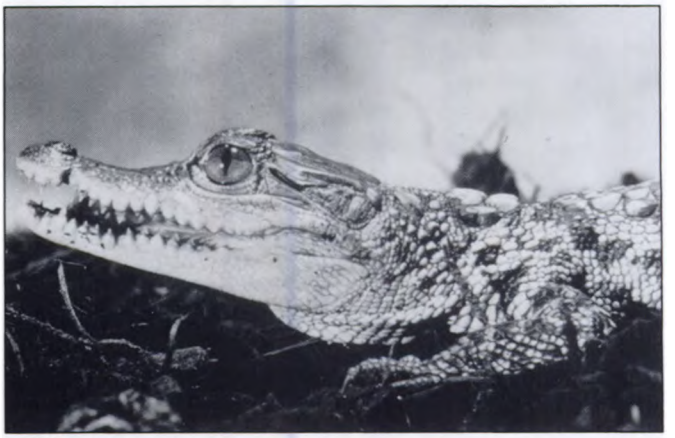
Siamese crocodile (*Crocodylus siamensis*)

Status of Wild Populations: No recent survey data are available. This species was at one time widespread throughout southeastern Asia (Thailand, Laos, Cambodia, Vietnam, and Malaysia) as well as on some of the Indonesian islands. Today it is considered to be extinct throughout most of its range in Thailand. Smith (1931) reported it to be common in several places in Thailand (formerly Siam), although he indicated that a number had been shot in the area near Nakon Sawan (along the Chao Phraya River). Only one site has been reported still to contain wild crocodiles, the Bung Boraphet Reservoir in Nakhon Sawan Province, Thailand. The total wild population in Thailand was estimated to be 100-200 by Whitaker (1982), but Whitaker and Whitaker (1989b) suggest that the wild population may only be 50, all at the Bung Boraphet Reservoir. However, the population of crocodiles at this site has been declining and no recent sightings have been made (Bain and Humphrey 1980). Ross (in litt. June 23, 1990) suggests that wild populations, if they remain, would be most likely to be found in eastern Thailand along the Cambodia or Laos borders.

Management and Conservation Programs: According to Groombridge (1982) this species is legally protected in Thailand, and the Bung Boraphet Reservoir is a non-hunting area. However, Klemm and Navid (1989) report that *C. siamensis* is not protected by law.

Although perhaps extinct in the wild, this species is numerous in captivity in Thailand. The reported 1985 stock at the Samutprakarn Crocodile Farm was 7,780 (Suvanakorn and Youngprapakorn 1987). The farm has made an offer to the Thai government to provide crocodiles for restocking programs, but as yet no such program has been developed.

A major conservation concern has been the interbreeding of



Juvenile Siamese crocodile, *Crocodylus siamensis* (Photo by F.W. and S. King).

C. porosus with *C. siamensis* on the Samutprakarn farm. The hybridization of the species has actually been encouraged at the Samutprakarn farm because the hybrids grow faster, have higher survival rates, and produce larger clutches (Groombridge 1982). The hybridization was the result of deliberate attempts to cross the two species, and was viewed as somewhat of a scientific achievement by the farm management (Youngpraprakorn 1990). Actually, hybridization among members of the genus *Crocodylus* is not uncommon in captivity, and represents a threat to the genetic integrity of the species involved. This is especially true for *C. siamensis* because there are no confirmed wild populations in Thailand, and the bulk of the captive specimens are maintained at the Samutprakarn farm. No known efforts have been made to separate a pure stock of *C. siamensis* at the farm.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 3-severely depleted/endangered
Management Program: E.3-farming

Tomistoma (*Tomistoma schlegelii*)

Status of Wild Populations: No recent survey data are available. This species was formerly found in southern Thailand (Taylor, 1970), but reports from the late 1970s indicate that it has been extirpated from the region, or survives in very low numbers.

Management and Conservation Programs: Legally protected by Ministerial Regulation in 1982 (Klemm and Navid 1989). *Tomistoma* is maintained in captivity at the Samutprakarn Crocodile Farm, where the 1985 stock numbered 200+ (including five adults). Despite claims to the contrary, it appears that no captive breeding of *Tomistoma* has been done at Samutprakarn, and that all the animals have come from the wild. The only confirmed captive breedings have been in the Bronx Zoo and the Miami Metro Zoo (J. Behler, pers. comm.).

Country Rating
Survey Data: I-no survey planned

Wild Population Status: 3-severely depleted/endangered
Management Program: C-legislation

Contact: Phairot Suvanakorn, Charoon Youngprapakorn, Dr. Parntep Ratanakorn

Vanuatu

Saltwater crocodile

Saltwater crocodile (*Crocodylus porosus*)

Status of Wild Populations: Groombridge (1982) cites Dickinson (1981) who reported that the main crocodile population (approximately 50) is located in the Silver River on Vanua Lava in the Banks Island group, with isolated individuals being sighted on south Espiritu Santo and west Malo. This is the easternmost reported range for the species. Crocodiles of all sizes have been sighted, indicating that breeding is taking place. In 1983, D. Leeders reported on a survey of Vanua Lava in *Naiba, The Journal of the Vanuatu Natural Science Society*. He saw no crocodiles. The Banks Island group is also located only a few hundred miles from Vanikolo Island in the Santa Cruz group of the Solomon Islands, where a small population is known to exist (H. Messel, pers. comm.). Sporadic hunting of crocodiles has been reported (Groombridge 1982).

M.R. Chambers and D. Essom of the Environment Unit, Ministry of Lands, Port Vila, Vanuatu, surveyed crocodiles in 1989. They reported that the available habitat for the crocodiles appears to be extensive and in good condition but that there are very few crocodiles remaining on the island, perhaps only two or three. No young have been seen for several years and it appears that breeding has ceased. Local people believe that crocodiles were accidentally introduced to Vanua Lava in the mid-19th century. Crocodiles are reported to have been decimated by cyclones and by being shot. The crocodile population now appears to be non-viable. Crocodiles are unpopular among the islanders as they are thought to eat domestic stock and have recently begun to attack people. In view of the expense and difficulty of building up the crocodile population, it was recommended that nothing be done to save the crocodiles from probable extinction, which would mean a shrinkage of the crocodiles' extensive range. This recommendation is controversial and could be opposed by many conservationists.

Management and Conservation Programs: None.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 3-severely depleted/endangered
Management Program: B-none

Contact: Prof. Harry Messel, M.R. Chambers , D. Essom

Vietnam

Saltwater crocodile
Siamese crocodile

Saltwater crocodile (*Crocodylus porosus*)

Status of Wild Populations: No recent survey data are available. Some information from the mid-1970s suggests that this species was still found in the lower Mekong River and the Rung Sat Swamp (Nowak 1976).

Management and Conservation Programs: Apparently there is no legal protection for this species (Whitaker and Whitaker 1989b).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: B-none

Siamese crocodile (*Crocodylus siamensis*)

Status of Wild Populations: Presumed to have been present in Vietnam in the lower Mekong River. Its present status is unknown, though there are recurrent reports that substantial numbers occur on farms. There may still be important populations in the wild.

Management and Conservation Programs: *C. siamensis* does not have legal protection (Whitaker and Whitaker 1989b).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: B-none

Contact: Prof. Vo Quy

Country Accounts

North and South America

Argentina

Broad-snouted caiman
Yacare

Broad-snouted caiman (*Caiman latirostris*)

Status of Wild Populations: Waller (1987) reviews the known distribution of both species of *Caiman* in Argentina but does not present data on current status. This species was reported to be extirpated in the Pilcomayo, Paraguay, and the lower Paraná in the provinces of Jujuy, Formosa, Chaco, Santa Fe, and Entre Rios (Freiberg, in Groombridge 1982). However, Scott et al. (1988) found *C. latirostris* in the Pilcomayo in Paraguay adjacent to Formosa, and King and Videz Roca (1989) also report it in the Pilcomayo of Bolivia near the border of Argentina and Paraguay. A population, which numbered approximately 380 individuals in 1979, was reported to remain in the Iguazú National Park in Missiones province. A larger number (5,000-7,000) was reported from the Esteros del Iberá in Corrientes (Groombridge 1982). Waller (1989) reported a population of 500-800 subadult and adult *C. latirostris* on a 10,000 ha cattle ranch in Corrientes.

Management and Conservation Programs: Caiman are protected by a ban on commercial hunting. According to Klemm and Navid (1989) the hunting of this species is regulated by state laws, for which no information is available. Interstate and international commerce is banned by federal law (Act No. 22.421 of 1981).

No national management program has been enacted but a number of private individuals are starting farming projects (Anon. 1987). Larriera (1990) reports on plans to establish a population monitoring program and a management program based on egg collection and rearing for reintroduction into the wild.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: E.3-farming

Yacare (*Caiman yacare*)

Status of Wild Populations: Freiberg (in Groombridge 1982) and Medem (1983) reported populations in the 1970s to be extremely depleted. However, Fitch and Nadeau (in Groombridge 1982) estimated population size in the Esteros del Iberá in Corrientes province to be 200,000. On one 10,000 ha ranch in Corrientes, Waller (1989) estimates the *C. yacare* population to be 1,000 adults and subadults.

Management and Conservation Programs: See *C. latirostris* account above. Recently, private commercial interest in farming has developed (Anon. 1987).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: E.3-farming

Contact: Jorge Luis Cajal, Claudio Chehébar, Dra. Pia Urruzuno, Tomás Waller, Alejandro Larriera, Fundación Vida Silvestre Argentina (Grupo Herpetofauna)

Belize

American crocodile
Morelet's crocodile

American crocodile (*Crocodylus acutus*)

Status of Wild Populations: No systematic surveys have been done for *C. acutus* in Belize. A CITES-sponsored survey is currently being planned. Powell (1971) reported that *C. acutus* was rare on the mainland but more common on offshore islands. More recent reports suggest that some of these offshore populations may have been extirpated (King *et al.* 1982). The survey by Abercrombie *et al.* (1980) failed to find any *C. acutus*. However, interviews with hunters and former skin exporters suggest that American crocodiles are widely distributed along the coastline of Belize, including a number of offshore atolls. The largest remaining population was said to be on Turneffe Island, where a nesting population of 500-600 animals was reported in the early 1980s. The species is considered to be relatively common and increasing due to a ban on hunting (Perkins 1983).

Management and Conservation Programs: Upon attaining independence in 1981 Belize passed a comprehensive "Wild-

life Protection Act" and banned commercial wildlife trade for a period of seven years (Fuller et al. 1985). The government has no active management policy regarding crocodilians; however, at the request of the Belize government, a CITES survey is planned to begin in 1991.

Country Rating
Survey Data: II-surveys planned
Wild Population Status: 4-depleted/vulnerable
Management Program: C-legislation only

Morelet's crocodile (*Crocodylus moreletii*)

Status of Wild Populations: Powell (1971) reported that this species was severely depleted in Belize. More recently, Abercrombie *et al.* (1980) surveyed much of the northern half of Belize. They found crocodiles to be generally depleted, but relatively abundant in several areas, and estimated the total *C. moreletii* population (greater than nine months of age) as 2,200-2,500. These figures were considered to be underestimates. Nothing is known about population status in the southern half of the country.

Management and Conservation Programs: Protection status is the same as for *C. acutus*. A CITES survey has been requested by the government.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: C-legislation only

Contact: Oscar Rosado, Dr. Clarence Abercrombie, Howard Hunt, Prof. F. Wayne King

Bolivia

Broad-snouted caiman
Yacare
Black caiman
Dwarf caiman and Smooth-fronted caiman

Broad-snouted caiman (*Caiman latirostris*)

Status of Wild Populations: Surveys by King and Videz Roca (1989) show that *C. latirostris* is critically endangered in Bolivia. King and Videz Roca visited most of the species localities as reported by Medem (1983), and found the species still extant in only one of the localities (Río Pilcomayo) and in very low numbers. A small number of this species were reported by hide hunters and buyers to be still found in parts of the Ríos Itenez, Mamore, and the Beni.

Management and Conservation Programs: Although *C. latirostris* is not specifically mentioned in the wildlife protection legislation, this species is generally included in the regulations dealing with *Caiman crocodilus* (*yacare*). *Caiman* are protected by law (Decreto Supremo 16605), but illegal hunting has continued unabated (King and Videz Roca 1989).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 3-severely depleted/endangered
Management Program: C-legislation only

Yacare (*Caiman yacare*)

Status of Wild Populations: Following Medem (1960, 1983) and King and Burke (1989) *Caiman yacare* is considered a full species. Surveys conducted in 1986-1987 found this species in virtually all bodies of water throughout lowland Bolivia, although usually at low densities (King and Videz Roca 1989). Populations in easily accessible areas have been largely decimated. Densities ranged from 0.0/km in some rivers to 70.0/km in one lake. The overall mean density from 18 sites was 5.0/km, although in most areas densities were below 2.0/km.

Management and Conservation Programs: Although protected by legislation which regulates a wild harvest program (Decreto Supremo 16606 of 1979; Klemm and Navid 1989), illegal hunting is still widespread (King and Videz Roca 1989). The minimum legal size for commercial hunting of *C. yacare* is 1.5 m. A closed hunting season exists from 1 July to 31 December.

The export of *Caiman* hides from Bolivia is under a quota system. In 1985, a quota of 100,000 was established as part of a cooperative agreement between CITES and the Bolivian Forestry department (CDF). Annual quotas for 1986-1987 were established at 50,000, but three separate directors of CDF illegally sold the CITES export documents to hide exporters in Paraguay (King and Videz-Roca 1989). The export of 100,000 registered skins was permitted in 1988 under CITES cooperative agreement, but was stopped in 1989. Because of the illegal sale of the CITES country of origin export permits, at the present time CITES no longer accepts Bolivian permits.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: E.1-cropping

Black caiman (*Melanosuchus niger*)

Status of Wild Populations: Black caiman were historically widespread throughout northern and eastern Bolivia, but were heavily impacted by hide hunting during the period 1942-1960 (Plotkin et al. 1983). Surveys in 1986-1987 found black caiman to still be distributed throughout most of its historical range, but in very low numbers (King and Videz Roca 1989). Very few individuals, mostly juveniles or sub-adults, were encountered. Illegal commercial hunting is still taking place, indicating that in some areas *Melanosuchus* may still be found in reasonable numbers, but these populations are fast disappearing. Repro-

ductive populations of this species are reported to be found within the protected area of the Beni Biological Station (E. Ruiz, pers. comm.).

Management and Conservation Programs: Prior to 1979, Bolivian laws permitted the legal cropping of wild *Melanosuchus* populations (Decreto Supremo 08063 of 1967). Hunting was prohibited between 31 July and 1 January, and the minimum legal size was 2.5 m (Medem 1983). Nevertheless, these regulations had little effect in controlling the widespread hunting. Presently, the species is fully protected under Decreto Supremo 16606 of 1979 (Klemm and Navid 1989), but some illegal hunting continues (King and Videz-Roca 1989).

In August, 1990, a total of 25 adult black caiman (>2.2 m total length) were released in the Laguna Normandia, located adjacent to the Beni Biological Station near San Borja. These animals came from a group of approximately 150 captive individuals on the El Dorado cattle ranch where they had been brought, in the late 1970s, for the establishment of a commercial farm. The release project was sponsored by PRODENA, a Bolivian conservation group, in association with the Beni Biological Station and the owners of El Dorado. Plans are being made to monitor the released caiman.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 3-severely depleted/endangered
Management Program: D-restocking/reintroduction

Dwarf caiman (*Paleosuchus palpebrosus*) and Smooth-fronted caiman (*Paleosuchus trigonatus*)

Status of Wild Populations: Medem (1983) did not consider *P. trigonatus* to be rare in Bolivia. King and Videz Roca (1989) noted that both species are commonly found in northern Bolivia but only *P. palpebrosus* occurs in the central and southeastern parts of the country. Owing to the lack of commercial hunting of these species, populations are healthy.

Management and Conservation Programs: Both species of *Paleosuchus* are fully protected under Decreto Supremo 16606 of 1979 (Klemm and Navid 1989).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 5-not depleted
Management Program: C-legislation only

Contact: Geronimo Grimaldez Cordero, Dante H. Videz Roca, Dr. Mario Baudoin W., Luis Fernando Pacheco Acosta, Prof. F. Wayne King, Ernesto Ruiz Richi

Brazil

Common caiman
Yacare
Broad-snouted caiman
Black caiman
Dwarf caiman and Smooth-fronted caiman

Common caiman (*Caiman crocodilus*)

Status of Wild Populations: *C. crocodilus* is found throughout the Amazon drainage. The taxonomic differentiation of *Caiman crocodilus* from *Caiman yacare* is still somewhat unclear and there may be a zone of hybridization/intergradation with *C. yacare* in the Río Madeira (Brazaitis et al. 1990).

A number of population surveys have been conducted in the Brazilian Amazon for this species. Vanzolini and Gomes (1979) surveyed parts of the Río Japura and found *Caiman* to be relatively common. Magnusson (1979,1982) censused Lago Amana (effluent of the Río Japura), areas near the city of Manaus, and the Amazonas National Park on the Río Tapajos and found *Caiman* populations to be high in most areas. *Caiman* densities in the Río Tapajos ranged from 0.67/km to 6.43/km (33 km surveyed). Magnusson (1982) states that hunting for *Caiman* is widespread in the Brazilian Amazon but that the species is resilient to this hunting pressure because it breeds at a small size. This is supported by size data from confiscated skins (Rebelo and Magnusson 1983).

Management and Conservation Programs: All species of crocodilians are protected by Brazilian law banning commercial hunting (Klemm and Navid 1989). However, widespread illegal hunting occurs and skins are smuggled across the borders to Colombia, Bolivia, and Paraguay (Brazaitis et al. 1990).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 5-not depleted
Management Program: C-legislation only

Yacare (*Caiman yacare*)

Status of Wild Populations: *Caiman yacare* is principally found in the Río Paraguay drainage, the Pantanal, and north along the Río Guapore (Rio Mamore in Bolivia). A recent CITES sponsored survey covered most of the range of this species in Brazil (Brazaitis et al. 1990). Recent widespread hunting of *Caiman* has taken place throughout most of south central Brazil, and habitat loss and environmental pollution are also negatively impacting *Caiman* populations in the states of Acre, Rondonia, and Mato Grosso. Populations have declined dramatically in most areas, although in the Pantanal and in some inaccessible regions of Mato Grosso *C. yacare* are still classified as "common" (15-30/km; Brazaitis et al. 1990). However, hunting has altered population structure and a male-biased sex ratio with few large individuals is typical. Caiman have managed to survive in present numbers only because of their great resilience to hunting (reproducing at a small size), their ability to adapt to different habitat types, and their ability to become extremely secretive and wary (Brazaitis et al. 1988).

Management and Conservation Programs: Despite the outlawing of commercial hunting (Act No. 5197 of 1967;

Klemm and Navid 1989) in Brazil, poaching is commonplace. Local hunters operate throughout extensive areas of Acre, Rhondonia, and northern Mato Grosso. Hunting is done during the dry season, and skins are transported down river with the rising water levels of the early rainy season. The Río Abuna and the Río Guapore are major collection routes for skin purchasers. Shipments of thousands of skins are reported to move south each year from Manaus to Abuna or Brasilia, and then into Bolivia. Hunting in the Pantanal of Mato Grosso and Mato Grosso du Sul is also intensive, and done largely by groups of professional hunters who move into the area during the dry season and operate on private lands with or without the landowners' permission. Hides move from Brazil directly (or indirectly through Bolivia) to Asunción, Paraguay. The total volume of hides being smuggled out of Brazil each year is hard to estimate, but a figure of one million per year may not be an exaggeration (Brazaitis et al. 1988).

Plans for developing a management program for the species are underway. Two government agencies, the Instituto Brasileiro de Meio Ambiente e dos Recursos Naturais Renovaveis (IBAMA), and Centro de Pesquisa Agropecuaria do Pantanal (EMBRAPA) are conducting investigations on the ecology of wild populations. Three private organizations are also involved in *Caiman* studies. Fundaçao Estadual ed Meio Ambiente (FEMA) is conducting surveys for *C. yacare* in the Pantanal. Sociedad de Defensa do Pantanal (SODEPAN) and the Associacao Brasileira de Criadores de Jacare are supporting the government's efforts to crack down on poaching in the Pantanal. A number of government-sponsored and private *C. yacare* ranches have begun operation (Brazaitis et al. 1990).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: E.2-ranching

Broad-snouted caiman (*Caiman latirostris*)

Status of Wild Populations: Populations have declined dramatically due to overhunting, but localized populations remain. Vanzolini (in Groombridge 1982) reported that the species was still reasonably abundant along the coast of Sergipe, but only small individuals could be found. Gudyas (in Groombridge 1982) also reported populations between Porto Alegre and the Uruguayan border (Lagoa dos Patos, Lagoa Merim). Yamashita (pers. comm.) reports that good populations are found in the Río Doce (Espirito Santo state). In the São Mateus area in northern Espirito Santo state, especially near Conceição da Bara, this species is common where habitat is available. Brazaitis et al. (1990) note that hunting pressures on this species have not declined significantly since the implementation of the CITES treaty, but that locally common populations exist in the state of São Paulo. Besides commercial hide exploitation, much of the hunting pressure is of a subsistence nature (Brazaitis et al. 1988).

Management and Conservation Programs: *Caiman latirostris* is protected by law in Brazil; Federal Law No. 5.197 of 1967 (Verdade and Lavorenti 1990) and Portaria of 13.5.1973 (Klemm and Navid 1989), but this has done little to reduce hunting. Commercially oriented ranches have begun operations in the states of São Paulo and Río Grande do Sul (Brazaitis et al. 1990). The University of São Paulo is developing a program of captive breeding for reintroduction of this species in Brazil (L.M. Verdade, pers. comm.).

Country Rating
Survey Data: II-surveys planned
Wild Population Status: 3-severely depleted/endangered
Management Program: E.2-ranching

Black caiman (*Melanosuchus niger*)

Status of Wild Populations: Black caiman were at one time found throughout much of the Brazilian Amazon, but today have been extirpated from many of these areas (Plotkin et al. 1983). Hide hunting was particularly intense in the early 1950s (Fittkau 1973), but was still in evidence in the late 1970s (Magnusson 1979). Magnusson (1979) found a small population of *Melanosuchus* in the Tapajos National Park. The largest concentration was in a small lake, Lago das Piranas, where 16 individuals were seen over a distance of 3 km. Brazaitis et al. (1988, 1990) report that the species is seriously depleted throughout central and southern Brazil, but did find localized populations in the Río Galera in Mato Grosso, the Río Madeira in Amazonas, and the Lago region at Amapá.

Management and Conservation Programs: As with all wildlife, commercial hunting of the black caiman is prohibited. Nevertheless, poaching continues. No ranching operations for *Melanosuchus* are known at this time in Brazil.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 3-severely depleted/endangered
Management Program: C-legislation only

Dwarf caiman (*Paleosuchus palpebrosus*) and Smooth-fronted caiman (*Paleosuchus trigonatus*)

Status of Wild Populations: Magnusson (1979) found moderate densities (to 4.0/km) of *P. trigonatus* in the Río Tapajos National Park (49.8 km surveyed). No *P. palpebrosus* were seen and the species was assumed not to occur in the park. Brazaitis et al. (1990) reported that both species were widely distributed throughout central Brazil, although the southern limits of their distribution are unclear. Although limited hunting occurs, it does not seem to have had much of a negative impact on population levels.

Management and Conservation Programs: *Paleosuchus* is legally protected from commercial utilization.

Country Rating
Survey Data: III-basic survey data

Wild Population Status: 5-not depleted
Management Program: C-legislation only

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Colombia

American crocodile
Orinoco crocodile
Common caiman
Black caiman
Dwarf caiman and Smooth-fronted caiman

American crocodile (*Crocodylus acutus*)

Status of Wild Populations: The work of Medem (summarized in Medem 1981) has left little doubt that populations of *C. acutus* in Colombia were extremely depleted from the 1950s through the 1970s. Isolated populations may still remain in the lower and middle Magdalena River, and in its tributaries (the Cauca and the San Jorge rivers) where dense mats of water hyacinth (*Eichornia crassipes*) make hunting difficult (Medem 1981). Little is known about the status of populations along the Pacific coast. The Colombian government has requested a CITES sponsored survey.

Management and Conservation Programs: Since 1969, all crocodilians have been protected by Colombian law (Klemm and Navid 1989), but this has apparently done little to control hunting (Medem 1981). A total of 22 crocodilian farms have been licensed by the Colombian government, of which three are authorized to rear *C. acutus*. Near the town of Zambrano, Monterrey Forestal, a timber company, has begun a captive rearing program for crocodilians. Initial work has been with *Caiman crocodilus*, but plans call for the development of a conservation program and eventual commercial rearing of *C. acutus*. Captive breeding of *C. acutus* began in 1987 (Rodriguez 1988). According to Colombian legislation pertaining to farms, commercial utilization of farm-reared animals can only be of second generation captive individuals, and 5% of the young produced must be returned to the Instituto Nacional de Recursos Naturales (INDERENA) for use in restocking programs. The founder stock of farms can be derived from the capture of wild individuals (with an authorized permit), but cannot exceed 10 animals, and all captive animals must be marked (Resolution N. 0017-87).

Country Rating
Survey Data: II-surveys planned
Wild Population Status: 3-severely depleted/endangered
Management Program: E.3-farming

Orinoco crocodile (*Crocodylus intermedius*)

Status of Wild Populations: No recent surveys have been conducted, but populations of *C. intermedius* are known to be extremely depleted in Colombia. Medem (1974, 1976) surveyed the Colombian llanos in 1974 and 1976, and found evidence of only 280 adult crocodiles throughout a large part of the drainages of the Arauca, Casanare, Meta, and Vichada rivers.

Management and Conservation Programs: The Orinoco crocodile is legally protected in Colombia, but this has had little effect on hunting (Medem 1969). No other management programs are currently underway, although the government has requested a CITES sponsored survey of the country. Regulations pertaining to the commercial rearing of this species are the same as for *C. acutus*, but no known farming operations are in existence.

Country Rating
Survey Data: II-surveys planned
Wild Population Status: 3-severely depleted/endangered
Management Program: C-legislation only

Common caiman (*Caiman crocodilus*)

Status of Wild Populations: Populations of *Caiman* in Colombia are divided into four subspecies: *C. c. chiapasius* along the Pacific coast and the Caribbean coast as far east as the Sinu River, *C. c. fuscus* on the Caribbean coast east of the Sinu river, *C. c. crocodilus* in the interior Orinoco and Amazon river drainages, and *C. c. apaporiensis* in the Apaporis River in the Amazon drainage. No recent survey data are available. Informal surveys by Medem and Foote in the 1970s (Medem 1981) suggested that populations were depleted in the Amazon and Orinoco drainages, but that relatively healthy populations still existed in some areas. Illegal hunting was reported to be common, and the small size of the skins indicates that the adult population has been overhunted (Medem 1980). The little-known subspecies *C. c. apaoriensis* is apparently restricted to the upper regions of the Apaporis river in southeastern Colombia. Since the original work done by Medem, very little is known about the status of wild populations of this subspecies. The Colombian government has requested a CITES survey of the country's crocodilians.

Management and Conservation Programs: *Caiman* are nominally protected by law in Colombia. In recent years a large number of *Caiman* farms have started. The Colombian government reported 22 registered *Caiman* farms in 1989. Many of these farms are also planning to rear *C. acutus* or other animals such as iguana or capybara. Farms are required to obtain permits to take breeding stock from the wild, and are obligated to return 5% of the young produced to INDERENA for the restocking of wild populations (M. Rodriguez, pers. comm.). The founder stock can be taken from the wild (with an authorized permit), but may not exceed 4,000 individuals (Resolution

N. 0017-87). Ranching or cropping programs are illegal. No commercial rearing of *C. c. apaporiensis* is permitted.

Country Rating
Survey Data: II-surveys planned
Wild Population Status: 4-depleted/vulnerable
Management Program: E.3-farming

Black caiman (*Melanosuchus niger*)

Status of Wild Populations: Black caiman were at one time abundant in the Colombian Amazon region from the southern city of Leticia to the Río Atacuari along the border with Peru, and in the Putumayo, Caquetá, and lower Apaporis rivers (Plotkin et al. 1983). Commercial hide hunting began in the 1940s and populations were rapidly depleted. Wild populations of black caiman have been virtually extirpated in Colombia. Surveys by biologists in the 1970s found very few individuals in the Amazon and Putamayo region (Plotkin *et al.* 1983).

Management and Conservation Programs: *Melanosuchus* has been legally protected in Colombia since 1969 with the implementation of a total ban on hunting (Resolution No. 411). Hunting and egg collection is also specifically banned for *Melanosuchus* (INDERENA Resolution No. 573 of 1969; Plotkin *et al.* 1983), but little enforcement has been in effect and significant commercial hide hunting continued into the 1970s. Regulations pertaining to the commercial rearing of this species are the same as for *C. acutus*, but no known farming operations are in existence.

Country Rating
Survey Data: II-surveys planned
Wild Population Status: 3-severely depleted/endangered
Management Program: C-legislation only

Dwarf caiman (*Paleosuchus palpebrosus*) and Smooth-fronted caiman (*Paleosuchus trigonatus*)

Status of Wild Populations: Very little is known about the status of these species in the wild. They are secretive species, rarely seen by day. Because of their highly developed osteoderms, virtually no hide-hunting for these species has occurred. However, in many areas they are killed for food, especially by indigenous tribes, or by hide hunters when mistaken for *Caiman crocodilus* (Medem 1981). Medem (1981) considered these species not to be endangered in Colombia.

Management and Conservation Programs: Both species of *Paleosuchus* are protected under Colombian law.

Country Rating
Survey Data: II-surveys planned
Wild Population Status: 5-not depleted
Management Program: C-legislation only

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Costa Rica

American crocodile
Common caiman

American crocodile (*Crocodylus acutus*)

Status of Wild Populations: Fuller (1983) conducted preliminary surveys for crocodilians in the Tortuguero and Tempisque rivers. Only one juvenile crocodile was observed in the Tortuguero River, but crocodiles were relatively abundant in the lower Tempisque (mean 3.7/km). Fuller notes that crocodiles appear to be widely distributed throughout the lowlands of Costa Rica. Allsteadt (pers. comm.) reports this species is more commonly found along the Pacific coast, and that stable populations occur in the Tempisque, Tarcoles, and San Carlos rivers, and in Santa Rosa and Corcovado National Parks. This species is not hunted commercially, but numerous problem crocodiles are killed annually.

Management and Conservation Programs: Crocodiles have been legally protected in Costa Rica since 1970. The current legislation is Decreto 15273A of 1984 (Klemm and Navid 1989). An experimental farm, presumably for both species, has been proposed by Bolanos (pers. comm.) for both conservation and economic purposes.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: C-legislation only

Common caiman (*Caiman crocodilus*)

Status of Wild Populations: Reported to be common in wet lowland areas throughout the entire country (J. Allsteadt pers. comm.). Allsteadt has been conducting surveys of the *Caiman* population in the Caño Negro National Wildlife Refuge, where the population is recovering from intense hunting pressure (which stopped in 1980 with the end of illegal trade through Nicaragua). Total *Caiman* population size in the area was estimated to be over 2,500, with dry season densities up to 166/ha in lagoons, and average densities in rivers and canals being 85/km. Annual surveys between 1986 and 1989 indicate that the caiman population has increased. Nesting is frequent and the population appears to be recovering rapidly.

Management and Conservation Programs: Costa Rica has had strict wildlife protection laws since 1970. *Caiman* are currently protected under the Decreto 15273A of 1984. There is a ban on commerce in wildlife, and the Subdireccion General de Vida Silvestre allows commercial exports of wildlife only from registered captive breeding centers (Fuller et al. 1985).

An experimental commercial farm was being established along the Atlantic coast near Siquires in 1984 (Luxmoore 1985, Wade 1987). Stock in 1984 numbered some 100 *Caiman* (1-3 years old). Currently no other active management programs involving crocodilians have been established.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 5-not depleted
Management Program: C-legislation only

Contact: John Allsteadt, David Norman, Carlos Eduardo Salas Araya, Earl Junier Wade, Juan R. Bolaños

Cuba

American crocodile
Cuban crocodile
Common caiman

American crocodile (*Crocodylus acutus*)

Status of Wild Populations: Mainland populations were reported by Varona (1987) to be depleted and declining. Better populations were said to be found on offshore islands along both the northern and southern coasts. Varona (1980, 1987) reports that populations on offshore islands are being destroyed and only remain in the most isolated areas. The species was reported to be more common on Isla de la Juventud (Isle of Pines), especially on the southwest corner of the island and in the Lanier Swamp. However, reports by Ramos (1989) indicate that *C. acutus* is commonly found on mainland Cuba in the Zapata and Birama swamps (near Manzanillo), but no survey data are available. Ottenwalder (pers. comm., Oct. 1990) reports that *C. acutus* are locally common in Cuba, with the largest population being located in the Birama Swamp and surrounding areas near the mouth of the Cauto River.

Management and Conservation Programs: According to Ramos (1989), crocodile hunting was prohibited in 1967; however, Groombridge (1982) reports that hunting is only banned locally (Res. No. 21-79). Ottenwalder (pers. comm.) indicated that the current resolution (Decree No. 103 of 1982) permanently protects both species of *Crocodylus* and even *Caiman crocodilus* throughout mainland Cuba, the Isle of Pines, and surrounding archipelagos.

There are presently at least five crocodile farms in Cuba (J. Ottenwalder, pers. comm., Oct. 1990). The first and largest farm (Criadero de Cocodrilos de Laguna del Tesoro) was established in 1959 along the northern boundaries of Laguna del Tesoro, a freshwater lagoon situated in the southeastern region of the Zapata Swamp, Matanzas Province. This facility was created as part of the newly declared Zapata Swamp National Park, and many specimens of *C. acutus* and *C. rhombifer* were collected from the swamp to provide farm stock. The facility has been run by the Ministry of Fisheries Industry since 1975, within the Department of Experimental Breeding since 1980. The Laguna del Tesoro farm is also an important tourist facility receiving an estimated 17,000 visitors annually (J. Ottenwalder, pers. comm. Oct. 1990). The adult *C. acutus* population at this facility was estimated to be 50 (Luxmoore et. al 1985). Hybridization with *C. rhombifer* became a serious problem during the early operation of the farm but attempts have been made to isolate pure stocks under the management of the Ministry of Fisheries Industry from 1974-1980.

Due to overcrowding at the Laguna de Tesoro facility, thousands of crocodiles were reportedly slaughtered in 1965. During the efforts to separate pure stocks in the 1970s it appears that a large number of crocodiles (probably largely hybrids) were killed. FAO fisheries statistics for 1976, 1977, and 1980 reveal that 531 metric tons of crocodiles were reported, suggesting the slaughter of thousands of crocodiles. Furthermore, following the decision to concentrate on *C. rhombifer* at the Laguna del Tesoro farm, approximately 150 adult *C. acutus* and most of the remaining hybrids were harvested between 1980 and 1982 (J. Ottenwalder, pers. comm., Oct. 1990).

Four additional captive rearing centers are currently in operation, three of which have *C. acutus* stock. Of these three, one is a closed-cycle breeding farm and two are ranches rearing wild-produced hatchlings (Ramos 1989). Ottenwalder (pers. comm., Oct. 1990) reports a closed-cycle *C. acutus* farm operating in Sabanalamar (established 1986, 35 adult females, 15 adult males), and two ranching operations in Jobabito (Las Tunas Province; established 1988; 650 juveniles in August 1988), and Birama (Granma Province; proposed to open in 1989). Long-term plans for the Birama facility include closed-cycle breeding. Another ranching facility is being planned for *C. acutus* in Nuevitas. These rearing centers are being developed as part of a National Program for the Protection and Rational Utilization of Crocodiles, and are operated through the Empresa Nacional para la Protección de la Flora y Fauna, a governmental agency working under a cooperative agreement with the Ministry of Fisheries Industry. The objectives of the project are commercial exploitation (hides and meat), and conservation of both native species of crocodiles. Plans call for the establishment of 10 crocodile farms/ranches by 1995 (J. Ottenwalder, pers. comm., Oct. 1990).

Surveys of both species of crocodiles in Cuba are presently being planned (Ottenwalder, pers. comm.).

Country Rating
Survey Data: II-surveys planned
Wild Population Status: 4-depleted/vulnerable
Management Program: E.2-ranching, E.3-farming

Cuban crocodile (*Crocodylus rhombifer*)

Status of Wild Populations: Recent populations have been restricted to the Zapata Swamp and the Lanier Swamp, the latter on the Isla de Pinos. Extensive hunting of *C. rhombifer* (and *C. acutus*) in the early part of the century is reported to have resulted in the killing of over 90,000 crocodiles over a period of 10 years (Cosculluela 1918, cited in Varona 1966). Recent reports suggest that the Lanier Swamp population may have been extirpated (Ramos 1989) and that the introduction of *Caiman crocodilus* played a significant role. Juvenile *C. rhombifer* have reportedly been found in the stomachs of

Caiman in the Lanier Swamp, but this indicates that some breeding *C. rhombifer* must still remain (J. Ottenwalder, pers. comm., Oct. 1990). The number of *C. rhombifer* remaining in the Zapata Swamp is unknown, but Ramos (1989) reports that "large numbers" are found. Plans for a survey of wild crocodile populations are presently being developed (Ottenwalder, pers. comm.)

Management and Conservation Programs: Legal protection is as described above for *C. acutus*. As with *C. acutus*, a large number of the wild stock in the Zapata Swamp was collected in 1959 to form a captive breeding colony at Laguna del Tesoro. Hybridization with *C. acutus* threatened the loss of the species, and from 1974 to 1980 a pure stock of *C. rhombifer* was segregated. Another closed-cycle breeding operation was established in 1986 on the Isle of Pines (Cayo Potrero). Breeding stock in August 1988 numbered 35 females and 15 males. Offspring produced by this breeding operation are to be used for commercial purposes and also for future reintroduction programs in the Lanier Swamp (J. Ottenwalder, pers. comm., Oct. 1990). Another farm for *C. rhombifer* is currently being planned in the Zapata Swamp near the La Habana-Matanzas province border. Both these latter farms are being operated by the Empresa Nacional para la Protección de la Flora y Fauna (see *C. acutus* account above). An additional facility for *C. rhombifer* was reportedly planned at Tasajera, near Habana, but apparently was never finished (J. Ottenwalder, pers. comm., Oct 1990).

Total adult population at the Laguna del Tesoro facility is approximately 10,000, with 1,500 breeding adults. This total includes some *C. acutus* and hybrids that have managed to remain in with the *C. rhombifer* stock. Sex ratio among adults is approximately 1:1.5 (males:females), and the annual production of hatchlings is between 5,000 and 7,000 (J. Ottenwalder, pers. comm., Oct. 1990). The total number of *C. rhombifer* removed from the wild and placed on farms has been estimated at 36,000 (Luxmoore et al. 1985).

The only commercially operative farm at present is the one at Laguna del Tesoro. Ottenwalder (pers. comm., Oct. 1990) was told by farm personnel that skins are not being exported, but are sold locally to Cuban artisan companies ($1/cm) for the elaboration of leather goods (purses, wallets, belts, shoes, suitcases, cigar boxes and key rings). Meat is sold locally at $2.45/kg to the Institute of Tourism (INTUR) for sale at INTUR run restaurants. Leather goods made from crocodile skins are also sold by INTUR along with other crocodile byproducts (tooth necklaces, stuffed heads, claw key rings). Juvenile crocodiles that die in farms are also stuffed and marketed by INTUR (J. Ottenwalder, pers. comm., Oct 1990).

Captive breeding of *C. rhombifer* has also taken place in the Zoo in Havana, in the United States at the Bronx Zoo and the National Zoo, and in zoos in Stockholm (Sweden), Wroclaw (Poland), and Ho-chi Minh City in Vietnam (J. Ottenwalder, pers. comm., Oct. 1990, Honegger and Hunt 1990).

Country Rating
Survey Data: II-surveys planned
Wild Population Status: 3-severely depleted/endangered
Management Program: E.2-ranching, E.3-farming

Common caiman (*Caiman crocodilus*)

Status of Wild Populations: An introduced population of *Caiman crocodilus* became established on the Isle of Pines (Isla de Juventud) in 1959. The founder population consisted of nine individuals, presumably *C. c. fuscus*, that were in captivity at the "El Dique" Fluvial Re-population Center (Varona 1976). Although no systematic censuses appear to have been conducted, the 1988 population size was estimated to be 1,000-3,000 (J. Ottenwalder, pers. comm., Oct. 1990). Some reports indicate that the feral caiman have played a significant role in the decline (and possible extirpation) of the *C. rhombifer* population (Ramos 1989).

Management and Conservation Programs: An attempt to eradicate *Caiman* from the Lanier Swamp is being planned by the Ministry of Fisheries Industry. Larger animals would be utilized for their skin and meat and juveniles stuffed for sale to tourists (J. Ottenwalder, pers. comm., Oct. 1990).

Country Rating
Survey Data: II-surveys planned
Wild Population Status: 1-unknown
Management Program: B-none

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Dominican Republic

American crocodile

American crocodile (*Crocodylus acutus*)

Status of Wild Populations: Surveys done by Ottenwalder and Inchaustegui (pers. comm, Ottenwalder 1988) and Thorbjarnarson (1986) found only one small coastal population in the Río Massacre along the northwestern border with Haiti. The largest remaining *C. acutus* population on the island of Hispaniola, and one of the largest anywhere for this species, is located in Lago Enriquillo, a large hypersaline lake. Nesting studies by Ottenwalder and Inchaustegui indicate that 100-150 nests are laid annually in the lake, and total adult population size is 385-525 (Thorbjarnarson 1986). Low hatchling survivorship due to the lake's high salinity is a problem.

Management and Conservation Programs: Crocodiles have been legally protected in the Dominican Republic since 1978 (Ley 85 and Decretos de Veda, J. Ottenwalder, pers. comm.), although little enforcement takes place. The Lago Enriquillo population is protected in Isla Cabritos National Park. The Río Massacre region was also recently designated as a national park (Parque Nacional Montecristi; J. Ottenwalder, pers. comm.).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: C-legislation only

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Ecuador

American crocodile
Common caiman
Black caiman
Dwarf caiman and Smooth-fronted caiman

American crocodile (*Crocodylus acutus*)

Status of Wild Populations: The American crocodile was at one time very abundant along the coast of Ecuador (King et al. 1982). A survey for *C. acutus* by Parrales et al. (1980), conducted in late 1978, showed that small remnant populations remained in the Estero Penafiel, the Río Churute and the Río Guyas. More recently (1987), Asanza (pers. comm.) counted approximately 20 crocodiles in the rivers and channels near San Lorenzo and in the Miguel-Cayapas river (Esmeraldas Province). In the Esmeraldas and Aguas Verdes, Asanza reported seeing 40 individuals. In the Manglares-Churute Reserve and Estero Peñafiel 60 well-dispersed individuals (juveniles and adults) were counted. Another 30 individuals were counted in 1987 at Taura, on land owned by the Ecuadorian Air Force. During the 1982-1983 El Niño, approximately 20 crocodiles were found near Yaguachi (Guyas Province) (Asanza, pers. comm.).

Management and Conservation Programs: Hunting for crocodiles is banned locally (Groombridge 1982), and the commercial export of wildlife is prohibited (Fuller et al. 1985). In 1985-1986 the Ecuadorian Ministry of Agriculture assigned five million sucres (about U.S. $50,000) for a conservation program for *C. acutus* in the Guyas river system, but this project failed (E. Asanza, pers. comm.).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: C-legislation only

Common caiman (*Caiman crocodilus*)

Status of Wild Populations: The two recognized subspecies of *Caiman crocodilus* in Ecuador are *C. c. chiapasius* on the Pacific coast and *C. c. crocodilus* in the Amazon drainage. Populations of *C. c. chiapasius* were considered by Medem (1973) to be on the verge of extinction. Asanza (pers. comm.) reported caiman to be found throughout the coastal region in low numbers. During a 1987 survey of 20 km along the Esmeraldas river 40 caiman were counted, and near Quinindé (Esmeraldas river) 30 individuals were counted along 10 km of river. Asanza also reported seeing six individuals near the town of Vinces in 1987.

Numbers of *C. c. crocodilus* were not reported to be severely depleted in the early 1970s (Medem 1973). Jahoda (1990) reported that although *Caiman* are hunted for food, they remain widespread throughout the Amazon region. Asanza (pers. comm.) reports *Caiman* are common throughout the white and black water systems in the Amazon of Ecuador. The population of caiman in the Cuyabeno lake system was estimated to be more than 2,000, with good populations also reported from Limoncocha and Zancudococha lagoons. *Caiman* are sympatric with *Melanosuchus* in all areas (Asanza, pers. comm.).

Management and Conservation Programs: *Caiman* are completely protected by law in Ecuador (Groombridge 1982). Asanza (pers. comm.) reported seeing five "cropping farms" with *Caiman c. chiapasius* kept in ponds in Guyas and Esmeraldas Provinces in 1987.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: C-legislation only

Black caiman (*Melanosuchus niger*)

Status of Wild Populations: Medem (King 1973) stated that Ecuador was the only place where *Melanosuchus* was not on the verge of extinction. Small populations are known to exist in several parts of the Ecuadorian Amazon (Plotkin et al. 1983), mostly in isolated oxbow lakes such as Limoncocha and Zancudococha (Asanza, pers. comm.; Jahoda 1990). Miyata (in Groombridge 1982) reports that the species may be relatively common in the lower Río Aguarico and the Río Yasuni-Rio Lagartococha area near the Peruvian border. The Zancudococha population appears to be a healthy one with an estimated population size of slightly over 100 (Jahoda, in litt. April 5, 1990); however, based on two years' census data Asanza (pers. comm.) estimated total population size to be 260, with a mean density of 23.0/km. Asanza also reports populations of *Melanosuchus* in the oligotrophic lake system in the Cuyabeno region. In recent years an illegal trade in small (40-120 cm total length) live *Melanosuchus* has emerged. Although their final destination is unknown, these animals are being illegally exported over the Colombian and Peruvian borders (Asanza, pers. comm.).

Management and Conservation Programs: The black caiman was not protected by the wildlife resolution of 1970, but is included in the total ban on export of commercial wildlife (Plotkin et al. 1983). Efforts to have the Zancudococha lake protected as a wildlife reserve have been unsuccessful to date. The population in Limoncocha is well protected owing to that site being a research station.

Efforts are underway to have the Zancudococha lagoon included in the national park system, and a biological station similar to the one on Limoncocha established (Asanza, pers. comm.).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: C-legislation only

Dwarf caiman (*Paleosuchus palpebrosus*) and Smooth-fronted caiman (*Paleosuchus trigonatus*)

Status of Wild Populations: Few survey data are available for these species in Ecuador. Medem (1983) mentions that *P. trigonatus* is common throughout the Napo and Pastaza river systems, but that *P. palpebrosus* is rarely encountered. The rarity of *P. palpebrosus* was not attributed to overhunting but may result from natural limits of its distribution (Medem 1983). Asanza (pers. comm.) reports that *P. trigonatus* is commonly found in black water rivers and clear water creeks up to 800 m elevation. He also found *P. palpebrosus* in the Cuyabeno region, in Yasuní National Park, and in the central and southern Amazon of Ecuador. Both species are consumed by indigenous tribes.

Management and Conservation Programs: Legal status unknown, but protected under the total ban on commercial hunting (Klemm and Navid 1989).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 5-not depleted
Management Program: C-legislation only

Contact: Dr. Eduardo Asanza, Dr. John C. Jahoda

El Salvador

American crocodile
Common caiman

American crocodile (*Crocodylus acutus*)

Status of Wild Populations: Virtually no information is available on the status of crocodilians in El Salvador. Powell (1971) reported that *C. acutus* was becoming scarce due to hunting, and that the best remaining populations were in Lake Guija and Lake Jocotal.

Management and Conservation Programs: El Salvador currently lacks any law regarding wildlife protection or management (Fuller et al. 1985).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 3-severely depleted/endangered
Management Program: B-none

Common caiman (*Caiman crocodilus*)

Status of Wild Populations: Very little information is available for this species in El Salvador. Populations were reported to be very depleted in the early 1970s. Throughout Central America populations of *Caiman* were in better shape than those of *C. acutus*, but the reverse was reported to be true in El Salvador (Powell 1971).

Management and Conservation Programs: Caiman are not legally protected. El Salvador serves as a transshipping ("laundering") nation of illegal caiman hides from Central and South America (F.W. King, pers. comm.).

From 1970 to 1971, 250 American alligators (*Alligator mississippiensis*) were shipped from Louisiana to El Salvador in an attempt to establish a commercial farm (Joanen and Ensminger 1978). The farm was located on the coastal plain near the mouth of the Limpa River approximately 65 km southeast of Zacatecoluca. Nesting was known to occur in 1972 (1 nest), 1976 (12 nests), and 1977 (17 nests). Reportedly, the farm ended operations around 1978-1980 and all the animals were killed. However, the possibility exists that some may have escaped and established an introduced population (F. W. King, pers. comm.).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 3-severely depleted/endangered
Management Program: B-none

Contact: No contacts currently available.

French Guiana

Common caiman
Black caiman
Dwarf caiman and Smooth-fronted caiman

Common caiman (*Caiman crocodilus*)

Status of Wild Populations: Medem (1983) comments on the species' presence in French Guiana, but presents no data on status. Medem (cited in Groombridge 1982) reported that the species was not in serious danger of extinction in 1973. Behra (1989) also mentions the presence of *Caiman* in the country, and indicates that it appears to be restricted to the coastal region, where habitat loss may become a significant threat (Behra, pers. comm.).

Management and Conservation Programs: Groombridge (1982) and Klemm and Navid (1989) indicate that there are no laws protecting this species in French Guiana, but Behra (in litt. July 13, 1990) reports that *Caiman crocodilus* is included in Article 3 of Decree No. 77-1295 of 1977. This article apparently prevents commerce and utilization of the species within French Guiana, but permits commercial export to France. French Guiana is a Department of France, so there is no customs control for shipments between the two countries.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 5-not depleted
Management Program: B-none

Black caiman (*Melanosuchus niger*)

Status of Wild Populations: Black caiman are found in the northeastern coastal Kaw region in French Guiana, principally in the seasonally flooded grasslands bordering the Kaw River and in the neighboring Savanne Angelique Swamp. Smaller numbers of black caiman were also reported from the area between the lower Approuague River and the Ounary River located to the east of the Kaw, and in the small Ouapou Creek to the south of the Montagnes de Kaw. *Melanosuchus* was formerly known from areas to the west of the Kaw including the Gabrielle Creek, and the Mahury River, but has since been extirpated. Along the border with Brazil black caiman were known from the lower Oyapock River and its tributaries, but they have been virtually eliminated from this area by Brazilian hunters (Plotkin *et al.* 1983).

The population in the vicinity of the Kaw was reported to be quite large, but has been severely impacted in recent years by hide hunting (Plotkin et al. 1983). Recent surveys by Behra (1989) have been conducted but no results have yet been published; however, Behra (pers. comm.) considers that the presence of juveniles in the Kaw region indicates that the population could recover if protected.

Management and Conservation Programs: Black caiman were protected in French Guiana in 1968 (Plotkin et al. 1983) but this law apparently did little to stop the commerce in *Melanosuchus* skins. Stronger legislation enacted in 1975 was not immediately effective, but resulted in officials seizing skins and appears to have reduced some illegal trade (Plotkin et al. 1983). Black caiman are included in Article 1 of the Decree No. 77-1295, which provides complete protection throughout the country (Behra, in litt. July 13, 1990). This species is also protected in the newly designated Kaw Swamp Sanctuary (Behra 1990).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 3-severely depleted/endangered
Management Program: C-legislation only

Dwarf caiman (*Paleosuchus palpebrosus*) and Smooth-fronted caiman (*Paleosuchus trigonatus*)

Status of Wild Populations: Medem (1983) reported that both species were relatively abundant not only in the interior forested regions of the country but also in the coastal swamps. Behra (pers. comm.) reported finding both species.

Management and Conservation Programs: Behra (in litt. July 13, 1990) reports that both species are included under Article 2 of Decree No. 77-1295, which permits subsistence exploitation but prohibits commercial exploitation.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 5-not depleted
Management Program: B-none

Contact: Olivier Behra

Guatemala

American crocodile
Morelet's crocodile
Common caiman

American crocodile (*Crocodylus acutus*)

Status of Wild Populations: Little is known about the status or distribution of *C. acutus* in Guatemala. Populations in the 1970s were reported to be severely depleted (Powell 1971, King *et al.* 1982). Lara (pers. comm.) reports that illegal hunting of crocodilians in Guatemala is severe. Also, many crocodiles are killed by fishermen when they become entangled in nets. A comprehensive CITES sponsored survey of crocodilians in Guatemala is currently being planned (Lara, pers. comm.).

Management and Conservation Programs: The Guatemalan government is currently beginning a captive breeding program for *Caiman crocodilus*. If successful, the program will be extended in the future to include *C. acutus* and *C. moreletii* (L.R. Loesener, in litt. Dec. 23, 1987). The Ley de Caza of 1970 prohibits the export of CITES Appendix I species (Fuller et al. 1985), but the species is listed as a game animal and a closed season has been established (Klemm and Navid 1989).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 3-severely depleted/endangered
Management Program: C-legislation only

Morelet's crocodile (*Crocodylus moreletii*)

Status of Wild Populations: No past survey work has been done on this species in Guatemala (Lara 1988). Populations are known to exist in the Peten region of the country, where in some areas they are not uncommon (M. Brenner, pers. comm.). The total population of *C. moreletii* in three lakes in the Peten in 1989 was 75 individuals (Lara, pers. comm.). The presence of reproductive-sized females and nesting suggests that the population, though depleted, is capable of recovery.

Management and Conservation Programs: Morelet's crocodile is legally protected under the 1970 Ley General de Caza (Klemm and Navid 1989). A management program for the species will be developed based on the results of the CITES survey (Lara, pers. comm.).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: C-legislation only

Common caiman (*Caiman crocodilus*)

Status of Wild Populations: No information is available concerning the past or present status of this species in Guatemala.

Management and Conservation Programs: This species is considered to be a game animal under Guatemalan law (Reglamento sobre la caza de lagartos, 1955), and may be hunted under license (Klemm and Navid 1989). The Guatemalan government has initiated a captive breeding program for economic and conservation purposes (L.R. Loesener, in litt. Dec. 23, 1987).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: E.1-cropping, E.3-farming

Contact: Dr. Leonel Rosales Loesener, Oscar F. Lara

Guyana

Common caiman
Black caiman
Dwarf caiman and Smooth-fronted caiman

Common caiman (*Caiman crocodilus*)

Status of Wild Populations: A recent country-wide survey was conducted by Gorzula and Woolford (1990). Generally, caiman were found to be widespread, but most populations were depleted (P. Hall, pers. comm.). Caiman densities varied widely according to habitat type, with high densities generally being found in shallow, vegetated swamps (Gorzula and Woolford 1990). Hide hunting appears to have had a significant effect on populations in many parts of the country, especially in channeled bodies of water where populations may have been reduced by as much as 90%. Mean uncorrected *Caiman* density in rivers, creeks, and canals was 1.86/km (663.6 km surveyed). In dammed conservancies a mean uncorrected density of 0.05/ha was observed (340 ha surveyed). A higher density (18.03/ha) was found in natural swamps (7.6 ha surveyed) (Gorzula and Woolford 1990).

Management and Conservation Programs: Under the Fisheries Regulations of 1966, *Caiman* is considered to be a game animal (Klemm and Navid 1989). The management of *Caiman* in Guyana is based on a cropping program and the sale of live hatchlings for the pet trade. Hide hunting was particularly intense during the period 1984-1989 (peaking in 1985), during which time approximately 500,000 skins were exported. During the period 1985-1989 a total of 54,194 live hatchling *Caiman* were exported from Guyana (Gorzula and Woolford 1990). In addition, an unregulated trade of stuffed juveniles exists, most of which are sold to tourists. A CITES established quota of 40,000 hides and 20,000 live hatchlings was established in 1987.

One farm (Nested Ltd.) is currently in operation, located approximately 22 km south of Georgetown. Stock in November 1989 numbered approximately 2,000 *Caiman*, including 500 adults. The first captive breeding took place in 1989 (P. Hall, E. Urueña, pers. comm.).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: E.1-cropping, E.2-ranching, E.3-farming

Black caiman (*Melanosuchus niger*)

Status of Wild Populations: This species is apparently restricted to the upper and middle Essequibo, Rupununi, Rewa, Berbice, and Takatu/Ireng river basins in Guyana. A survey conducted by Medem (1983), following a period of intensive hide hunting, found black caiman to be close to extinction in Guyana. During the period of peak hunting, Guyanese residents would apply for permits, then have Brazilian hide dealers from Boa Vista cross the border and organize hunting parties of local Amerindians (Plotkin *et al.* 1983)

The recent survey by Gorzula and Woolford (1990) found that *Melanosuchus* populations had apparently made a recovery in the northern Rupununi region, where they were locally abundant. The overall mean uncorrected population density was 7.4/km (41.2 km surveyed). No *Melanosuchus* were seen in the Berbice River.

Management and Conservation Programs: Following a period of intensive hunting, the Guyanese government initiated a five-year ban on caiman hunting in 1968 (Plotkin et al. 1983). As with *Caiman*, this species was classified as a game animal under the Fisheries Regulations of 1966 (Klemm and Navid 1989). No management program is currently in operation.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: C-legislation only

Dwarf caiman (*Paleosuchus palpebrosus*) and Smooth-fronted caiman (*Paleosuchus trigonatus*)

Status of Wild Populations: *Paleosuchus palpebrosus* was positively identified at 10 localities during the survey conducted by Gorzula and Woolford (1990). This species was mostly found in white sand regions of the coastal plain. Mean uncorrected density was 0.29/km (102.8 km surveyed). *Paleosuchus trigonatus* was reported to be present at four localities at very low densities. Combined *P. trigonatus/P. palpebrosus* densities averaged 0.93/km.

Management and Conservation Programs: These species are classified as game animals and may be taken under license (Klemm and Navid 1989). Hatchlings of both species, but

predominantly *P. palpebrosus*, are exported for the pet trade. The total number exported during the period 1985-1989 was 1,206. Little or no commercial trade exists, but subsistence hunting by Amerindian groups is common (Gorzula and Woolford 1990).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 5-not depleted
Management Program: E.1-cropping

Contact: Karen Pilgrim, Dr. Stefan Gorzula, Rabindra Singh, Phil Hall

Haiti

American crocodile

American crocodile (*Crocodylus acutus*)

Status of Wild Populations: The only survey of crocodiles in Haiti is that of Thorbjarnarson (1986, 1988a). Crocodiles are scattered in small populations around the Haitian coast. The largest remaining population is in Etang Saumatre, a landlocked lake near the border with the Dominican Republic. Total crocodile population size in Etang Saumatre in 1984 was estimated to be 450, with some 70 adults. Crocodiles are not widely hunted in Haiti due to religious taboos, but incidental mortality and habitat destruction are severely impacting coastal populations.

Management and Conservation Programs: Crocodiles are not legally protected and there are no wildlife management programs pertaining to this species in Haiti.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 3-severely depleted/endangered
Management Program: B-none

Contact: Dr. John B. Thorbjarnarson

Honduras

American crocodile
Common caiman

American crocodile (*Crocodylus acutus*)

Status of Wild Populations: Surveys of the Mosquitia region of northeastern Honduras were conducted by Klein in 1977. A low population density of *C. acutus* was found (mean 0.51/km), and the population size structure was biased towards small individuals (Klein, 1981). More recently (Feb-Jun 1989), a CITES sponsored survey was conducted, covering 1,162 km of rivers, lagoons, and lake habitat (King et al. 1990). The results of these surveys still show the *C. acutus* populations to be depleted (mean 0.34/km, range 0-2.4/km) and dominated by small individuals. Based on a sighting fraction of 0.20, the estimated average population density was 1.7/km. The largest surveyed populations were in the El Cajón reservoir (estimated population size 410) and in the Aguan river (estimated population size 75), both located along the Atlantic drainage. The few remaining populations still found in the Pacific drainage are all quite small, with a maximum estimated population size of 10 in the Choluteca river.

In June 1990 follow-up surveys of two areas (El Cajon reservoir, and the San Bernardo Estuary/Río Negro and the La Berbice Estuary) and first-time survey of the middle Patuca river were conducted (King and Cerrato 1990). Crocodile populations in the resurveyed areas were found to have not changed significantly. The Patuca River, which was surveyed specifically because it was purported to contain a sizeable crocodile population, but which subsequently had been hunted to stock a crocodile farm, only contained a relatively small number of mostly juvenile and subadult animals. Furthermore, no hatchlings were seen, suggesting that reproduction may not have occurred that year. These data were taken as strong evidence of the negative impact that collection of adult crocodiles is having on wild populations.

Management and Conservation Programs: The current legal status of *C. acutus* in Honduras is unclear. There appears to be no control over hunting or collecting specimens from the wild, but as a member of CITES, no crocodiles or crocodile products may be legally exported. Currently three farming operations in Honduras have begun captive breeding of *C. acutus*. Nevertheless, the uncontrolled development of the farming industry represents a potential threat to the few remaining wild populations of *C. acutus* in Honduras. To address this problem the Honduran government (RENARE) recently (1990) revoked all wildlife collecting licenses until better information is available on the activities of these farms (S. Midence, pers. comm.).

The first farm, located on the Agropecuario de Colon ranch near Trujillo, was stocked with more than 400 crocodiles from the Aguan and Chapagua rivers. Another farm is being jointly developed by the Banco Continental and Clal Crocodile Farms (Israel). Plans to maintain a breeding stock of 1,200 crocodiles would make this the world's largest crocodile farm. Stock for this farm was being collected from wild populations. A third crocodile farm is being developed by Grupo Ganadero Industrial, which had collected 105 individuals from the area near Trujillo. These animals had originally been captured for sale to the Agropecuario de Colon farm, but were not purchased due to their extremely poor condition, mostly resulting from harpoon wounds. More than half of these animals were reported to have died subsequently (Villagran, pers. comm.). As yet none of the farms are officially CITES approved operations and no legal exports have been made.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: E.3-farming

Common caiman (*Caiman crocodilus*)

Status of Wild Populations: *Caiman* have been subjected to hunting pressure in many parts of the country, and good populations remain only in the northeastern region of the country, east of the Aguan River. Populations in the northwestern and central parts of the country are very depleted, and none were observed in the south (Fonseca Bay) (King et al. 1990). Surveys by Klein (1979) in the Mosquitia region of northeastern Honduras found a mean uncorrected *Caiman* density of 6.17/km (range 0-41.9/km). Surveys conducted in 1989 (King et al. 1990) over the entire country (1,162 km surveyed) found a lower mean density of 1.3/km (range 0-85.5/km). Based on an estimated sighting fraction of 0.60, the 1989 corrected mean *Caiman* density was 2.2/km. The highest densities were observed in peripheral wetland habitats such as small streams or lagoons, but *Caiman* were found in virtually all types of wetlands. Although few large breeding-sized animals were seen, the numbers of juvenile caiman provide evidence that reproduction is taking place.

Management and Conservation Programs: The management of *Caiman* in Honduras is based on the cropping of wild individuals, and the export of skins under an annual quota. Since 1988, the export quota has been suspended pending the results of the CITES survey (King et al. 1990). The recommendations of that report include the establishment of size limits (minimum legal size 1.6 m total length), and establishment of a quota of 10,000. Other recommendations included regulations for issuing permits and tagging skins.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 5-not depleted
Management Program: E.1-cropping

Contact: Sergio Midence, Carlos A. Cerrato B., Mario Espinal, Eric Fernández, Rigoberto Romero Meza, Adolfo S. Midence, Erica Villagran, Prof. F. Wayne King

Jamaica

American crocodile

American crocodile (*Crocodylus acutus*)

Status of Wild Populations: This species is found principally along the south coast. A 1975 survey revealed populations to be extremely low with a total of only 41 crocodiles sighted (King et al. 1982). As part of a research project, Garrick (1982) captured and marked 212 crocodiles at three sites around the Black River Morass region. A recent survey by Abercrombie (in litt. Jan. 31, 1990) found crocodiles to be widely scattered along the southeastern part of the island and reasonably abundant in several areas including the Black River, the Parotee River, and the Milk River.

Habitat destruction has become a major problem in recent years. Besides the intense human population pressures in coastal lowland areas, a proposal has been made to mine peat from the Black River Lower Morass, the last remaining large wetland in Jamaica (Garrick 1986).

Management and Conservation Programs: Crocodiles are legally protected under the Wildlife Protection Act of 1945 (Klemm and Navid 1989). One crocodile farm was reported in operation by Luxmoore et al. (1985), but this was mostly a tourist attraction. More recent reports suggest that a commercial crocodile farm and research center will be opened (Shelly 1989).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: C-legislation only

Contact: Dr. Clarence L. Abercrombie, Dr. Leslie Garrick, Elma Shelley

Mexico

American crocodile
Morelet's crocodile
Common caiman

American crocodile (*Crocodylus acutus*)

Status of Wild Populations: Populations of the American crocodile in Mexico are greatly depleted. Extensive hide hunting reduced this species to small, remnant populations in isolated areas. Few recent surveys have been done to examine population trends in the late 1970s and 1980s. Powell (1971) reported populations to be severely depleted, with the best remaining population in mangroves near San Blas (Pacific coast) where he averaged one sighting per day. Surveys by Powell (1973) in 1972 suggest that populations near El Dorado, Sinaloa (Bahia de Pabellon) were recently extirpated. Crocodiles still remained in some of the coastal swamps in Nayarit. Small populations were also reported in the Atlantic drainage in Veracruz. Casas-Andreau and Guzman (1970) document the decline in the hide trade, which peaked in the 1940s in Campeche but continued sporadically through the late 1960s in Chiapas. King et al. (1982) reviewed information on this species in Mexico and considered its status to be endangered.

Lazcano-Barrero (pers. comm.) reports the existence of three separate populations of *C. acutus* in Mexico: in the Usumacinta and Grijalva river system (Gulf Coast drainage), the Caribbean coast (Quintana Roo) and the Pacific coast. Lazcano-Barrero (1989) conducted nocturnal spotlight counts in a canal in Cuixmala (Jalisco), and found a high density 8/km of crocodiles (total counted=42). Lazcano-Barrero (pers. comm.) considers the *C. acutus* population in Quintana Roo to be threatened, principally by habitat loss due to development associated with the tourist industry. Four factors are viewed by Lazcano-Barrero (1989) as being important in Mexico: habitat

destruction, overexploitation through hunting and live capture for the pet trade, drowning in fishing nets, and the introduction of exotic species.

Surveys on the Pacific coast in Jalisco state were conducted in 1989 by Méndez de la Cruz and Casas-Andreu (1990). Twenty-one coastal habitats (each 1-7 km in length) were surveyed, and *C. acutus* was present in 11 of these. Casas-Andreu and Méndez de la Cruz (1990) reported the largest population in Jalisco to be found in the Cuitzmala River. The 1988 count revealed the presence of 205 crocodiles, but only 86 were spotted in 1989, perhaps due to construction activity in the area. Population density was 29.3/km in 1988 and 12.3/km in 1989, and a total of 8 nests have been found in the area. Total crocodile population size in Jalisco outside of the Cuitzmala River was estimated to be 260, with some 50 adults.

Management and Conservation Programs: Crocodiles are protected permanently by federal law (Lazcano-Barrero, pers. comm.). A 1982 law prohibits commercial hunting (Klemm and Navid 1989) and the export of live wildlife and products (Fuller et al. 1985).

Two government organizations are involved in establishing crocodile farms. The Secretaria de Desarollo Urbano y Ecologia (SEDUE) and the Instituto Nacional de Investigaciones sobre Recursos Bioticos (INIREB). SEDUE is currently running seven farms and INIREB has one, but no commercial production has started (Luxmoore *et al.* 1985). A number of privately run farms have also started in the last few years. Of the 14 farms reported by Luxmoore *et al.* (1985), four had *C. acutus* stock.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 3-severely depleted/endangered
Management Program: C-legislation only, E.3-farming

Morelet's crocodile (*Crocodylus moreletii*)

Status of Wild Populations: This species is limited to the Atlantic coast drainages of Mexico, but relatively little is known about its current status. Powell (1973) reported populations as being very depleted in Tamaulipas and Veracruz. Campbell (1972b) estimated a minimum population of 200 *moreletii* in the Lago de Catamaco area in Veracruz. Other reports from the late 1970s suggest that small populations were still found and that small individuals were not uncommon in certain areas (Groombridge 1982). Small remnant populations in Veracruz were reported by Perez-Higareda (1979). Recent reports suggest that populations are recovering to some degree and viable populations are found in several reservoirs in northeastern Mexico (Lazcano-Barrero and Abercrombie, pers. comm.). Lazcano (pers. comm.) considers the populations in Tabasco and Campeche to be severely threatened. Populations in the Lacandon region of southern Chiapas and in the Sian Kaán Biosphere Preserve in Quintana Roo are reported to be not presently endangered (Lazcano-Barrero, pers. comm.).

Management and Conservation Programs: The protective status of Morelet's crocodile is the same as for *C. acutus*. As with *C. acutus* the only active management programs have involved captive breeding. Of the 14 farms reported by Luxmoore *et al.* (1985), 12 had *C. moreletii* stock. Three farms on the Pacific coast are planning on rearing *C. moreletii*, outside the natural range of the species in Mexico, despite the fact that *C. acutus* is native to the area. Two of the farms are owned by the government (SEDUE) and are located in Oaxaca and Colima. Some *C. moreletii* are reported to have escaped in Oaxaca and are apparently breeding in the wild (in an area where *C. acutus* exists) (Lazcano-Barrero, pers. comm.), and the effects of the introduced *C. moreletii* on the native crocodile populations has not been determined.

The status and ecology of this species in the Sian Kaán Biosphere Preserve is currently under investigation by Marco Lazcano-Barrero.

Country Rating
Survey Data: II-surveys planned
Wild Population Status: 4-depleted/vulnerable
Management Program: E.3-farming

Common caiman (*Caiman crocodilus*)

Status of Wild Populations: No specific survey work has been done for this species in Mexico, which is only found along the Pacific coast in the states of Chiapas and southern Oaxaca. Caiman have been reported to be relatively abundant, but declining due to exploitation (Groombridge 1982).

Management and Conservation Programs: Although there is no specific legislation for this species, a ban on hunting and skin exportation exists (Groombridge 1982, Klemm and Navid 1989).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 4-depleted/vulnerable
Management Program: C-legislation only

Contact: Marco Antonio Lazcano-Barrero, Dr. Gustavo Casas-Andreu, Dr. Fausto R. Mendez de la Cruz

Nicaragua

American crocodile
Common caiman

American crocodile (*Crocodylus acutus*)

Status of Wild Populations: Reports from the 1960s and 1970s indicate that *C. acutus* populations had been severely depleted (Powell 1971, King *et al.* 1982). Camacho (1983) briefly summarized information on this species in Nicaragua. Although no survey data are presented, *C. acutus* is characterized as being rare and near extinction in the Pacific and central regions of the country. Illegal crocodile skins were reportedly smuggled out through Honduras and Costa Rica (Camacho

1981a,b). Recent reports suggest that the illegal trade through Honduras and then to El Salvador has continued. Camacho (1981a,b) reported that from 1973 to 1976, and in 1981 a total of 2,069 *C. acutus* were killed. Morales (1990) stated that *C. acutus* is distributed along the entire Pacific coast from the Reserva de Recursos Estero Real to the upper mouth of the Río San Juan. The largest populations were reported to be found in the former system, bordering with Honduras on the Bahia de Fonseca. Crocodiles were reported to be more common along the Atlantic coast, and were widely distributed in the majority of the rivers, lakes, and lagoons in the coastal region. A CITES sponsored survey is currently being planned.

Management and Conservation Programs: Crocodiles were legally protected prior to 1980, but these regulations were not enforced (Camacho 1983). Beginning in 1980, with the establishment of the Instituto Nicaraguense de Recursos Naturales y del Ambiente (IRENA), protection of *C. acutus* was initiated and an artisanal industry based on use of *Caiman* was begun. The species is fully protected under Acuerdo No. 2, 1983 (Klemm and Navid 1989). Recently, a new management authority has been established in Nicaragua (DIRENA-Direccion General de Recursos Naturales y del Ambiente), but no new information on crocodile conservation and management has been available.

Country Rating
Survey Data: II-survey planned
Wild Population Status: 3-severely depleted/endangered
Management Program: C-legislation only

Common caiman (*Caiman crocodilus*)

Status of Wild Populations: No recent surveys for *Caiman* have been conducted in Nicaragua. However, the project initiated by the Nicaraguan government in 1979 for the sustainable utilization of *Caiman* suggests that *Caiman* populations were not severely depleted. From 1973 to 1981 a total of 51,213 *Caiman* were reportedly harvested. A recent report by Morales (1990) states that *Caiman* is widely distributed along both coasts. In the Pacific drainages, *Caiman* were said to be most common along the river margins and near the entrances of rivers into the large coastal lagoons (Cocobolca, Xolotlán). The highest densities were seen around the mouths of rivers at the south end of the Cocibolca lagoon (Río Mena, Zapotillo, Sabalo, Cañita, Sapoá, Tirurí, Cardenas) and the Río Istian just west of the Ometepe island. Similar to *C. acutus*, densities of caiman were reported to be higher along the Atlantic coast, where this species is widely distributed throughout the coastal plain.

Management and Conservation Programs: According to Klemm and Navid (1989), *Caiman* is listed as a game species and a minimum legal size of four feet was established. A legal harvest of *Caiman* for an artisanal industry began in 1979. Prior to 1979, virtually all skins were exported. The IRENA program handles all skins for internal markets. The program resulted in a large reported increase in *Caiman* hunting (31,355 in 1980; Camacho 1981a,b). During the period 1980-1985, 81,201 skins were reported to have been harvested (Morales 1990). All skins originated from the Atlantic coastal plain, principally (71%) from the northern Atlantic provinces. Most harvested caiman were in the 3-5 ft. total length range.

A recent management program, developed under the new management authority (DIRENA), has established new regulations for the cropping program. An annual quota of 15,000 was established in 1989. A closed season was established during the reproductive period (June-Sept.), and a minimum legal size of four feet was established (Rodriguez, in litt. April 23, 1990). Skins are to be exported through the company Reptiles de Nicaragua, S.A. (Reptinicsa).

Country Rating
Survey Data: II-surveys planned
Wild Population Status: 4-depleted/vulnerable
Management Program: E.1-cropping

Contact: Jairo Rodríguez Blandino, José Vicente Morales Molina

Panama

American crocodile
Common caiman

American crocodile (*Crocodylus acutus*)

Status of Wild Populations: Populations in the early 1980s were characterized as being depleted or threatened (King *et al.* 1982). American crocodiles were reported to remain in small numbers in several parts of the country including: Gatun Lake, the Chagras River, and the lower Bayano River. Crocodiles may also remain in the San Blas coast region (King *et al.* 1982). Crocodiles were reported to be not uncommon by Ramierez (pers. comm.), especially along the Pacific coast of the country. One Atlantic coast region reported to have crocodiles was the Changuinola River.

Management and Conservation Programs: Crocodilians are protected under Resolution 2-80 of 1980 (Klemm and Navid 1989). One farm is currently in existence in Panama, owned by Panapiel. The stock of crocodiles in 1990 numbered 260, and captive breeding had not yet been accomplished (Ramierez, pers. comm.). A CITES sponsored survey of crocodilians is planned for 1992 (F.W. King, pers. comm.).

Country Rating
Survey Data: II-surveys planned
Wild Population Status: 4-depleted/vulnerable
Management Program: E.3-farming

Common caiman (*Caiman crocodilus*)

Status of Wild Populations: Powell (1971) commented that *Caiman* were very abundant in Panama. Ramierez (pers.

comm.) stated in 1990 that this species was common throughout the country.

Management and Conservation Programs: Crocodilians are protected under Resolution 2-80 of 1980 (Klemm and Navid 1989). A CITES sponsored survey of crocodilians in Panama is currently being planned. One farm is currently in operation (Panapiel), with a stock of 5,116 *Caiman*, some of which have bred in captivity (Ramierez, pers. comm.)

Country Rating
Survey Data: II-surveys planned
Wild Population Status: 5-not depleted
Management Program: E.3-farming

Contact: Ing. Carlos Ramierez, Dr. A. Stanley Rand, Einar Velasco

Paraguay

Broad-snouted caiman
Yacare
Dwarf caiman

Broad-snouted caiman (*Caiman latirostris*)

Status of Wild Populations: A CITES sponsored survey of Paraguay found *C. latirostris* to be scarce. Small populations remain scattered throughout the species' former range, including many ephemeral habitats such as cattle tanks (Scott et al. 1988). Some individuals have been introduced by a rancher into the northern Chaco region in a semi-arid habitat where they live in cattle tanks outside their former distribution (Aquino-Shuster, pers. comm.). Hunting continues to be a problem, especially in eastern Paraguay, where many *Caiman* populations are readily accessible.

Medem (1983) reported on the possible presence of *Melanosuchus niger* in Paraguay, based largely on anecdotal evidence. However, Scott et al. (1988) did not find this species in the country.

Management and Conservation Programs: Under Decreto No. 18.796 of 1975, all hunting and trade in wildlife is banned (Fuller et al. 1985). Nevertheless, a large illegal commerce in *Caiman* exists in Paraguay (Medem 1983). Large numbers of *Caiman* from Brazil are also purchased by Paraguayan hide dealers (Brazaitis 1989).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: C-legislation only

Yacare (*Caiman yacare*)

Status of Wild Populations: Scott et al. (1988) found *Caiman yacare* to be present in good numbers in many parts of Paraguay. Illegal hunting persists and has reduced population size in many areas, particularly in eastern Paraguay.

Management and Conservation Programs: See account for *Caiman latirostris*. There has been much interest shown recently in the farming and ranching of this species in Paraguay (Aquino-Shuster, pers. comm.).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: C-legislation only

Dwarf caiman (*Paleosuchus palpebrosus*)

Status of Wild Populations: The presence of this species in Paraguay was unconfirmed prior to the survey by Scott *et al.* (1988). Although they did not see any in the wild, a stuffed specimen taken from the Río Apa was viewed. *Paleosuchus* were also reported from other areas in eastern Paraguay. No hunting was reported by Scott *et al.* (1988).

Management and Conservation Programs: Legally protected under Decreto No. 18.796 in 1975.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: C-legislation only

Contact: Aida Luz Aquino-Shuster, Dr. Norman J. Scott, Jr.

Peru

American crocodile
Common caiman
Black caiman
Dwarf caiman and Smooth-fronted caiman

American crocodile (*Crocodylus acutus*)

Status of Wild Populations: The American crocodile reaches its southernmost distribution in the Río Chira in northern Peru (King et al. 1982). The presence of a small population just to the north in the Río Tumbes has been confirmed by Hofmann (1970) and Medem (1983). During a 1987 trip, 10 crocodiles were spotted basking in the sun near the center of Tumbes City (Anon. 1989). Crocodiles are also reported from an area of mangroves along the border with Ecuador (Vasquez 1982-1983). Nevertheless, the survival of this small population is extremely precarious.

Management and Conservation Programs: The American crocodile was legally protected in Peru by Ministerial Resolution in 1977 (Klemm and Navid 1989).

American crocodile, *Crocodylus acutus*, Lima Zoo, Peru (Photo courtesy of WWF-Dr. Hartmut Jungius).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 3-severely depleted/endangered
Management Program: C-legislation only

Common caiman (*Caiman crocodilus*)

Status of Wild Populations: Population surveys in the late 1970s and early 1980s found *Caiman* densities of 8.51/km in the Río Samiria (Verdi et al. 1980), and 6.6/km in the lower Río Urubamba (20.8 km surveyed; Moreley and Sánchez 1982). Counts done by Herron (1985) in Cocha Cashu, an oxbow lake (4 km shoreline) in the Manu National Park found from 54-97 caiman (13.5-24.25/km shoreline). Populations in the early 1970s were apparently overhunted, but illegal hide hunting diminished in the 1970s and Vásquez (1982-1983) suggests that *Caiman* numbers have recovered somewhat.

Management and Conservation Programs: Caiman are protected by law under Decreto Supremo 158-77-AG, and also protected under a ban on commercial hunting (Klemm and Navid 1989).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: C-legislation only

Black caiman (*Melanosuchus niger*)

Status of Wild Populations: Plotkin et al. (1983) considered the black caiman to be on the verge of extinction in Peru. Historically the species was common throughout the upper Amazon drainages in Peru, but was depleted by hide hunting which began around 1950 (Plotkin et al. 1983). Surveys by Otte (1974) found no *Melanosuchus* along the Sotileja, Heath, and the Pariamanú rivers, but some black caiman were observed in the upper Río de las Piedras. Based on information from caiman hunters and skin buyers, Otte (1974) concluded that exploitable populations were only found in the upper regions of the Tambopata, Manú, Piedras, and Amigo rivers. More recently, viable populations were observed in lagoons along the Tampopata River (Plotkin et al. 1983). Population surveys have been conducted in Cocha Cashu in Manú National Park since the early 1970s. Otte (1974) estimated the 1971-1972 population size to be 37. Similar counts done in 1978 suggested a 50-60% increase in population size. A census in 1982 estimated population size to be 213 (Vasquez 1982-1983). During nocturnal counts in Cocha Cashu (4.0 km) by Herron (1985), 99-111 black caiman were sighted (uncorrected population estimate; density=24.74-27.75/km shoreline). Another small population remains in the Pacaya-Samiria National Reserve. Nocturnal counts in the Samiria River found a mean *Melanosuchus* density of 0.28/km (Verdi et al. 1980). During the early 1970s Vasquez (1981) conducted nocturnal counts of black caiman in the Jenaro Herrera region and found densities of 0.46/km in lake habitat to 3.11/ha in swamp areas (4.5 ha surveyed). Vasquez (1982-1983) suggests that *Melanosuchus* populations have recovered to some degree since the decline in illegal hide hunting.

Management and Conservation Programs: Hunting of black caiman is prohibited in all cases except for subsistence purposes; however in some areas illegal commercial hunting continues (Plotkin et al. 1983). Ecological studies of *Melanosuchus* in the Manu region have been conducted by Otte (1978), Herron (1985), and Pendleton (in prep.).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 3-severely depleted/endangered
Management Program: C-legislation only

Dwarf caiman (*Paleosuchus palpebrosus*) and Smooth-fronted caiman (*Paleosuchus trigonatus*)

Status of Wild Populations: As is true through the range of these species, little is known about population status. Nocturnal counts in the Río Samiria found a *Paleosuchus* (both species) density of 0.23/km (Verdi et al. 1980). During other surveys in the Jenaro Herrera region, no *Paleosuchus* were encountered (Vasquez 1982-1983). Vasquez (1982-1983) characterized the *Paleosuchus* population status in Peru as indeterminate.

Management and Conservation Programs: *Paleosuchus* are legally protected except for subsistence hunting (Plotkin et al. 1983).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 5-not depleted
Management Program: C-legislation only

Contact: Manuel A. Rios, Ing. Pedro Vasquez Ruesta, Dr. Lorgio Verdi O., Ana María Trelancia

Smooth-fronted caiman, *Paleosuchus trigonatus*. This small (1-2 m) caiman is widely distributed in South America (Photo by J. Thorbjarnarson).

Suriname

Common caiman
Dwarf caiman and Smooth-fronted caiman

Common caiman (*Caiman crocodilus*)

Status of Wild Populations: Medem (King 1973) reported that large numbers of *Caiman* were found throughout the country during surveys conducted in 1972, but fewer were seen during 1978 surveys (Medem 1983). In 1978-1979, extensive hide-hunting occurred in northern Suriname, depleting populations. However, Glastra (1983) stated that caiman were still locally abundant. A 1981 census of the Coesewijne River found mean densities of 3.56/km in the wet season and 6.85/km in the dry season (160 km surveyed; Glastra 1983). Surveys along 12 km of the same river in 1982 found densities ranging from 1.4/km during high water to 25.8/km during low water (Ouboter and Nanhoe 1988). Both these surveys included hatchlings in the density estimates.

Management and Conservation Programs: At present there are no laws protecting or regulating trade of *Caiman crocodilus* in Suriname (Klemm and Navid 1989).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 5-not depleted
Management Program: B-none

Dwarf caiman (*Paleosuchus palpebrosus*) and Smooth-fronted caiman (*Paleosuchus trigonatus*)

Status of Wild Populations: Few data are available concerning the status of either species of *Paleosuchus* in Suriname. Medem (1983) confirmed that both species are present but gave no data on population densities. Ouboter (1987) reported maximum densities in the oligotrophic waters of the savannah belt and the interior as: *P. trigonatus* 5.0/km creek, *P. palpebrosus* 3.0/km creek. More recent surveys by Ouboter (1989) reported lower densities in rivers in the vicinity of Amerindian villages (maximum 1.0/km), and showed a clear impact of subsistence hunting on these populations.

Management and Conservation Programs: Both species are protected by the Game Resolution of 1970 (Fuller et al. 1985), but only in the northern region of the country. Klemm and Navid (1989) report that these species are fully protected under the Game Resolution of 1970.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 5-not depleted
Management Program: C-legislation only

Contact: Paul E. Ouboter

Trinidad and Tobago

Common caiman

Common caiman (*Caiman crocodilus*)

Status of Wild Populations: Caiman are reported to be abundant in parts of Trinidad and were still abundant in the vicinity of the capital in the early 1980s (Groombridge 1982). Caiman were also found on Tobago at Hillsborough Dam as recently as 1988 (H.E. Boos, in litt.) where dwarf individuals may represent a subspecies (Medem 1983). Captive breeding is being attempted at the Emperor Valley Zoo, Port of Spain, Trinidad.

Management and Conservation Programs: Caiman are protected by law but are said to be hunted illegally (Groombridge 1982.)

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 5-not depleted
Management Program: C-legislation only

Contact: H. E. Boos

United States of America

American alligator
American crocodile
Common caiman

American alligator (*Alligator mississippiensis*)

Status of Wild Populations: Extensive population surveys have been completed over virtually the entire range of this species. Throughout its range alligator populations are considered to be stable or increasing. A summary of survey work is given by state.

Louisiana. Giles and Childs (1946) estimated alligator population size in Sabine National Wildlife Refuge based on data collected from harvest figures. Chabreck (1966), using a variety of techniques (including night counts, mark-recapture, counts of bellowing males, and nest counts), began surveying alligator populations in coastal wildlife refuges in 1957. Aerial nest counts have been conducted annually since 1970 (McNease and Joanen 1978, Joanen and McNease 1987). Total population size (extrapolated from nest counts) in coastal marsh habitat has ranged from 134,000 to 523,000, with an increasing trend (mean annual increase 10.1%). Joanen *et al.* (1981) conservatively estimated alligator population size (including hatchlings) in non-marsh habitats to be 168,000. Night counts in 1987 along transects in 23 different parts of the state averaged 6.5/mile (4.0/km) (Chabreck 1988, cited in Joanen and McNease 1990a). Population size in 1988 was estimated at 483,000, down slightly from the peak estimate of 523,000 in 1987 (Joanen and McNease 1990a).

Florida. Thompson and Gidden (1972) estimated alligator population size on four national wildlife refuges (one in Georgia) based on sighting "recaptures" of basking individuals. Woodward and Marion (1978) examined the effects of environmental factors on night-light counts. Kushlan (1982) also found an inverse relationship between water level and alligator density in the Florida Everglades. Based on three years of night counts in canals in Conservation Area 3, average density was 5/mile (8.1/km). This was reported as being lower than mean density inside the Everglades National Park, where maximum densities could reach over 50/mile (80.6/km). Hines (1979) conducted night counts in canals in the Everglades and reported a maximum density of 9.3/km. Hines (1979) also reported a value of 13.5/km of canal in the Loxahatchee Refuge in 1967. Hines (1979) concluded on the basis of number of nuisance alligator reports that alligator populations increased between 1968 and 1974. Night counts conducted statewide from 1974 to 1978 also show an increasing trend (Hines 1979).

Systematic night counts throughout the state were conducted by the Florida Game and Freshwater Fish Commission from 1971 to 1982 to examine population trends (Wood *et al.* 1985). Overall results appeared to indicate an increasing population but were greatly affected by environmental variability (particularly water level). Average alligator density in Florida lakes prior to 1977 was 11.9/mile (7.3/km) and 13.8/mile (8.4/km) between 1977 and 1981. Similar figures for marsh habitats were: pre-1977- 11.3/mile (6.9/km), post-1977-13.3/mile (8.1/km) (Neal 1984).

Non-hatchling density has increased from 1980 through 1987. Data from 16 transects indicates that from 1986 to 1987 mean densities of non-hatchling and >4 ft. (1.2 m) alligators increased 19.6% and 12.5% respectively (Woodward 1988, cited in Joanen and McNease 1990a).

Due to the rapid increase in the human population in Florida, habitat loss must be considered the gravest threat to the long-term survival of healthy populations. Schortemeyer (1972) estimated that approximately 30% of the alligator habitat in southern Florida had been lost due to urbanization and agricultural development. While this problem has been the most severe in southern Florida, habitat loss is becoming a significant threat in other parts of the state as well.

Georgia. Population surveys were conducted from 1982 to 1984 in 102 counties covering a total of 5,824,000 acres. Alligator populations increased in 56 counties, were stable in 45, and decreased in only one (Joanen and McNease 1986). Overall mean density was 4.4/mile (2.7/km) (Chabreck 1984, cited in Joanen and McNease 1986). Surveys in 1988 indicate that populations continue to increase (1-5% over the 1986 surveys). Mean density at 20 surveyed sites was 7.2/mile (4.4/km) (Chabreck 1988, cited in Joanen and McNease 1989). In 1988, alligators were present in 103 counties, and breeding had been documented in 66 (Ruckle 1990).

Texas. Total alligator population size was estimated in the early 1980s to be well over 100,000 (Thompson *et al.* 1983). Average density from night counts was 4.4/mile (2.7/km), and populations were considered to be stable or increasing. Surveys in 1988 indicate populations are continuing to increase. Total population size in the coastal region was estimated to be 180,000, with an average density of 0.65/acre (0.26/ha). Linear densities based on night counts averaged 6.0-6.4/mile (3.7-3.9/km) (Johnson 1988 cited in Joanen and NcNease 1990a).

American alligator, *Alligator mississippiensis* (Photo courtesy of the Chicago Zoological Society).

North Carolina. O'Brien and Doerr (1986) conducted night counts in 19 coastal counties from 1979-1980. Mean densities were quite low (usually less than 0.2/km) and most were found clumped in areas under federal, state, or private protection. Isolated areas in the middle and southern parts of the state were reported to have sizeable populations, and the outlook was for stable or increasing populations. Some of these surveys were being repeated (1988) and preliminary data suggest that no appreciable changes in alligator density are being seen (Joanen and McNease 1990a).

South Carolina. Data collected by T. Murphy in the early 1980s indicated that alligator populations were increasing as much as 5-10% annually in 15 of the 28 counties reported to have alligators (Joanen and McNease 1986). The principal alligator

habitat is coastal marsh. No perceivable population change has been reported since 1986 (Joanen and McNease 1990a). Censusing will be reinstituted in 1990.

Other States. Limited survey data are available for the other states in the alligator's range and are summarized in Joanen and McNease (1986, 1990a). In Alabama, 13 of the 14 counties reporting alligators report an increasing population. Population trends in Arkansas and Oklahoma were considered to be stable or increasing. In Arkansas, since 1972 a total of 2,800 alligators from Louisiana have been released as part of a restocking program. Populations in the lower two-thirds of Mississippi have stable to increasing populations.

Mean alligator density based on night counts during the late 1980s was: Arkansas-0.04/mile (0.02/km), Mississippi-3.1/mile (1.9/km), Alabama-12.5/mile (7.6/km).

Management and Conservation Programs: The alligator was classified as an endangered species under the U.S. Endangered Species Act in 1969. Subsequent alligator population recovery has resulted in the alligator's reclassification to the category "threatened due to similarity of appearance" on a state-by-state basis, thereby turning the management of the alligator over to the state management authorities. Threatened due to similarity of appearance indicates that the population in question is no longer endangered in the wild, but that its hide is sufficiently similar to that of other endangered crocodilians to warrant monitoring of trade. The alligator was officially declared to be threatened due to similarity of appearance throughout its range in 1987 (Federal Register 52(107), 4 June 1987). A brief summary of state management programs is given below.

Louisiana. Alligator management in Louisiana is based on four programs: the cropping of commercially-sized alligators from the wild, the collection of eggs from the wild for ranching, captive breeding (farming), and a nuisance alligator program. Research and management programs are run through the Louisiana Department of Wildlife and Fisheries. Most of the following information is summarized in Joanen and McNease (1987).

Alligator management in Louisiana began in 1972 with a sustainable-yield cropping program, based on 15 years of research (Joanen and McNease 1987). The harvest began in one coastal parish (in 1972) and expanded until hunting was opened statewide in 1981. Hunting occurs exclusively on private land, and is done by setting baited hooks during the day. State law prohibits the taking of alligators between sunset and sunrise. The minimum legal harvestable size is 4 feet (1.2 m). From 1972-1983 a total of 100,712 alligators were harvested. Joanen and McNease (1987) detail the size structure and sex ratio of the harvested population. Initially, all hunters were required to bring their skins to a central checkpoint (1972-1977), where they were checked by state personnel. As the harvest grew, the checkpoints were abandoned and buyers were required to submit reports on all skin purchases. After 1979, a computer program was designed to monitor the trade in hides from the hunter through the tanning stage. Trophy specimens, alligator meat, and parts were monitored separately using a report system (Joanen and McNease 1987).

The alligator nuisance program began in 1979 in a number of coastal parishes. The program was extended statewide in 1981. Special skinning instructions are issued each year to prevent the sale of stockpiled skins. From 1979 to 1983, a total of 771 alligators were harvested through this program (Joanen and McNease 1987).

In Louisiana, 85 farms/ranches are currently in operation. Total captive stock prior to the 1989 hatch numbered 67,719. Including the 1989 production current stock numbers 223,072. While some captive breeding is currently being done, most of the stock comes from eggs collected from wild nests. An egg collection program began in 1977 with the collection of eggs from the Rockefeller Refuge. The aim of this program was to provide farmers with enough stock so that they could eventually become self-sustaining in the production of hatchlings. In 1988, 9,200 hatchlings collected from the wild were distributed among farmers in Louisiana. During the same year the number of young obtained from captive breeding was approximately 3,000. In 1989 the program was expanded to include private wetlands and the harvest of eggs and hatchlings was greatly expanded. The 1989 collection totals were 7,175 hatchlings from public wetlands and 182,671 eggs and 1,351 hatchlings from private lands. The 1989 total of young produced on farms was 3,737.

An essential part of the ranching program consists of releasing a certain fraction of the young back into the wild. Farmers are required to release 17% of alligators more than four feet long, or 30% of the number of hatchlings. In 1989, a total of 9,000 alligators were released (Joanen and McNease 1990b, Joanen 1989).

Florida. As in Louisiana, the Florida alligator management program is based on a multifaceted approach to sustainable utilization. The program is based on a scientific research program which began in 1975. Research and management is coordinated through the Florida Game and Freshwater Fish Commission (FGFFC). This summary of the Florida program is based largely on a draft copy of the Florida Alligator Management Program prepared by M. Jennings and D. Dennis.

The alligator management program in Florida, in contrast to the program in Louisiana, concentrates on the sustainable utilization of alligators on public lands. The public land program has three principal components: the collection of hatchling alligators, the collection of alligator eggs for sale to commercial ranches, and the cropping of alligators greater than four feet (1.2m) for hides and meat.

Commercial cropping began in 1981 with an experimental harvest program in a few counties in north-central Florida. Harvests are based on a 15% annual extraction of alligators greater than four feet. This program was extended statewide in 1987. Only specified public wetlands grouped for the purposes of investigation, management, or analysis are harvested. Population censuses are performed and a quota established not exceeding 15% of the harvestable population. During the period 1988-1989 a total of 6,019 alligators were harvested. Hunters are issued permits based on a lottery system and keep all the proceeds from the sale of hides and meat. Skins are brought to a central validation site where they are measured, checked for compliance with the special skinning instructions,

and fixed with a numbered locking plastic CITES tag. Hunters are charged a $30 validation fee. Skins are either sold to buyers at the validation sites or separately through an agent. Meat is sold in officially sealed packages and annual reports of meat sales are provided to the FGFFC.

Collection of hatchling alligators began in 1987 and is done on a county-by-county basis. Collection permits are issued to authorized alligator farms or ranches, who purchase official tags for marking the hatchlings. Tags cost $15 each, and $5 of this goes towards alligator husbandry research conducted by the state. Quotas are estimated conservatively based on the quantity and quality of wetland habitats. Hatchling collection over a three-year period (1987-1989) has totaled 12,170, only 39.8% of the assigned quota.

Pilot egg-collecting programs led to the establishment of a statewide program on public (state) wetlands in 1988. Quotas for specific wetlands are established based on aerial nest surveys. Working with two state-appointed egg collection coordinators, authorized alligator farms and ranches collect eggs from up to 50% of the nests. Eggs are purchased at a cost of $5 per egg. Over a two-year period (1988-1989) 15,682 eggs were collected. Eggs were also collected as part of an egg viability study. The Florida Cooperative Fish and Wildlife Research Unit, working with two alligator farmer associations, has collected alligator eggs since 1987 to study potential differences in egg viability. The research was funded by the farmers, who in return received the hatchlings. 14,187 hatchling alligators have been distributed to farmers through this program.

In conjunction with the public land management program, in 1988 Florida began a similar program on private lands. Private landowners are issued permits for the collection of eggs and hatchlings, and the cropping of alligators over four feet (1.2m). Quotas are established by the FGFFC based on nest, hatchling, and adult population censuses conducted by certified wildlife biologists employed by the landowner. Quotas are similar to those for public lands. This program is smaller than the public lands management program with 7 and 21 landowners participating in 1988 and 1989 respectively.

Florida initiated a nuisance alligator program in 1977. Licensed trappers are authorized by the FGFFC to remove nuisance animals based on complaints received from the public. Nuisance animals over four feet long are trapped. Sale of the meat and skin is similar to that of the cropping program described above. Over the period 1978-1988, 27,641 nuisance alligators were trapped (about 2,500/yr.).

Florida also has a developing alligator farming and ranching industry. There are currently 52 farms/ranches licensed in the state. Thirty of these have received state permits for the collection of hatchlings and eggs. Current captive production is approximately 10,000 per year, with about 20,000 coming annually from the wild.

Arkansas. The state began a restocking program in 1972. Since then a total of 2,800 alligators from Louisiana have been released in 40 of the 45 counties within the historical range of the species. Successful reproduction has been documented in six of those counties (Joanen and McNease 1979).

Texas. The Texas alligator management program is based on a multiple-use approach not unlike the ones in Florida and Louisiana (Johnson et al. 1990). The alligator population is monitored by helicopter nest counts and nocturnal spotlight counts. A cropping program began in 1984 based on hunting on private lands. Tags are issued based on a harvest quota of 8% of the alligators more than four feet long. Population estimates are based on a three-year average from nest counts (to reduce year-to-year variation in the number of tags issued). In 1988, the harvest area was composed of a 15 county region in the southeastern part of the state. Of a total of 2,016 possible tags, 1,745 tags were issued for 763 hunters. Hunting is done by the landowner, or the tags are used for guided hunts on their land. The 1988 season lasted 17 days, during which time 1,646 alligators were taken. Alligators are captured using baited hooks, archery, harpoons, gigs, or handheld snares. All harvested alligators have to be verified by Texas wildlife officials. Although some of the skins are kept for personal use, 85.1% were expected to be sold commercially. Commercial buyers of skin and meat are licensed by the state.

The state of Texas has a nuisance alligator program where problem animals are either killed or relocated. Nuisance calls are handled either by the Texas Parks and Wildlife Department or by contracted nuisance control hunters. In 1988, 56 alligators (of 92 nuisance reports) were removed.

Texas also has an alligator farming program. In 1988, 20 farmers were registered with a total stock of 1,414 alligators. Harvesting of farm-reared alligators began in 1988. Beginning in 1988, Texas also initiated an experimental ranching program with the collection of 2,246 eggs.

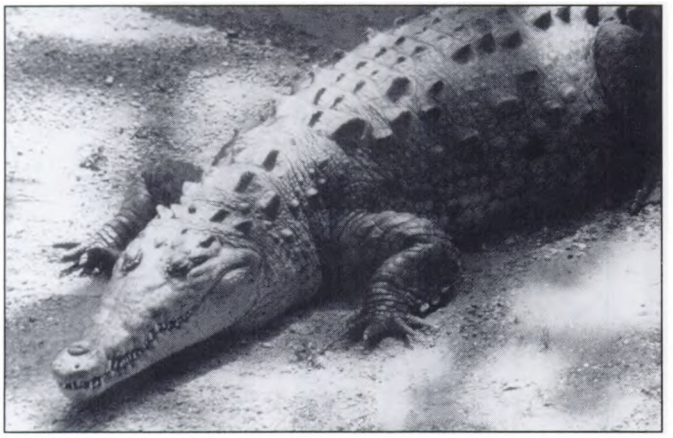
Georgia. Georgia has implemented a nuisance alligator program similar to the one in Florida. Private "agent-trappers" are contracted to capture or harvest alligators after an initial investigation by Georgia Department of Natural Resource personnel. Trappers may harvest the skin, meat, and derivatives, keeping 100% of the proceeds, or they have the option of selling the alligator to a licensed farmer. By 1989, seven licensed farms in Georgia held 1,190 alligators. The first culling of farm-reared alligators was expected to begin in 1990 (Ruckle 1990).

South Carolina. Alligator management in South Carolina currently consists of a nuisance control program which harvests identified large, dangerous individuals. This program was instituted in 1988 and is based on the Florida nuisance program. Three hundred and seventy one animals were harvested in 1988 and 268 were taken in 1989. Public harvest or possession of animals except under special permit is prohibited (T. Swayngham, pers. comm.).

Country Rating
Survey Data: IV-widespread survey data
Wild Population Status: 5-not depleted
Management Program: E.1-cropping, E.2-ranching, E.3-farming, C-legislation only (some states)

American crocodile (*Crocodylus acutus*)

Status of Wild Populations: In the United States the American crocodile occurs only in southernmost Florida. Kushlan and



American crocodile, *Crocodylus acutus*, U.S.A. (Photo by R. Godshalk).

Mazzotti (1989a) summarize the species' past and present distribution in Florida. Ogden (1978) speculated that the historic population size may have been 1,000-2,000. Based on nest counts Ogden (1978) estimated population size in the 1970s was between 100 and 400. Recent survey work has centered on three areas: the Florida Bay portion of the Everglades National Park (Kushlan and Mazzotti 1989a), the northern Florida keys, especially Key Largo (P. Moler, pers. comm.), and the cooling canal system of the Turkey Point nuclear power plant (F. Mazzotti pers. comm.). Kushlan and Mazzotti (1989a) concluded that the distribution of crocodiles in Florida has not changed significantly, with the exception of some loss of habitat near urban areas (e.g. Miami). However, this loss of habitat has been compensated for somewhat by the creation of artificial nesting habitat in the southern Biscayne Bay area (Kushlan and Mazzotti 1989a). The number of nests found annually has been used as an index of population trend and indicates that over the last 20 years the number of nesting females has been stable or increasing (Kushlan and Mazzotti 1989b, P. Moler, pers. comm.)

Kushlan and Mazzotti (1989b) also published results of an ecological study in the Florida Everglades, and Paul Moler of the Florida Game and Freshwater Fish Commission has been conducting an ecological study on northern Key Largo. This study has shown that in some years hatchling survivorship can be quite high (>50% over the first year), and that, in general, growth rates are quite high (0.1-0.2 cm/day total length) (P. Moler, pers. comm.).

One of the principal threats to the crocodile population is people. Shootings and automobile collision-induced mortality of adult crocodiles crossing highways have accounted for 17 of the 26 known deaths between 1971 and 1983 (Kushlan 1988). Many of the road kills have been gravid females searching for nest sites.

Management and Conservation Programs: The American crocodile is completely protected in the United States under the 1973 Endangered Species Act. The principal thrust of the conservation program for this species has been the protection of habitat (U.S. Fish and Wildlife Service 1984). Currently the entire nesting distribution of the species is within federally protected land (Everglades National Park and the Crocodile Lake National Wildlife Refuge), or privately protected land (Turkey Point power plant; Florida Power and Light Co.). During the late 1970s, a feasibility study for the captive breeding of American crocodiles was done for the U.S. National Parks Service (Behler 1978). However, this program was never implemented.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: C-legislation only

Common caiman (*Caiman crocodilus*)

Status of Wild Populations: Breeding populations of introduced *Caiman crocodilus* have become established in southern Florida (Ellis 1980). The largest known population is located on the Homestead Air Force Base, in Homestead, Dade County, but individuals have been sighted as far north as Lake Jessup (Seminole County) and as far south as Florida City (Dade County).

Another feral population of *Caiman crocodilus* is known to exist in the Tortuguero Lagoon along the northern coast of Puerto Rico.

Both populations presumably originated from the release of animals imported for the pet trade.

Management and Conservation Programs: Efforts to eradicate the *Caiman* in both Florida and in Puerto Rico have been largely unsuccessful.

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 1-unknown
Management Program: Eradication

Contact:
A. mississippiensis
Louisiana: Ted Joanen, Larry McNease
Florida: Dennis David, Tracy Howell, Prof. F. Wayne King, Dr. Franklin Percival, Dr. Kent Vliet, Allan Woodward
South Carolina: Mark O. Bara, Phil Wilkinson, Thomas Swayngham
Texas: Lee Ann Johnson
Mississippi: Dr. James A. Kushlan
Georgia: Howard Hunt, Ron R. Odum, Steve Ruckle

C. acutus
Dr. James A. Kushlan, Dr. Frank J. Mazzotti, Paul Moler

Uruguay

Broad-snouted caiman

Broad-snouted caiman (*Caiman latirostris*)

Status of Wild Populations: Populations are known from the

northwest (Rio Uruguay drainage) as well as in the coastal lagoons in the northeast (Laguna Merim). However, *C. latirostris* populations in these areas were reported to be declining (Groombridge 1982). Recently, a few individuals have been reported from the Departamento de Rocha to the north of Laguna Negra (Achaval and San Martin 1983). Medem (1983) states that while some commercial hide hunting has taken place, it was never as widespread or organized as in other countries. The principal problem has been habitat destruction.

Management and Conservation Programs: *C. latirostris* is completely protected under Decreto No. 273/974 of 1974 (Medem 1983).

Country Rating
Survey Data: I-no survey planned
Wild Population Status: 4-depleted/vulnerable
Management Program: C-legislation only

Contact: Dr. Federico Achaval, Juan Villalba-Macías

Venezuela

American crocodile
Orinoco crocodile
Common caiman
Dwarf caiman and Smooth-fronted caiman

American crocodile (*Crocodylus acutus*)

Status of Wild Populations: Seijas (1986, 1988) conducted surveys for *C. acutus* along the Venezuelan Caribbean coast and found crocodile populations in 14 areas, including rivers, coastal lagoons and freshwater reservoirs. The confirmed presence of crocodiles at four additional sites was reported by Seijas (1990). More intensive surveys were done at seven localities (total 148.7 km) by Seijas (1988). Mean densities ranged from 0.24/km to 3.89/km. Relatively healthy populations were found in several areas including the Yaracuy river, and the Pueblo Viejo and Jatira reservoirs. The work by Seijas suggests that competition is occurring between *C. acutus* and *Caiman crocodilus* where the two species are sympatric, and that this may retard the recovery of *C. acutus* populations. Although the known population size in 1989 was much larger than in 1984, this is principally due to more complete survey work and there is no firm evidence of population recovery. In many areas habitat destruction is becoming a severe problem (Seijas 1990).

Management and Conservation Programs: The American crocodile was legally protected in Venezuela in 1970 (Klemm and Navid 1989). The Venezuelan Ministry of Environment has conducted a small-scale restocking program of *C. acutus* in a few locations. One small-scale captive breeding program for restocking is operational. This program is run by Tomás Blohm on Hato Masaguaral in the Venezuelan llanos. Plans are being drawn up to initiate a release program for captive-bred young in the Cuare National Wildlife Refuge (A.E. Seijas, pers. comm.).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 4-depleted/vulnerable
Management Program: D-restocking/reintroduction

Orinoco crocodile (*Crocodylus intermedius*)

Status of Wild Populations: Surveys by Godshalk (1978, 1982) in the late 1970s indicated that populations of the Orinoco crocodile were severely depleted in Venezuela. More recent surveys by Franz et al. (1985), Ramos and Busto (1986), Ayarzagüena (1987), and Thorbjarnarson (1988) confirm these findings. Orinoco crocodiles today remain at extremely low densities, with a few larger concentrations in remnant populations. The largest known populations are in the Cojedes and Capanaparo river systems. The Capanaparo population is thought not to exceed 500 non-hatchlings. The Cojedes population can be divided into three sections with approximately 20 non-hatchlings in the Sacare/Eneal section, 200-400 non-hatchlings in the Caño de Agua section, and 100 in the Caño Amarillo section; however, nesting in 1990 was very reduced. At least 30 nests a year are produced in the Caño de Agua section (Ayarzagüena 1990). Severe habitat modification from a government-sponsored river canalization project has greatly impacted the Cojedes population over the last few years and will continue into the near future. Other isolated populations are known to exist in areas of low population density, and at least two smaller populations are in reservoirs (Camatagua and the Tucupido; Thorbjarnarson 1988).

Management and Conservation Programs: The Orinoco crocodile is legally protected in Venezuela (Resolution No. 95, 1979). A number of non-governmental organizations, including FUDENA and the LaSalle Society, the UNELLEZ University, individuals (Tomas Blohm), and the Venezuelan government are working towards a reintroduction/restocking program for the species. Two sites have been selected for the release of crocodiles, a newly created National Wildlife Refuge (Caño Guaritico), and a national park on the Capanaparo and Cinaruco rivers (Parque Nacional Santos Luzardo). Captive breeding is being done at Hato Masaguaral and at the UNELLEZ University. A program for collecting eggs from the wild has been conducted in the Cojedes river. The first group of 31 captively reared young were released in April 1990 in Caño Guaritico (A.E. Seijas, pers. comm.). Plans call for the release of 300 individuals into the river over the next three years (Ayarzagüena 1990).

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 3-severely depleted/endangered
Management Program: D-restocking/reintroduction

Common caiman (*Caiman crocodilus*)

Status of Wild Populations: Two subspecies of *Caiman crocodilus* are currently recognized in Venezuela. *Caiman c. fuscus* occurs along the northwestern coast of the country. In other parts of the country the subspecies is *C. c. crocodilus*.

Common caiman, *Caiman crocodilus crocodilus*, and capybara, *Hydrochaeris hydrochaeris*, in Masaguaral, Venezuela. Sustainable use of wildlife provides valuable economic returns to owners of llanos habitat (Photo by R. Godshalk).

Extensive surveys of *C. c. crocodilus* have been conducted throughout the llanos region of the country in association with the *Caiman* management program. *Caiman* populations in most of the llanos are healthy, with dry-season densities frequently surpassing 100/ha in isolated bodies of water (Seijas 1984). Wet season densities, when caiman are spread over much larger areas, have been reported to be 0.17/ha to 0.21/ha (Gorzula and Seijas 1989). Linear densities in llanos rivers ranges from 1.24/km (wet season) to 107.5/km (dry season) (total 188.7 km surveyed; Thorbjarnarson and Hernandez, 1990).

In the forested Guyana region of southern Venezuela, *Caiman* occur at lower densities. A mean value of 2.52/km was reported by Gorzula and Paolillo (1986) for river and lakeshore habitats (18.1 km surveyed). Along the coast, Seijas (1986) surveyed a total of 286 km of rivers and reservoirs in northern Venezuela and found relatively high densities of *Caiman c. fuscus* (0.2-196.6/km) and *C. c. crocodilus* (0.9-26.3/km). Where the *Caiman* were coexisting with *C. acutus*, *Caiman* populations appeared to be depressed. Caiman densities in the Orinoco delta are also high; Gorzula and Woolford (1990) report mean uncorrected densities of 20.27/km in channeled bodies of water (136.3 km surveyed), and 29.37/ha in ponds and lagoons (12.9 ha surveyed).

Management and Conservation Programs: Following a ten-year ban on caiman hunting, the Venezuelan government initiated an experimental harvest in 1982 (Gorzula 1987). The initial year's harvest was small (2,214) but the program rapidly expanded. Following a peak harvest of 232,063 in 1986, the program was halted for one year, then reinitiated in 1987 with a smaller quota (MARNR 1986, 1987, Cartaya 1990, Thorbjarnarson, 1990). Harvests since then have been in the 100,000-150,000 range. The caiman management program is based on the harvest of approximately 7% of the censused population size. A minimum size limit of 1.8 m ensures that virtually all harvested animals are adult males. Hunting is limited to private lands in five states in the llanos region of the country. Landowners submit requests to harvest caiman on their property. The Venezuelan Ministry of Renewable Natural Resources and the Environment trains and certifies individuals to census *Caiman* populations and submit a report to the Ministry. Quotas are assigned by the Ministry based on the census data. Individuals or companies certified to census *Caiman* for the Ministry are paid by the landowners. Under the present system, all hides and meat are certified by representatives of the Venezuelan National Guard, then brought to a central check station for validation. Skins are sold to local tanners. The salted meat is sold locally or in some of the larger northern cities.

A number of landowners in the llanos have begun to ranch caiman. Eggs are collected from wild nests, hatched, and the young are reared in pens. The Venezuelan government has started to incorporate these ranching programs into their official management program.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 5-not depleted
Management Program: E.1-cropping, E.2-ranching

Dwarf caiman (*Paleosuchus palpebrosus*) and Smooth-fronted caiman (*Paleosuchus trigonatus*)

Status of Wild Populations: Gorzula and Paolillo (1986) conducted surveys in the Guyanan region of Venezuela and reported a mean *Paleosuchus trigonatus* of 0.79/km (77.8 km surveyed). Low densities of *P. palpebrosus* were also reported from one site. Thorbjarnarson and Hernandez (in press) reported similar densities of *P. trigonatus* in the Caura (0.83/km over 6 km) and Nichare (0.14/km over 7 km) rivers in southeastern Venezuela. *Paleosuchus palpebrosus* is also known to occur at relatively low densities in moriche swamps in Apure and southern Guarico states (Thorbjarnarson, unpublished data).

Management and Conservation Programs: Both species of *Paleosuchus* are protected in Venezuela (Resolution No. 95, 1979; Klemm and Navid 1989). Owing to the low value of the hide, little commercial hunting for this species has ever taken place. Subsistence hunting by a number of Indian tribes takes place in Amazonas territory and Bolivar state.

Country Rating
Survey Data: III-basic survey data
Wild Population Status: 5-not depleted
Management Program: C-legislation only

Contact: Lic. Hugo Arnal D., Dr. Jose Ayarzagüena Sanz, Tomás Blohm, Cecilia Blohm, Jerone Caraguel, Eduardo Cartaya, Dr. Alex Fergusson L., Dr. Stefan Gorzula, Gonzalo Medina Padilla, Glenda Medina Cuervo, José Luis Méndez Arocha, Dr. Carlos Rivero Blanco, Andres Eloy Seijas, Dr. John Thorbjarnarson, Alejandro Carrillo Garciá

Species Accounts

Introduction

The species are presented alphabetically by genus and species in the standard taxonomic order. The data presented in this Action Plan represent the information available to the compiler on or before October 1990. Owing to the extremely fluid situations concerning most of this information, especially in terms of management programs, some of this information may be superseded even before this document is published.

Species Ratings

In the Species Accounts, a coding system was devised to summarize the information for each species presented in the County Accounts. By their very nature these ratings are highly subjective but they represent the best evaluation of the CSG. Three categories were defined: *Availability of Survey Data*, *Need for Wild Population Recovery*, and *Potential for Sustainable-yield Management*. These ratings are given in the Conservation Overview section of each species account with the CITES appendix listing and IUCN Threatened Species Category.

Availability of Survey Data
This is a measure of the quality of the survey data available for a species over its entire range. These categories used are: *Good*, *Adequate*, *Poor*, *Very Poor*, and *Extremely Poor*. Good surveys are represented by consistent, repeated population surveys over large representative portions of the species range, utilizing well documented, quantitative techniques. The extensive surveys over 20 years for *C. porosus* in Northern Australia are an example. Adequate surveys are represented by surveys conducted using quantitative techniques that sample large enough areas and are sufficiently widespread that meaningful estimates of population density and variance were generated. The other categories represent survey data generated in brief periods, small areas of habitat, and non-quantitative or non-standard methods from which population densities cannot be estimated. They range from brief field visits by experienced observers to anecdotal accounts collected by non-specialists, and can only provide the most rudimentary "present or absent" and "abundant or rare" information about crocodilian populations.

Need for Wild Population Recovery
This is an overall rating of the need for recovery programs for the species in question, and is based primarily on the status of that species throughout its range. Species were divided into one of four priority categories: *Highest*, *High*, *Moderate*, and *Low*.

In general, the highest priority was given to species that are greatly depleted, suffering current active threats, and those having restricted distributions. Low ratings were assigned to species that are abundant and widely distributed, particularly if they tend to reproduce rapidly, and also to species that enjoy active protection or effective management throughout their range and demonstrate stable or increasing populations. The Crocodile Specialist Group considers all the species in the Highest and High categories to be endangered in at least part of their range.

Potential for Sustainable-yield Management
The potential for using a species in sustainable-yield management programs (cropping, farming, or ranching) was classified as either *Highest*, *High*, *Moderate*, or *Low*. Again, the placement of a species in one of these categories was subjective, and was based on a number of factors including the commercial value of the hide, the current status of wild populations (with degree of threat being inversely related to commercial potential), and the amenability of that species to management (based on aspects of the species' population biology). This last criterion was only taken into consideration among species that were considered to be highly amenable to exploitation (e.g., the spectacled caiman, owing to its adaptability in terms of habitat requirements and ability to reproduce at a small size).

Principal Threats
In each species summary account, the principal threats to each species are listed:

HD—Habitat destruction and human population pressures (includes subsistence or non-commercial hunting)
IH—Illegal commercial hunting
LD—Limited geographic distribution
IE—Introduced exotic species

Species Accounts

American Alligator (*Alligator mississippiensis*)

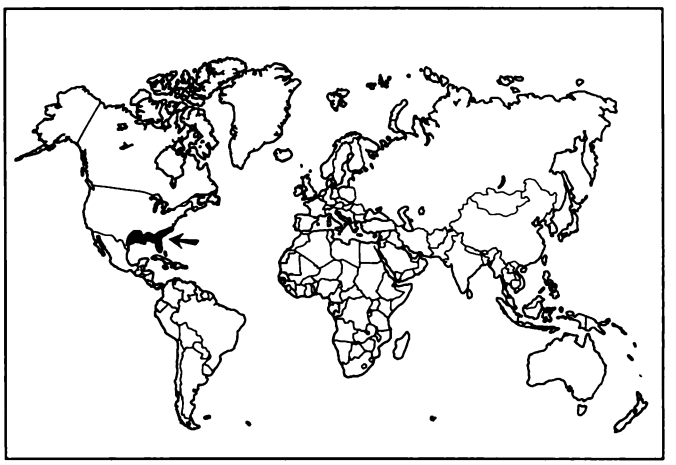
Range: United States

Conservation Overview
CITES: Appendix II
IUCN Red List 1990: Not listed
CSG Action Plan: Availability of Survey Data: Good
Need for Wild Population Recovery: Low
Potential for Sustainable-yield Management: Highest

Principal Threats: HD-Habitat destruction
Availability of Survey Data: (1 country)
No survey data: 0 countries (0%)
Surveys planned: 0 countries (0%)
Basic survey data: 0 countries (0%)
Widespread survey data: 1 country (100%)

Status of Wild Populations: (1 country)
Extirpated: 0 countries (0%)
Severely depleted: 0 countries (0%)
Depleted: 0 countries (0%)
Not depleted: 1 country (100%)
Unknown: 0 countries (0%)

Existing Management Programs: (1 country)
No management plan: 0 countries
Complete protection: 0 countries
Reintroduction or restocking: 1 country
Cropping: 1 country
Ranching: 1 country
Farming: 1 country



Distribution of American alligator, *Alligator mississippiensis*.

Ecology and Natural History: The American alligator, along with the Nile and the saltwater crocodiles, is one of the best-known species in terms of behavior and ecology. Alligators are widely distributed throughout the southeastern United States. Maximum size of adult males rarely exceeds 4.5 m, but historical accounts of larger specimens exist.

American alligators are principally inhabitants of swamps and marshes, although they may be found in lower densities along streams, rivers, and in lakes. In some regions alligators are even known to inhabit coastal brackish water habitats. In many areas alligators are well-known burrowers and spend many of the cooler months hibernating in these dens. Alligators are one of the most temperate species of crocodilians and are known to survive short spells of below-freezing weather by resting in shallow water with their snouts at the surface, thus keeping a breathing hole open in the surrounding ice (Brisbin et al. 1982).

The name "alligator" presumably derives from a corruption of the Spanish word "el lagarto." The work of McIlhenny (1935) in Louisiana was among the first to document some of the remarkable aspects of the natural history of this species. More recent studies on alligator social behavior have demonstrated a significant degree of complexity in the species' ability to communicate vocally (through bellows and headslaps), and visually (through a complex series of body postures) (Garrick et al. 1978, Vliet 1989). Females become sexually mature at a size of about 1.8 m. Courtship and mating take place during the spring warming period, and nesting is done during the early part of the warm, wet summers. Females construct a mound nest and lay 30-50 eggs. Females open the nest and will remain near the pod of hatchlings for varying periods of time. In some cases hatchlings overwinter with the female in her den.

Although at one time considered to be endangered, populations of American alligators have responded well to protection and have recovered rapidly. Extensive surveys of alligator populations have been done throughout the species' range. Many of the surveys have been conducted in conjunction with the development of sustainable-yield management programs on a state-by-state basis. Overall, alligator populations are quite healthy and, owing to increasing human population pres-

sures, nuisance alligator programs have had to be established. Populations in some peripheral regions of the species range (e.g., North Carolina) appear, at worst, to be holding their own.

Sustainable-yield management programs have been developed in a number of states, particularly Louisiana, Florida, and Texas. Management is based on a combination of farming, ranching, and direct cropping of wild adults. Farming and ranching is now being done on a large scale, particularly in Louisiana and Florida. Current stock on farms and ranches in Louisiana alone is well over 200,000, and throughout the country there are over 150 farms and ranches involved in commercial alligator production. In Louisiana, 17% of the animals commercially ranched (>1.2 m long) are required to be returned back to the wild. In some states near the periphery of the alligator's distribution, alligator populations are less dense and are completely protected.

Priority Projects:

Moderate Priority

Investigations of population biology. The presence of healthy alligator populations, and the availability of institutional and financial resources has resulted in numerous investigations of alligator biology being conducted over the years. Although the American alligator is the most thoroughly studied of all crocodilians, we still know relatively little about its population dynamics. A better understanding of the population ecology of this species would not only benefit the management of alligators, but other large crocodilians as well. These investigations are facilitated by the presence of management programs such as cropping and ranching, and are currently underway in Florida.

Contact: Alan Woodward, Ted Joanen

Research on husbandry techniques: Because of the extensive commercial ranching and farming industry in the United States, the American alligator is a prime candidate for research on captive husbandry. Captive breeding, incubation, and rearing techniques need to be improved to increase the efficiency of the industry. Extensive research on these topics is currently underway, particularly in Louisiana and Florida.

Contact: Ted Joanen, Dennis David, Dr. Franklin Percival, Dr. Kent Vliet

Chinese Alligator (*Alligator sinensis*)

Range: China

Conservation Overview

CITES: Appendix I
IUCN Red List 1990: Endangered
CSG Action Plan: Availability of Survey Data: Extremely Poor
Need for Wild Population Recovery: Highest
Potential for Sustainable-yield Management: Low

Principal Threats: HD-Habitat destruction, LD-Limited distribution

Availability of Survey Data: (1 country)
No survey data: 1 country (100%)
Surveys planned: 0 countries (0%)
Basic survey data: 0 countries (0%)
Widespread survey data: 0 countries (0%)

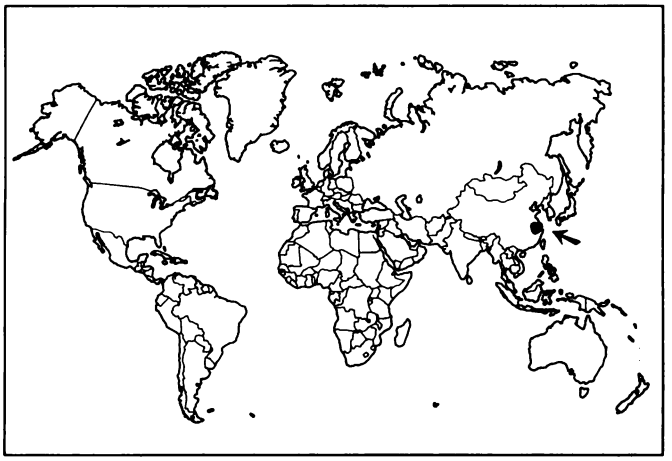
Status of Wild Populations: (1 country)
Extirpated: 0 countries (0%)
Severely depleted: 1 country (100%)
Depleted: 0 countries (0%)
Not depleted: 0 countries (0%)
Unknown: 0 countries (0%)

Existing Management Programs: (1 country)
No management plan: 0 countries
Complete protection: 0 countries
Reintroduction or restocking: 0 countries
Cropping: 0 countries
Ranching: 1 country
Farming: 1 country

Ecology and Natural History: The Chinese alligator is a relatively small crocodilian with a maximum length of approximately 2 m (Brazaitis 1973). Although it was at one time more widely distributed in China, the Chinese alligator is currently found in part of the lower Yangtze (Chang Jiang) River, principally in the provinces of Anhui, Zhejiang, and Jiangsu (Huang 1982). Because they occur at a comparably high northern latitude, Chinese alligators spend a large portion of the year hibernating in subterranean burrows (Huang 1982, Watanabe and Huang 1984). The burrows can be quite complex, with above and below ground pools and numerous airholes. The extensive use of these burrows and very secretive behavior has allowed Chinese alligators to inhabit wetland habitats in areas with dense human populations (Chen 1990b). The three principal habitat types where this species can currently be found are riverine and swampy areas, low-elevation agricultural communes, and tree farm communes up to 100 m above sea level (Watanabe and Huang 1984).

Chinese alligators usually begin to emerge from their dens in May, usually to bask. In June, with warming temperatures, alligators will begin to make nocturnal sorties. Nesting occurs from early July to late August (Huang 1982). Like the Ameri-

Chinese alligator, *Alligator sinensis*, Bronx Zoo (Photo by F.W. and S. King).



Distribution of Chinese alligator, *Alligator sinensis*.

can alligator, Chinese alligators make a mound nest of decaying vegetation. Nesting takes places in mid-July, and clutches typically contain 10-40 eggs.

The Chinese alligator is without doubt one of the world's most endangered crocodilians. Although it was at one time widely distributed throughout the eastern Yangtze River system, the current distribution of the species comprises only one-tenth of its former range. Undoubtedly, the single greatest problem facing the Chinese alligator is habitat destruction related to the intense human population pressures in the region. Very little natural wetland habitat remains, and what does exist contains very few alligators due to past extensive flooding. Most of the remaining populations are located in modified wetlands associated with agricultural or tree-farm communes, where they are vulnerable to human predation. There are no firm data on the status of wild populations, but estimates in the early 1980s suggested that no more than 500 wild individuals remained. Alligators are legally protected, and a number of the communes have been classified as alligator preserves, but animals are still killed, or collected for sale to zoos or government-sponsored farms.

Besides the official protected status, the conservation of alligators in China has been based on the development of a number of rearing centers. Although captive breeding has been accomplished, the collection of animals for breeding stock and the subsequent ranching of alligators has probably had a major impact on the wild populations. The establishment of these rearing centers also does not appear to be associated with any attempt to conserve wild populations. No plans are being made to reintroduce or restock the species. Captive breeding of Chinese alligators has also been accomplished at the Bronx Zoo, the St. Augustine Alligator Farm, and the Rockefeller Refuge in the United States. At present there are 123 specimens in zoos outside of China; 84 in 13 U.S. zoos and 7 in four European zoos (Honegger and Hunt 1990).

Priority Projects:

High Priority

Surveys of the status of wild populations. No systematic work has been done to quantify the status of wild populations of Chinese alligators. These data are vitally needed as the first step of any conservation program, especially for one as severely endangered as *A. sinensis*. The survey should address the current status and distribution of wild populations and the effect of the recent collecting program for the stocking of the alligator farms. An important function of this survey should also be to identify suitable alligator habitat that could be used in reintroduction or restocking programs.

Contact: Dr. Huang Chu-Chein, Dr. Chen Bihui, Prof. Wang Sung

Increase the conservation role of the captive rearing centers. At present, the captive rearing centers are concerned solely with the production and rearing of captive alligators and play no role in the conservation of wild populations. Provided that sufficient habitat can be protected, trials should be made to determine the efficacy of restocking and reintroduction programs.

Contact: Dr. Zhang Zhengdong, Dr. Huang Chu-Chein, Dr. Chen Bihui, Prof. Wang Sung

Enhanced protection of wild populations. Many of the surviving alligator populations are located in human-made habitats living in close association with dense human populations. Efforts are needed, through education, to emphasize the protected status of the alligator and enforce the existing protective legislation. Part of this program should include an educational component to increase the awareness among local people of the protected status of Chinese alligators.

Contact: Prof. Wang Sung

Moderate Priority

Investigation of the ecology of wild animals. A prerequisite for any conservation action is a good understanding of the ecology of the species involved. Before any active management of wild Chinese alligator populations (such as restocking or reintroduction) is attempted, ecological studies should be initiated. A number of study sites need to be established where regular censusing can be conducted, and a number of basic ecological questions addressed. In particular habitat use, population size structure, sex ratio, and nesting ecology need to be investigated.

Contact: Dr. Huang Chu-Chein, Dr. Chen Bihui, Prof. Wang Sung

Common Caiman (*Caiman crocodilus*)

Range: Brazil, Colombia, Costa Rica, Ecuador, El Salvador, French Guiana, Guatemala, Honduras, Mexico, Nicaragua, Panama, Peru, Suriname, Trinidad and Tobago, Venezuela (introduced to Cuba, Puerto Rico, United States)

Conservation Overview

CITES: *C.c. apaporiensis*-Appendix I
C.c. crocodilus-Appendix II
C.c. fuscus-Appendix II
C.c. chiapasius-Appendix II

IUCN Red List 1990: Not listed
CSG Action Plan: Availability of Survey Data: Very Poor
Need for Wild Population Recovery: Low
Potential for Sustainable-yield Management: Highest

Principal Threats: IH-Illegal hunting
Availability of Survey Data: (16 countries)
No survey data: 6 countries (37%)
Surveys planned: 3 countries (19%)
Basic survey data: 7 countries (44%)
Widespread survey data: 0 countries (0%)

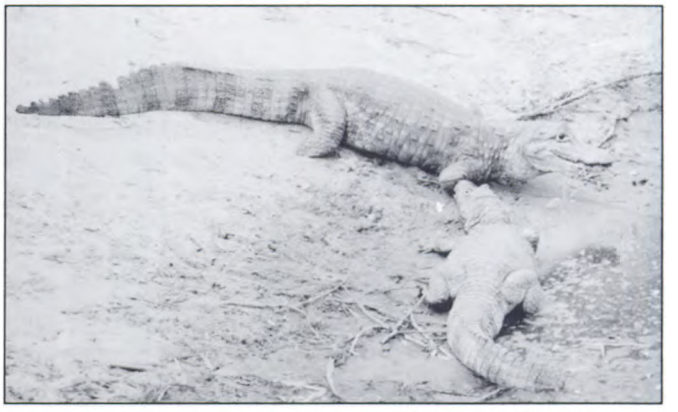
Status of Wild Populations: (16 countries)
Extirpated: 0 countries (0%)
Severely depleted: 1 country (7%)
Depleted: 6 countries (40%)
Not depleted: 8 countries (47%)
Unknown: 1 country (7%)

Existing Management Programs: (16 countries))
No management plan: 1 country
Complete protection: 7 countries
Reintroduction or restocking: 0 countries
Cropping: 5 countries
Ranching: 2 countries
Farming: 4 countries

Ecology and Natural History: The common caiman is the most widely distributed of the New World crocodilians, ranging from southern Mexico to central Brazil and northern Bolivia. It is also the most geographically variable species, with four subspecies generally being recognized (*C.c. apaporiensis*, *C.c. crocodilus*, *C.c. chiapasius*, and *C.c. fuscus*, (Medem 1981, King and Burke 1989)). The southern form, *C. yacare*, is variously considered to be a subspecies or a full species by different workers. Here the most recent taxonomic review (King and Burke 1989), which classifies *yacare* as a full species, is followed.

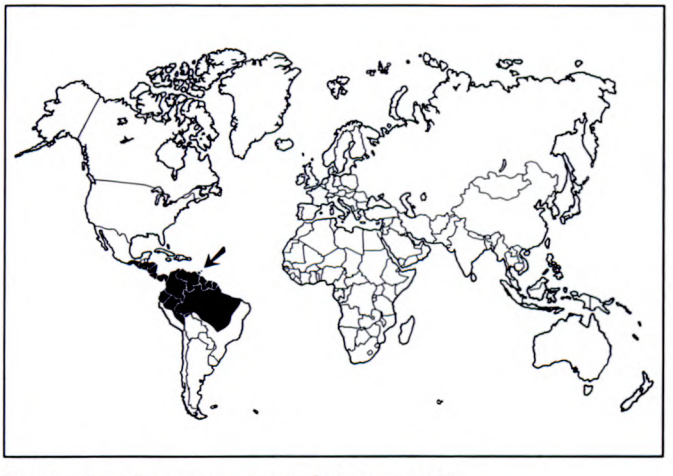
The common caiman is a small to medium-sized crocodilian (maximum length in males ca. 2.8 m) that is extremely adaptable in terms of habitat requirements. At one time this species may have been relegated to a much smaller ecological niche, but with the extensive commercial overharvesting of the larger sympatric species of crocodilians (*C. acutus*, *C. intermedius*, *M. niger*), the common caiman has come to inhabit virtually every type of low-altitude wetland habitat in the Neotropics.

A great deal of biological investigation has been carried out on this species, particularly in seasonal savannah habitats. Relatively less is known about its behavior and ecology in forested or swamp habitats (Ouboter and Nanhoe 1988). Much of the published ecological information for this species is summarized in Gorzula and Seijas (1989). Female common caiman reach sexual maturity at about 120 cm total length and lay an average of 20-40 eggs in a mound nest, usually during the annual wet season.



Common caiman, *Caiman crocodilus crocodilus*, at Madras Crocodile Bank, India (Photo by H. Andrews).

The current status of *Caiman crocodilus* is hard to evaluate due to the interaction of a number of factors. Owing to the extensive development of ventral osteoderms, caiman skins are of inferior commercial quality when compared to those of crocodiles and the American alligator, and usually only the lateral flank region is used. Because of the poor quality of the hide, caiman exploitation did not begin until the 1950s when stocks of the more valuable classic crocodiles had dwindled. However, since the 1950s, millions of caiman have been harvested, and caiman today (*Caiman crocodilus* and *C. yacare*) continue to supply the vast majority of skins on the market. Caiman appear to have been quite resilient to commercial hunting for a number of reasons, particularly because they reproduce at a relatively small size, and hunting in many areas appears to have concentrated on the larger adult males. Another important factor has been the near extirpation of larger, sympatric species of crocodilians of greater commercial value. Caiman now occupy habitats that formerly were dominated by *Melanosuchus niger*, *Crocodylus intermedius*, and *C. acutus* (Magnusson 1982, Thorbjarnarson in press). Furthermore, in areas such as the llanos of Venezuela and Colombia and the Brazilian Pantanal, the proliferation of manmade water bodies



Distribution of common caiman, *Caiman crocodilus*.

(e.g., borrow-pits) has increased the carrying capacity for *Caiman* populations in these habitats. In many of these areas it is difficult to assess the current status of caiman populations, because although they may be depleted with respect to environmental carrying capacity, present populations may be larger than they were historically. The ecological adaptability of the common caiman is evident in the United States (Florida), Puerto Rico, and Cuba, where feral caiman populations are creating problems. The Cuban population is alleged to have contributed to the extirpation of *Crocodylus rhombifer* from the Lanier Swamp on the Isle of Pines.

Relatively good survey data are available in only seven of the 17 countries in which *Caiman crocodilus* is found. However, surveys are currently being planned in several Central American and northern South American nations. Little information is available for the northern end of the species' range in Mexico, El Salvador, and Guatemala. Also, few surveys have been done on the introduced populations in the United States (Florida), Puerto Rico, and Cuba.

The status summary includes only countries where the common caiman occurs naturally. Although the available information is sketchy in many areas, caiman populations appear to be doing relatively well in most countries. Only in El Salvador are populations considered to be severely depleted, and very little recent information is available for that country. In many areas where recent surveys have been conducted, the species is facing an array of problems such as illegal hunting or habitat destruction, but populations do not appear to be significantly depleted (e.g., Honduras, Costa Rica, Venezuela).

Despite the overall good status of this species, urgent conservation action is needed for *Caiman crocodilus apaporiensis*. This virtually unknown subspecies has a very restricted range in the Colombian Amazon, and surveys are urgently needed to determine its population status.

A number of Latin American nations have developed sustainable yield management programs for the common caiman. Some of these management schemes are based on the cropping of wild populations. By far the largest such program is in Venezuela based on the harvest of adult males. Other cropping programs exist in Guyana, Nicaragua, and Honduras. In recent years a number of countries have begun to develop ranching and farming programs (see Appendix 2). However, because of the low relative value of caiman hides, it is unclear whether the ranching or farming of caiman will be economically viable (Magnusson 1984). This species, along with the Yacare caiman, is currently supplying approximately three-quarters of the crocodilian skins in trade.

Illegal trade in caiman skins has been, and continues to be, a major problem. Recently, the existence of an extensive illegal trade in caiman skins to Singapore and Thailand has been documented, with at least 750,000 skins imported into Thailand in 1988. Most of these caiman are thought to have been shipped from Brazil and Paraguay (Hemley 1990).

Priority Projects:

High Priority

Survey of Apaporis River caiman in Colombia. Caiman crocodilus apaporiensis is thought to be present only in the upper and middle Apaporis River and some adjacent areas in southern Colombia. No recent information on the status of these populations is available. Surveys are urgently needed to determine the present status of this unusual form of the common caiman.

Contact: Dr. Jorge Hernández-Camacho

Effect of caiman harvest on wild populations in Venezuela. Venezuela has established the largest cropping program for any species of crocodilian. Quotas are established based on census data, but virtually no site-specific data are available on the effects of the harvest on wild caiman populations. Long-term studies need to be set up to monitor accurately the effects of the harvest on population parameters. The program also offers an unparalleled opportunity to establish experimental harvesting regimes in conjunction with population studies.

Contact: Dr. John Thorbjarnarson, Andrés Eloy Seijas

Control of illegal trade in caiman skins. Caiman crocodilus and *C. yacare* comprise the majority of crocodilian skins in trade. However, an extensive network of caiman smuggling exists, with skins being shipped from Brazil and Paraguay, and some being smuggled through Colombia. Currently, most of these skins pass through Thailand or Singapore. Action needs to be taken to request that these two importing countries abide by CITES regulations. Political action is needed to pressure Singapore into dropping its reservation on *Caiman crocodilus*, and to ensure that Thailand passes legislation to implement CITES regulations.

Contact: Prof. Harry Messel, Dr. Obdulio Menghi, Juan Villalba-Macías

Moderate Priority

Implementation of caiman sustainable-yield management programs. Because *Caiman* are relatively fast-maturing and extremely adaptable in terms of habitat requirements, they have a very high potential for inclusion in sustainable-yield management programs. A CITES-sponsored initiative to implement a management program for this species has started in Honduras. Support for programs in Nicaragua and Panama are currently being planned. The program needs to be expanded to include Latin American countries such as Colombia, Ecuador, Peru, Costa Rica, and others that are interested in *Caiman* management. Initial work should center on conducting population surveys and making recommendations tailored to the type of management being considered (cropping, ranching).

Contact: Dr. Obdulio Menghi, Prof. F. Wayne King

Taxonomic study of the caiman species complex. The relationships among the caiman species complex are still poorly understood. This has created conservation problems due to the inability to recognize subspecific taxa that may differ in trade restrictions. Investigation of the southern *C. crocodilus-C. yacare* relationships has started. This work needs to be expanded to include northern South America and Central America.

Contact: Peter Brazaitis, Prof. F. Wayne King, Dr. Norman Scott

Long-term ecological studies in the Venezuelan llanos. The Venezuelan llanos have been the site of a considerable amount of research on the ecology of the common caiman. They also are the site of a large harvest program, and offer unequaled opportunities for the investigation of a number of aspects of the population biology of this species. This work could be done in conjunction with the monitoring of harvest effects in order to improve our ability to manage wild populations of this species.

Contact: Andrés Eloy Seijas, Dr. John Thorbjarnarson

Broad-snouted Caiman (*Caiman latirostris*)

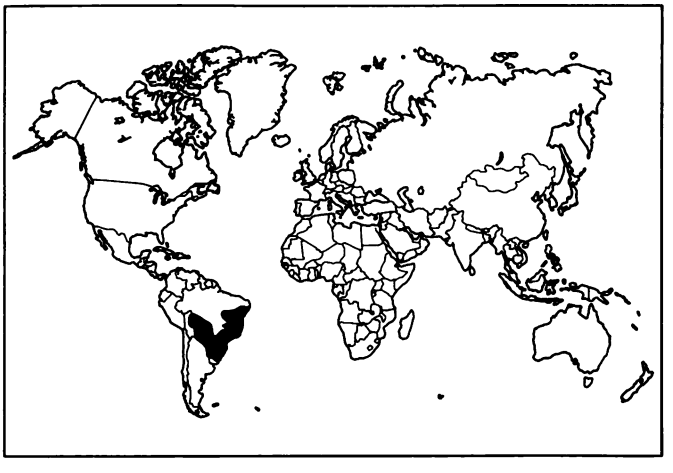
Range: Argentina, Brazil, Bolivia, Paraguay, Uruguay,

Conservation Overview
CITES: Appendix I
IUCN Red List 1990: Endangered
CSG Action Plan: Availability of Survey Data: Poor
Need for Wild Population Recovery: Moderate
Potential for Sustainable-yield Management: High

Principal Threats: IH-Illegal hunting, HD-Habitat destruction
Availability of Survey Data: (5 countries)
No survey data: 1 country (20%)
Surveys planned: 1 country (20%)
Basic survey data: 3 countries (60%)
Widespread survey data: 0 countries (0%)

Status of Wild Populations: (5 countries)
Extirpated: 0 countries (0%)
Severely depleted: 1 country (20%)
Depleted: 4 countries (80%)
Not depleted: 0 countries (0%)
Unknown: 0 countries (0%)

Existing Management Programs: (5 countries)
No management plan: 0 countries
Complete protection: 3 countries
Reintroduction or restocking: 2 countries
Cropping: 0 countries
Ranching: 1 country
Farming: 1 country



Distribution of broad-snouted caiman, *Caiman latirostris*.

Ecology and Natural History: The broad-snouted caiman is a medium-sized crocodilian with a maximum reported size of 3.5 m. This species is restricted to the Atlantic coast drainages in Brazil south of the Amazon, Uruguay, Paraguay, and northern Argentina, where it is principally a marsh- and swamp-dwelling species. Although this species is broadly sympatric with *Caiman yacare*, Medem (1983) reported that *C. latirostris* was generally found in more densely vegetated, quieter waters. In Paraguay, Scott et al. (1989) found *C. latirostris* to be a habitat generalist, but when in sympatry with *C. yacare* it tended to be found in more ephemeral habitats, and was a better colonizer of isolated cattle stock ponds.

Due to a lack of field studies, very little is known about the behavior and ecology of this species. Much of what is known about reproduction has come from individuals in zoos. Like the other caiman species, *C. latirostris* is a mound nester, typically laying 20-50 eggs during the wet season. The broad-snouted caiman, as its name implies, has the broadest snout of any crocodilian. Although it has a very generalized diet, in some parts of its range it feeds to a large extent on ampullarid snails (Diefenbach 1979).

Like the other members of the genus *Caiman*, the broad-snouted caiman has well-developed ventral osteoderms which reduce the commercial value of the hide. Commercial hunting began in the 1940s and 1950s throughout most of the range of this species, although according to Medem (1983) *C. latirostris* was never hunted commercially in Uruguay. Illegal hunting still continues to be a major problem for this species, and in some areas habitat destruction is also a severe threat, especially in coastal Brazil and Uruguay.

Survey data for the broad-snouted caiman are relatively good, with data available from three of the five countries with *C. latirostris*, and a general survey is being planned for a fourth country (Brazil). Populations of the broad-snouted caiman are considered to be severely depleted in Bolivia, which is on the limit of the species' natural range. Throughout the rest of its range populations are classified as depleted, with locally healthy populations still remaining.

The management of the broad-snouted caiman is based principally on the protection of wild populations. Two countries, Argentina and Brazil, are in the early stages of developing farming and ranching programs. In both these countries captive breeding for the restocking of wild populations is also being undertaken.

Priority Projects:

High Priority
Survey of status and distribution in Brazil. The largest part of the range of the broad-snouted caiman is located within Brazil but only scanty information is available concerning the species status in that country. Commercial ranches are starting up, but

Broad-snouted caiman, *Caiman latirostris*, Argentina (Photo by R. Godshalk).

information on the status of wild populations is necessary for the development of a conservation program based on sustainable utilization.

Contact: Peter Brazaitis, Carlos Yamashita, George Rebelo

Implementation of management programs. Management programs, based largely on sustainable-yield utilization, need to be implemented in Brazil, Paraguay, Argentina, and Bolivia. Initial surveys should be conducted, and population monitoring programs established. Ranching programs based on the collection of eggs or hatchlings appear to offer the greatest conservation benefits at present. The development of successful management programs should include public education, professional training, development of tanning industries, caiman husbandry research, and the implementation of a hide marking system.

Contact: Juan Villalba-Macías, Alejandro Larriera, Aida Luz Aquino-Shuster, Prof. F. Wayne King, Dr. Norman Scott, Carlos Yamashita, George Rebelo, Peter Brazaitis

Moderate Priority

Survey of status and distribution in Uruguay. Populations of *C. latirostris* are known from Uruguay, but no recent survey data are available and some reports suggest that they are in decline due to habitat destruction.

Contact: Juan Villalba-Macías, Dr. Federico Achaval

Investigations of population biology. Few field studies of the ecology of this species have been undertaken. Based on the results of the initial population surveys, study sites should be identified in Brazil, Paraguay, Uruguay, and Argentina. Long-term ecological studies need to be established as part of sustainable-yield management.

Contact: Juan Villalba-Macías, Alejandro Larriera, Aida Luz Aquino-Shuster, Prof. F. Wayne King, Dr. Norman Scott, Carlos Yamashita, George Rebelo, Peter Brazaitis

Yacare Caiman (*Caiman yacare*)

Range: Argentina, Brazil, Bolivia, Paraguay

Conservation Overview
CITES: Appendix II (as *C. c. yacare*)
IUCN Red List 1990: Not listed.
CSG Action Plan: Availability of Survey Data: Adequate
Need for Wild Population Recovery: Moderate
Potential for Sustainable-yield Management: Highest

Principal Threats: IH-Illegal hunting, HD-Habitat destruction
Availability of Survey Data: (4 countries)
No survey data: 0 countries (0%)
Surveys planned: 0 countries (0%)
Basic survey data: 4 countries (100%)
Widespread survey data: 0 countries (0%)

Status of Wild Populations: (4 countries)
Extirpated: 0 countries (0%)
Severely depleted: 0 countries (0%)
Depleted: 4 countries (100%)
Not depleted: 0 countries (0%)
Unknown: 0 countries (0%)

Existing Management Programs: (4 countries)
No management plan: 0 countries
Complete protection: 1 country
Reintroduction or restocking: 1 country
Cropping: 1 country
Ranching: 1 country
Farming: 1 country

Ecology and Natural History: The yacare caiman is found in southern Brazil and Bolivia, south through the Paraguay/Paraná River systems and into northern Argentina (see map). Morphologically and ecologically this species is very similar to the common caiman, and can similarly be found in a wide spectrum of habitat types. Most of the ecological studies on this species have been carried out in the Pantanal region of southern Brazil

Yacare, *Caiman yacare* (Photo by F.W. and S. King).

(Crawshaw and Schaller 1980, Schaller and Crawshaw 1982, Cintra 1985, 1986). A summary of information regarding the ecology of this species is provided in Gorzula and Seijas (1989).

Yacare caiman are mound nesters, with egg-laying usually peaking in the middle wet season. Clutch size is typically in the 25-35 range. The tendency of females to guard their nests is apparently influenced by human hunting pressure (Crawshaw 1987), with decreased nest attendance, and a lower hatching success, in areas with greater hunting pressure.

Most of what was written about the conservation of the common caiman applies equally well to this species. However, unlike the common caiman, basic survey information is available for this species in all countries where it occurs. This information has resulted principally from a series of CITES sponsored surveys of southern Brazil, Bolivia, and Paraguay. Populations of yacare caiman are considered to be somewhat depleted in all four countries where it occurs, and this is principally due to widespread illegal hunting during the 1970s and 1980s. Poaching remains a serious problem throughout much of this species' range, particularly in Brazil where it is a widespread and well-organized activity (Brazaitis et al. 1988). However, due to their small size at maturity, their ability to adapt to a wide variety of habitat types, and their learned wariness, caiman are particularly resilient to hunting pressure.

Commercially oriented management programs are in place in three of the four countries with yacare. The fourth, Paraguay, also appears to be moving toward sustainable-yield management. Cropping is permitted in Bolivia, and until recently hides were exported under a CITES quota. This, however, has stopped due to illegal commerce in yacare hides. In Brazil and Argentina hunting of wild animals is not permitted, but ranching and farming programs are developing. In Argentina a plan for the captive rearing of yacare for reintroduction is also underway.

Priority Projects:

High Priority

Implementation of management program in Brazil. Illegal trade in *C. yacare* from Brazil is a major international conservation problem. The current uncontrolled poaching must be replaced by a managed sustainable-yield program. A conservation agency should be established to coordinate conservation actions including long-term population research and monitoring, public education, professional training in wetlands management, and programs related to the development of a hide industry.

Contact: Luciano Martins Verdade, Zilca Campos, Carlos Yamashita, George Rebelo

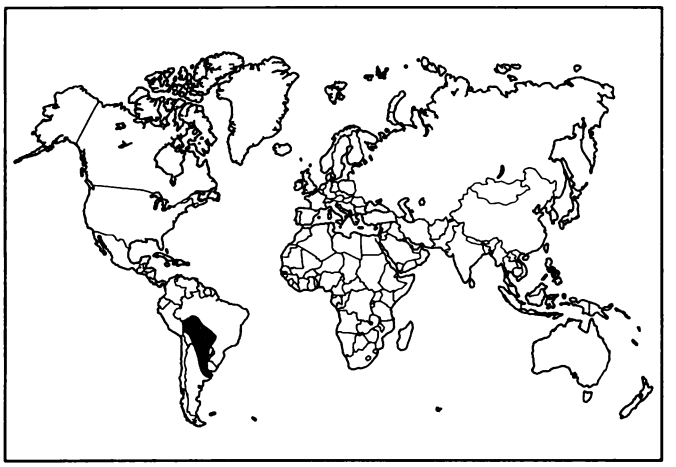
Control of illegal trade in Caiman yacare skins. This project is as described above under *Caiman crocodilus.*

Contact: Prof. Harry Messel, Dr. Obdulio Menghi, Juan Villalba-Macias

Moderate Priority

Long-term ecological studies in the Pantanal, Brazil. Like the llanos of Venezuela and Colombia, the Pantanal is a large, seasonally inundated savannah that offers excellent research opportunities for the study of *Caiman* population dynamics. The interest in the development of sustainable-yield management programs should foster the development of research programs to investigate aspects of the life history of the yacare. The funding needed for this research could be tied to the development of commercial management.

Contact: Carlos Yamashita, George Rebelo, Zilca Campos, Dr. William Magnusson



Distribution of yacare, *Caiman yacare.*

Black Caiman (*Melanosuchus niger*)

Range: Bolivia, Brazil, Colombia, Ecuador, French Guiana, Guyana, Peru

Conservation Overview

CITES: Appendix I
IUCN Red List 1990: Endangered
CSG Action Plan: Availability of Survey Data: Poor
Need for Wild Population Recovery: High
Potential for Sustainable-yield Management: Moderate

Principal Threats: IH-Illegal hunting, HD-Habitat destruction
Availability of Survey Data: (7 countries)
No survey data: 0 countries (0%)
Surveys planned: 1 country (14%)
Basic survey data: 6 countries (86%)
Widespread survey data: 0 countries (0%)

Status of Wild Populations: (7 countries)
Extirpated: 0 countries (0%)
Severely depleted: 4 countries (57%)
Depleted: 3 countries (43%)
Not depleted: 0 countries (0%)
Unknown: 0 countries (0%)

Existing Management Programs: (7 countries)
No management plan: 0 countries
Complete protection: 6 countries

Reintroduction or restocking: 1 country
Cropping:
Ranching: 0 countries
Farming: 0 countries

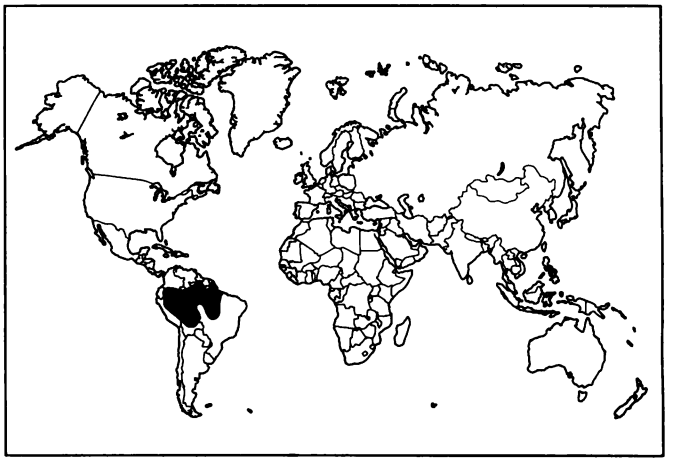
Ecology and Natural History: The black caiman is the largest member of the Alligatoridae, with adult males surpassing 4 m in length. This species is widely distributed throughout the Amazon River basin, but populations are known from peripheral areas outside the Amazon as well (the Rupununi and upper Essequibo River drainage in Guyana; the Kaw region of French Guyana; see map). The black caiman until recently has been little studied. However, during the 1980s several studies on wild and captive populations were carried out by Herron (1985) in Peru, Pacheco (1990) in Bolivia, and Asanza (pers. comm.) in Ecuador. Additionally, information on aspects of the ecology of this species was gathered during survey work conducted by Brazaitis et al. (1990), and King and Videz-Roca (1988). These studies have augmented the work done by Medem on this species in Colombia throughout the 1950s, 1960s and 1970s (Medem 1981), and the studies of Otte (1978) in Peru.

The black caiman occupies a wide variety of habitats including larger rivers and streams, oxbow lakes, and in some areas seasonally flooded savannahs. Ecological habitat partitioning between this species and the other Amazonian caimans appears to be taking place in many areas, but habitat relations among the species have been blurred by the severe reduction in numbers of black caiman in most areas (Magnusson 1982). Fittkau (1970) hypothesized that black caiman played a vital role in nutrient cycling in the rivers and mouth-lakes of the lower Amazon. The demise of *Melanosuchus* populations has been linked anecdotally with a decrease in fisheries productivity.

The black caiman, like all alligatorids, is a mound nester, however many aspects of this species' reproductive ecology are poorly known. Clutch size typically ranges from 30-60. Herron et al. (1990) report on a *Melanosuchus* nest in Peru followed throughout the entire period of incubation.

The black caiman, along with the Cuban and the Orinoco crocodile, is one of the three most threatened species of New World crocodilians. Commercial hunting of the black caiman did not begin in earnest until the 1940s, when stocks of the South American crocodiles (*C. acutus*, *C. intermedius*) were becoming very low. Hunting peaked during the 1950s, and declined markedly through the 1960s and into the 1970s when trade in *Caiman crocodilus* began to increase. However, in some areas significant trade in black caiman extended into the 1970s (Medem 1971, Plotkin et al. 1983). Commercial hunting continues to be problem in some areas. In addition, ecological competition with the smaller common caiman may also be playing an important role in slowing natural population recovery (Magnusson 1982, Brazaitis et al. 1988).

A reasonable amount of survey work has been conducted on the black caiman throughout most of its range. The one exception to this is Colombia, where the last surveys were conducted in the 1970s. Although it is widely distributed, principally in the Amazon basin, past overhunting and continued poaching has drastically reduced populations. Populations of black caiman are considered to be severely depleted in four of the seven nations in which the species occurs, and are depleted in the remainder. Relatively good populations remain scattered in isolated areas of Guyana, Peru, Ecuador, and Brazil, particularly in oxbow lakes where access is difficult. The population in the Kaw region of French Guiana has recently been decimated by hide hunting, and in Bolivia and Colombia black caiman appear to be still widely distributed, but in very low numbers. Relatively little is known about the behavior and ecology of this species. Surveys and ecological studies on the known remaining populations are required.



Distribution of black caiman, *Melanosuchus niger*.

Management programs for the black caiman are almost exclusively based on the legal protection of wild populations. However, as in the majority of developing countries, the enforcement of these laws is very difficult. The only attempt to reintroduce black caiman into the wild was in Bolivia, where a private conservation group (PRODENA) has been involved in establishing a release program using animals that have been maintained in captivity. The first release of 25 black caiman into the wild was conducted in July, 1990 at the Beni Biological Station.

Priority Projects:

High Priority

Initiate management programs in Brazil. Brazaitis et al. (1988) strongly urge the development of a coordinated management program for black caiman, and the other crocodilians, in Brazil. This program should include long-term ecological investigations in areas such as the Río Guapore (near Guajara Mirim and Costa Marques) and the Río Galera in Mato Grosso. Vital to the implementation of the program will be the establishment of an agency responsible for crocodilian conservation programs, staffed by trained biologists. Program initiatives should also include public education, marketing, tanning technologies, captive propagation, and husbandry.

Contact: Peter Brazaitis, Carlos Yamashita, George Rebelo, Dr. William Magnusson

Status and ecology in the Rupununi region of Guyana. The recently assessed population in the Rupununi savannah region of Guyana may be one of the largest remaining anywhere. A detailed status survey and ecological studies need to be under-

taken as a prerequisite for conservation planning.

Contact: Dr. Stefan Gorzula, Dr. Philip Hall

Population status in the Beni Biological Station, Bolivia. The Beni Biological Station contains 135,000 ha of mixed savannah and forest habitat. Recent reports suggest that populations of black caiman may remain in several isolated lagoons and in some rivers. This area was the site of the first black caiman restocking program. Ecological surveys and project follow-ups are needed.

Contact: Dr. Mario Baudoin, Luis Pacheco

Status and ecology in the Kaw region, French Guiana. Until recently, this was one of the largest remaining *Melanosuchus* populations. However, uncontrolled hunting has had a severe impact, and current population size is greatly reduced. Surveys are needed to examine the present status of the species in French Guiana, and initiate ecological studies. Although a newly declared Kâw Swamp Sanctuary exists, better protection for the species throughout the country should be secured.

Contact: Olivier Behra

Moderate Priority

Status and Distribution in Ecuador. Populations of *Melanosuchus* appear to be relatively healthy in some regions of Ecuador. The existence of other, unknown populations is quite likely. A complete survey of the Amazonian region of Ecuador is needed to determine the present status of *Melanosuchus*.

Contact: Dr. Eduardo Asanza

Population ecology in Ecuador. Relatively little is known about the ecology and behavior of this species. Studies by Asanza and co-workers have been among the most thorough to date. Financial support is needed to continue and expand these investigations in Limon Cocha and Zancudo Cocha, where two of the best *Melanosuchus* populations remain.

Contact: Dr. Eduardo Asanza

Dwarf Caiman (*Paleosuchus palpebrosus*)

Range: Bolivia, Brazil, Colombia, Ecuador, French Guiana, Guyana, Paraguay, Peru, Suriname, Venezuela

Conservation Overview
CITES: Appendix II
IUCN Red List 1990: Not listed
CSG Action Plan: Availability of Survey Data: Poor
Need for Wild Population Recovery: Low
Potential for Sustainable-yield Management: Low

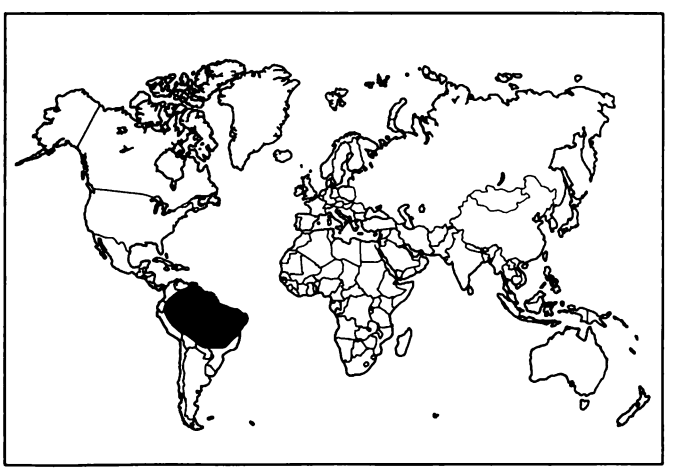
Principal Threats: HD-Habitat destruction
Availability of Survey Data: (10 countries)
No survey data: 1 country (10%)
Surveys planned: 1 country (10%)
Basic survey data: 8 countries (80%)
Widespread survey data: 0 countries (0%)

Status of Wild Populations: (10 countries)
Extirpated: 0 countries (0%)
Severely depleted: 0 countries (0%)
Depleted: 1 country (10%)
Not depleted: 9 countries (90%)
Unknown: 0 countries (0%)

Existing Management Programs: (10 countries)
No management plan: 0 countries
Complete protection: 9 countries
Reintroduction or restocking: 0 countries
Cropping: 1 country
Ranching: 0 countries
Farming: 0 countries

Ecology and Natural History: The two species of *Paleosuchus* are very often considered together because both are small, secretive species, and until recently very little work had been done on either. Most of the early work done on this genus was done by Federico Medem (summarized in Medem 1981, 1983), and to date very little else has been published on the ecology of dwarf caiman. This species is essentially restricted to the Amazon and Orinoco River drainages, and the Atlantic coast drainages that lie between these two rivers; however, some specimens inhabit the upper Paraguay River drainage in Paraguay (Medem 1983, Scott et al. 1988). Much of what is known concerning the ecology of the dwarf caiman is summarized in Magnusson (1989).

The principal habitat of the dwarf caiman in the central Amazon basin is inundation forests around the major rivers and lakes (Magnusson 1985). On the Brazilian shield (Rebelo and Louzada 1984), and in the Venezuelan llanos (pers. obs.) it occurs in streams lined by thin strips of gallery forest. In many of these latter habitats the dwarf caiman are found in very nutrient-poor waters. King and Videz-Roca (1989) report both species of *Paleosuchus* to be found in both large rivers and small streams in Bolivia, usually along stretches of shore devoid of floating or emergent vegetation and frequently in



Distribution of dwarf caiman, *Paleosuchus palpebrosus*.

Dwarf caiman, *Paleosuchus palpebrosus*, Colombia (Photo courtesy of WWF-P.C.H. Pritchard).

association with dead trees.

The dwarf caiman, as its name implies, is a small crocodilian. In fact, it is probably the smallest extant species of crocodilian in the world, with the maximum length of males reported to be only about 1.6 m (Medem 1981). Little is known about its reproduction, but females are known to make mound nests and lay 10-15 eggs.

Both species of *Paleosuchus* have well-developed double osteoderms present in the ventral scutes. This and the species' small size make the hide virtually worthless from a commercial point of view and has resulted in only limited hunting pressure. For a little-known, economically unimportant species, the survey data for the dwarf caiman is surprisingly complete. Surveys have been conducted to some extent in a large majority (80%) of the countries containing this species. Most surveys were undertaken to determine the status of other crocodilians, but reported *Paleosuchus* densities as well. Subsistence hunting does take place widely, and can locally reduce *Paleosuchus* densities, but populations of this species do not appear to have been much impacted. Gold mining activities and the resulting pollution are also having an impact on this species in certain areas.

Because of its small, very bony hide, this species holds little potential for the development of commercially oriented management programs. Management programs are based almost without exception on prohibiting commercial hunting, although subsistence hunting in many countries is permitted. The commercial exploitation in Guyana is based on the capture and sale of dwarf caiman for the pet industry.

Priority Projects:

Moderate Priority

Investigations of ecology and population biology. This species is perhaps the least known of the New World crocodilians. Even such basic topics as habitat preference and reproduction are poorly known. Ecological relations with other crocodilians and the effects of subsistence hunting would be important management topics to address. Areas where ecological investigations could be most fruitfully undertaken include the Brazilian Amazon, Guyana, and the Venezuelan Guyana region.

Contact: Dr. William Magnusson, Dr. Stefan Gorzula, Prof. F. Wayne King, Dr. P.E. Vanzolini

Smooth-fronted Caiman (*Paleosuchus trigonatus*)

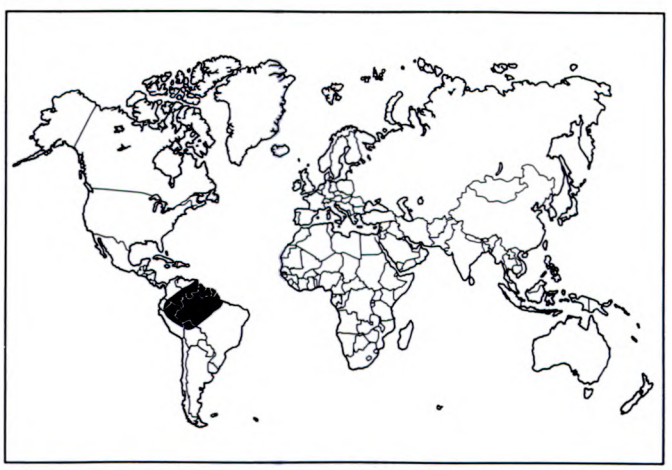
Range: Bolivia, Brazil, Colombia, Ecuador, French Guiana, Guyana, Peru, Suriname, Venezuela

Conservation Overview
CITES: Appendix II
IUCN Red List 1990: Not listed
CSG Action Plan: Availability of Survey Data: Poor
Need for Wild Population Recovery: Low
Potential for Sustainable-yield Management: Low

Principal Threats: HD-Habitat destruction
Availability of Survey Data: (9 countries)
No survey data: 1 country (11%)
Surveys planned: 1 country (11%)
Basic survey data: 7 countries (78%)
Widespread survey data: 0 countries (0%)

Status of Wild Populations: (9 countries)
Extirpated: 0 countries (0%)
Severely depleted: 0 countries (0%)
Depleted: 0 countries (0%)
Not depleted: 9 countries (100%)
Unknown: 0 countries (0%)

Existing Management Programs: (9 countries)
No management plan: 0 countries
Complete protection: 8 countries
Reintroduction or restocking: 0 countries
Cropping: 1 country
Ranching: 0 countries
Farming: 0 countries



Distribution of smooth-fronted caiman, *Paleosuchus trigonatu-*

Smooth-fronted caiman, *Paleosuchus trigonatus*, Venezuela (Photo by R. Godshalk).

Ecology and Natural History: The smooth-fronted caiman is somewhat larger than *P. palpebrosus* (maximum male length ca. 2.3 m; Medem 1981), and has a similar distribution, but does not enter the Brazilian shield region or the Paraguay River drainage. In Brazil, this species is found principally in small forest stream habitats (Magnusson 1989). In Venezuela, *P. trigonatus* is principally restricted to chemically poor rivers and streams of the southern forested region of the country (Gorzula and Paolillo 1986, Gorzula et al. 1988), and has been reported at elevations up to 1,300 m. The habitat in Bolivia is similar to that reported in the *P. palpebrosus* account (King and Videz-Roca 1989).

Ecological studies on this species by Magnusson and co-workers (Magnusson 1985, Magnusson et al. 1985, 1987) have revealed a number of interesting aspects of its life history. The diet is comprised to a large degree of terrestrial vertebrates. Egg laying apparently takes place at the end of the dry season, and many of the mound nests are located adjacent to or on top of termite mounds, which maintains a stable elevated nest temperature. The incubation period appears to be the longest of any crocodilian and is in excess of 100 days (Magnusson 1989). Magnusson (1989) summarizes much of the published information on this species.

As with the dwarf caiman, surveys, mostly for other species of crocodilians, have been conducted throughout much of the range of this species. Owing to the limited potential for commercial exploitation, the smooth-fronted caiman has been hunted mostly on a subsistence basis and populations appear to remain healthy throughout the species' range. Recent environmental pollution associated with gold mining in Venezuela and Brazil appears to be having an increasingly negative impact on populations of this species and other crocodilians.

Because of the species' small size and extensive ventral ossification, the commercial value of the hide of *P. trigonatus* is very low. The management of the smooth-fronted caiman is based principally on the protection of wild populations. Limited cropping is only allowed in Guyana, principally for the pet trade.

Priority Projects:

Moderate Priority

Investigations of ecology and population biology. Although more is known about the behavior and ecology of this species than is known about the dwarf caiman, many aspects of the smooth-fronted caiman's life history remain to be investigated. One of the important management-related topics is to determine the effect of gold mining on populations of *Paleosuchus.*

Contact: Dr. William Magnusson

American Crocodile (*Crocodylus acutus*)

Range: Belize, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Nicaragua, Mexico, Panama, Peru, United States, Venezuela

Conservation Overview
CITES: Appendix I
IUCN Red List 1990: Endangered
CSG Action Plan: Availability of Survey Data: Poor
Need for Wild Population Recovery: High
Potential for Sustainable-yield Management: Moderate

Principal Threats: IH-Illegal hunting, HD-Habitat destruction, IE-Introduced Exotics
Availability of Survey Data: (17 countries)
No survey data: 2 countries (12%)
Surveys planned: 6 countries (35%)
Basic survey data: 8 countries (47%)
Widespread survey data: 1 country (6%)

Status of Wild Populations: (18 countries)
Extirpated: 1 country (6%)
Severely depleted: 5 countries (28%)
Depleted: 12 countries (67%)
Not depleted: 0 countries (0%)
Unknown: 0 countries (0%)

Existing Management Programs: (17 countries)
No management plan: 2 countries
Complete protection: 8 countries
Reintroduction or restocking: 1 country
Cropping:
Ranching: 1 country
Farming: 5 countries

Ecology and Natural History: The American crocodile is one of the most widely distributed of the New World crocodiles, with a distribution including the southern tip of Florida, both the Atlantic and Pacific coasts of southern Mexico, Central America, and northern South America, as well as the Caribbean islands of Cuba, Jamaica, and Hispaniola (see map). The habitat of the American crocodile consists largely of freshwater or brackish water coastal habitats such as the saltwater sections of rivers, coastal lagoons, and mangrove swamps. However, populations are known from freshwater areas located well inland, including a number of reservoirs. Also, one of the largest known populations is in Lago Enriquillo, a landlocked hypersaline lake situated 75 m below sea level in the arid southwestern Dominican Republic.

American crocodile, *Crocodylus acutus*, Dominican Republic (Photo by J. Thorbjarnarson).

The American crocodile is a relatively large species, with males having maximum lengths in the 5-6 m range, although some 7 m individuals have been reported (Schmidt 1924, Medem 1981). This species is characterized by the most reduced and irregular dorsal armature (osteoderms) of any crocodilian.

Crocodylus acutus is one of the most adaptable crocodilians in terms of nesting ecology. Throughout most of its range, the American crocodile is a hole-nesting species. However, in areas where access to well-drained nesting beaches is limited, females will form mound-type nests (Campbell 1972a, Kushlan and Mazzotti 1989). Clutch size is typically in the 30-60 range, although in some populations mean clutch size is in the low 20s (Thorbjarnarson 1989). As with most hole-nesting species, *C. acutus* nests during the annual dry season with eggs hatching near the beginning of the annual rainy period (Thorbjarnarson 1989). Extensive nest protection has not been reported in most areas (although see Dugan et al. 1981) and maternal care of neonates appears to be minimal.

A number of studies have examined aspects of the population ecology of the species, in Florida (Kushlan and Mazzotti 1989, Ogden 1978), Haiti (Thorbjarnarson 1988), and Venezuela (Seijas 1988). Behavioral studies in captivity have been published by Garrick and Lang (1977). Much of the published information on the ecology of this species prior to 1988 was summarized by Thorbjarnarson (1989).

The American crocodile is found in 17 countries in the northern Neotropics. This species produces a commercially valuable hide, and the principal reason for past declines in population size can be attributed to the extensive commercial overexploitation that occurred from the 1930s into the 1960s. Current threats are habitat destruction, and in some areas, continued hunting. The collection of adult breeders to stock farms could become a serious problem in some countries if not closely regulated by the appropriate management authorities.

At present, the overall quality of survey data is poor. In eight countries, few or no survey data are available, but in six of these countries surveys are currently underway or being planned. The only countries for which no surveys are planned are El Salvador and Nicaragua. In eight countries some survey data are available, and in one (the United States) widespread survey work has been conducted.

Populations of *C. acutus* are considered to be severely depleted in five of the 17 countries (29.4%) in which it occurs. In the remaining countries populations are somewhat depleted. This species is considered to be depleted to a significant extent throughout its range.

A majority of countries (8) have management programs based on complete protection, but only a few have enforced this legislation. Two countries (El Salvador and Haiti) have no management programs whatsoever. In five countries farming of *C. acutus* has begun (farming is also being planned in Jamaica), and in Cuba ranching is also conducted.

As American crocodiles produce a commercially valuable hide, sustainable utilization programs based on ranching and farming are feasible. However, the development of management programs based on sustainable utilization must be approached on a country-by-country basis and be directly linked to the health of wild populations.

Priority Projects:

High Priority

Status and distribution in Colombia. Since the work of Medem (1983), very little work has been done on crocodilians in Colombia. Consequently, almost nothing is known about the present status of *C. acutus* populations in Colombia. While populations were widespread along both the Caribbean (particularly in the Magdalena River basin) and Pacific coasts at one time, they suffered heavily from commercial hide hunting. Interest has recently developed in farming *C. acutus*, and regulations allow the collecting of breeding stock from the wild, but farms must turn over a fraction of their juveniles for restocking programs. Surveys are urgently needed to establish the current status of populations as a first step towards establishing a management program for this species.

Contact: Prof. F. Wayne King, Jesus Ernesto Pachon R., Jorge Hernandez Camacho, José Vincente Rodríguez

Management of crocodiles in Cuba. Reports on the status of this species in Cuba have given conflicting information. The species is being farmed and ranched extensively, but apparently not much has been done with wild crocodile populations. The assessment of the state of crocodilian management programs in Cuba has also been impeded by the lack of contact between Cuban and western scientists. More cooperative work needs to be done to include Cuba in the worldwide crocodile conservation movement. Surveys of crocodile status and distribution are of primary importance.

Contact: Roberto Ramos Targarona, Jose Alberto Ottenwalder

Status and distribution in Nicaragua. Although some reports indicate *C. acutus* populations are widespread in Nicaragua, no data are available. Nicaragua has developed a management program for *Caiman* based on cropping, and this may result in increased hunting of crocodiles. Survey data will be needed if other management programs such as ranching or farming are to be planned.

Contact: José Vincente Morales Molina

Status and distribution in Panama. Farming and ranching schemes are being planned for Panama. Survey data are needed for the implementation of these programs.

Contact: Prof. F. Wayne King

Status and distribution in Belize. Due to recent interest in ranching or farming crocodiles in Belize, survey data on population status are needed.

Contact: Prof. F. Wayne King

Moderate Priority

Status and ecology in Costa Rica. Reports indicate the presence of healthy populations of *C. acutus* in Costa Rica, particularly in the Tempisque River. Because of its excellent institutional infrastructure, Costa Rica would be an ideal site to conduct population research on this species for management and conservation purposes.

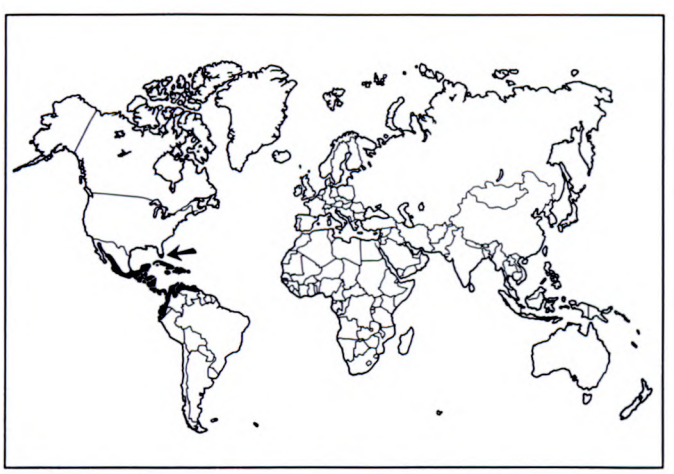
Contact: John Allsteadt, David Norman

Status and distribution in Mexico. Although some surveys are being conducted along the western coast in Jalisco, no coordinated effort is being made to assess the status of *C. acutus* in Mexico. With the developing interest in managing the species on a sustainable-yield basis, more extensive survey work will be necessary. Of related interest will be surveys of the status of the introduced *C. moreletii* populations along the Pacific coast and an assessment of the threat that they represent to the native *C. acutus.*

Contact: Marco Lazcano-Barrero, Dr. Gustavo Casas-Andreu, Dr. Fausto Mendez de la Cruz.

Restocking program in Venezuela. Although some population recovery of *C. acutus* has taken place along parts of the Venezuelan coast, in other areas crocodiles are still very scarce. The newly declared Cuare National Wildlife Refuge contains extensive crocodile habitat, but few crocodiles. Juvenile crocodiles from a captive breeding program are available for restocking Cuare and other protected areas. Funding is needed to conduct baseline surveys and support a monitoring project.

Contact: Andrés Eloy Seijas



Distribution of American crocodile, *Crocodylus acutus*.

Captive slender-snouted crocodile, *Crocodylus cataphractus*, a native of west and central Africa, Gator Jungle, Florida, U.S.A. (Photo by R.S. Funk).

Development of a management program in Jamaica. American crocodiles are reasonably abundant in a number of areas along Jamaica's southern coast. Recent interest has developed in farming this species, but a comprehensive management plan needs to be developed that addresses the well-being of wild crocodile populations. The relative advantages of farming vs. ranching should be addressed, and a crocodile population monitoring program established.

Contact: Elma Shelly, Dr. Leslie Garrick, Dr. Clarence Abercrombie

Slender-snouted Crocodile (*Crocodylus cataphractus*)

Range: Angola, Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Congo, Equatorial Guinea, Gabon, Gambia, Ghana, Guinea, Guinea Bissau, Ivory Coast, Liberia, Mali, Mauritania, Nigeria, Senegal, Sierra Leone, Tanzania, Togo, Zaire, Zambia

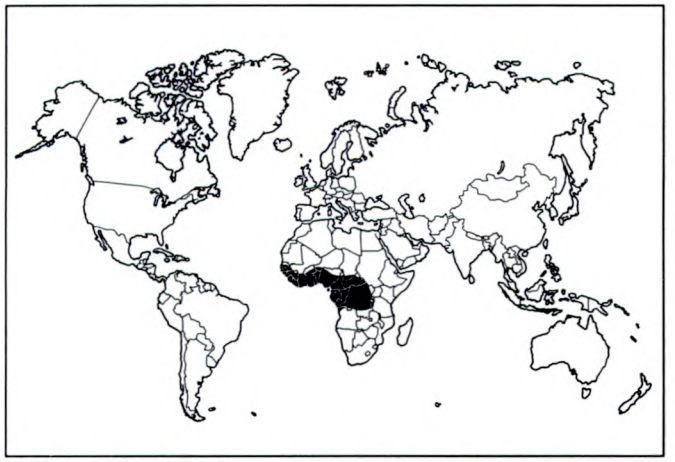
Conservation Overview

CITES: Appendix I
IUCN Red List 1990: Indeterminate
CSG Action Plan:
- Availability of Survey Data: Extremely Poor
- Need for Wild Population Recovery: High
- Potential for Sustainable-yield Management: Moderate

Principal Threats: HD-Habitat destruction, IH-Illegal hunting

Availability of Survey Data: (24 countries)
- No survey data: 20 countries (83%)
- Surveys planned: 0 countries (0%)
- Basic survey data: 4 countries (17%)
- Widespread survey data: 0 countries (0%)

Status of Wild Populations: (24 countries)
- Extirpated: 0 countries (0%)
- Severely depleted: 4 countries (17%)
- Depleted: 5 countries (22%)
- Not depleted: 0 countries (0%)
- Unknown: 15 countries (61%)



Distribution of slender-snouted crocodile, *Crocodylus cataphractus*.

Existing Management Programs: (23 countries)
No management plan: 1 country
Complete protection: 14 countries
Reintroduction or restocking: 0 countries
Cropping: 6 countries
Ranching: 0 countries
Farming: 0 countries

Ecology and Natural History: As its common name implies, this species is one of the more narrow-snouted of the crocodilians. It is a medium-sized species, with a maximum size of up to 4 m (Brazaitis 1973). It is distributed widely throughout western and central Africa, where it apparently prefers riverine habitats, especially in areas dominated by dense vegetation (Waitkuwait 1989).

This is another poorly-known species from an ecological viewpoint. Much of what is known about *C. cataphractus* in the wild has been summarized by Waitkuwait (1989). Mound nests of organic matter are principally constructed along riverbanks at the beginning of the wet season. The nesting season broadly overlaps that of the sympatric *Osteolaemus*, but is more concentrated in time, and there appear to be differences in types of nesting habitat used. Females lay an average of approximately 16 eggs, and egg size is very large relative to female size.

As with the dwarf crocodile, with which it is sympatric over much of its range, very few survey data are available for this species. The only information presently available comes from the work of Waitkuwait (1989) in the Ivory Coast and the surveys of Behra (1987) in Gabon, Congo, and the Central African Republic. In these four countries, populations of *C. cataphractus*, while somewhat depleted, do not appear to be imminently threatened. The largest remaining known population appears to be in the Ogoue River in Gabon. Incomplete information for five additional countries suggests that this species is somewhat depleted in Liberia, and severely depleted in Chad, Senegal, Gambia, and Angola. Population decline in the past has been attributed to increased hide hunting associated with the decline of *C. niloticus* populations. Subsistence hunting and habitat destruction have also contributed to population decline (Pooley 1982).

In most countries the management of *C. cataphractus* is based on the legal protection of wild populations. Limited sustainable utilization is beginning in some nations, based solely on the direct cropping of wild animals. The only country with a CITES export quota is Congo (600 per year 1990-1992). The regulated hunting of this species is permitted in Chad, Sierra Leone, Togo, Cameroon, and Zaire, but does not appear to be part of specific management plans. No ranching or farming of the species has been attempted.

Priority Projects:

High Priority
Surveys of population status throughout west and central Africa. Very little is known about the status of this species in the wild. Surveys need to be undertaken virtually throughout the species range. Surveys should be done on a country-by-country basis as part of an overall program for establishing conservation and management programs.

Contact: Dr. Ekke Waitkuwait, Olivier Behra, E.F. Brewer (Gambia), Gerald A. Punguse (Ghana)

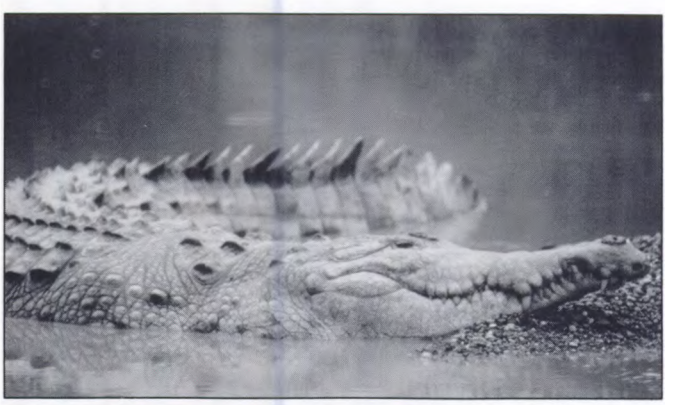
Moderate Priority
Studies on ecology and population dynamics. Very little is known about the ecology of this species. Ecologically it appears to be somewhat similar to *Tomistoma*, another virtually unknown crocodilian. Population studies need to be undertaken at a number of sites, again as part of an overall plan for developing conservation/management plans for the species in the wild.

Contact: Dr. Ekke Waitkuwait, Olivier Behra

Orinoco Crocodile (*Crocodylus intermedius*)

Range: Venezuela, Colombia

Conservation Overview
CITES: Appendix I
IUCN Red List 1990: Endangered
CSG Action Plan: Availability of Survey Data: Poor
Need for Wild Population Recovery: Highest
Potential for Sustainable-yield Management: Low



Orinoco crocodile, *Crocodylus intermedius*, Masaguaral, Venezuela (Photo by J. Thorbjarnarson).

Principal Threats: HD-Habitat destruction, IH-Illegal hunting, LD-Limited distribution

Availability of Survey Data: (2 countries)
- No survey data: 0 countries (0%)
- Surveys planned: 1 country (50%)
- Basic survey data: 1 country (50%)
- Widespread survey data: 0 countries (0%)

Status of Wild Populations: (2 countries)
- Extirpated: 0 countries (0%)
- Severely depleted: 2 countries (100%)
- Depleted: 0 countries (0%)
- Not depleted: 0 countries (0%)
- Unknown: 0 countries (0%)

Existing Management Programs: (2 countries)
- No management plan: 0 countries
- Complete protection: 1 country
- Reintroduction or restocking: 1 country
- Cropping: 0 countries
- Ranching: 0 countries
- Farming: 0 countries

Ecology and Natural History: The Orinoco crocodile is a large, relatively long-nosed crocodile restricted to the middle and lower reaches of the Orinoco River in Venezuela and Colombia (Thorbjarnarson and Franz 1987). Although this crocodile was found in a wide variety of habitats, including rivers in tropical evergreen forest and piedmont streams in the foothills of the Andes, it reached its greatest numbers in the seasonal rivers of the llanos savannah region (Medem 1981, 1983; Godshalk 1982.)

The Orinoco crocodile is a hole-nesting species, laying its eggs in seasonally exposed sandbars early in the annual dry season (January-February). Clutch size is typically in the 40-70 range, and the young hatch out during the seasonal rise in river levels associated with the wet season. Seasonal concentrations of these crocodiles during the annual low water periods were very dense, a factor which facilitated hide hunting (Medem 1981, 1983). In smaller rivers that are reduced to a series of interconnected or isolated pools during the dry season, crocodiles aestivate in burrows dug into the river banks.

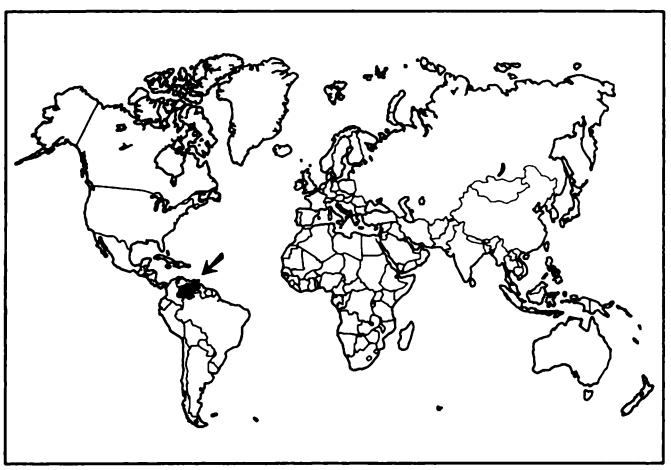
Only a limited amount of ecological information is available for this species. Accounts by Medem (1981, 1982) cover a number of aspects of the ecology of this species in Colombia and Venezuela. Godshalk (1982) and Thorbjarnarson and Hernandez (1990) deal with aspects of the species' status and ecology in Venezuela. Ecological and behavioral investigations are currently underway in Venezuela (Thorbjarnarson, pers. comm.).

The Orinoco crocodile is one of the most critically endangered New World crocodilians. Commercial overexploitation from the 1930s through the 1950s decimated wild populations and little recovery has been evident since that time. The species' current status in Colombia is very poorly known, the last surveys having been done in the early 1970s. In contrast, in Venezuela recent survey work has been completed throughout much of the crocodile's range.

The Orinoco crocodile is considered to be severely depleted throughout its range. In Venezuela, remaining populations are found in isolated areas where human impact has been minimal. However, even these remaining populations are being threatened today by a combination of factors including habitat destruction, egg collecting, intentional and incidental killing, and the collection of animals for sale. The potential for population recovery may also be inhibited by a large increase in populations of the sympatric common caiman. Although this species is legally protected in both countries, little effective enforcement is taking place.

In Venezuela, crocodile habitat has been protected in a newly declared national park (Parque Nacional Santos Luzardo) along the Capanaparo and Cinaruco Rivers, but no management plan has yet been implemented for the species. A recently declared wildlife refuge has been established along the Caño Guaritico, and this area has been the site of the first release of captive-reared young. Plans for restocking the Capanaparo River are also being developed.

Urgent action needs to be taken in both countries, but especially in Colombia, to locate surviving populations and initiate recovery programs.



Distribution of Orinoco crocodile, *Crocodylus intermedius*.

Priority Projects:

High Priority

Population status in Colombia. Virtually nothing is known about the present status of this species in Colombia. Work urgently needs to be undertaken to determine whether viable populations remain as a first step towards undertaking a conservation program.

Contact: Jesus Ernesto Pachon R.

Reintroduction program at the Caño Guaritico National Wildlife Refuge, Venezuela. The program was initiated in 1990 with the release of 31 individuals. The release program needs to be continued, and a monitoring program, including the use of radio telemetry, established. Enforcement of regulations and the restriction of fishing activities in the refuge needs to be assured.

Contact: Dr. José Ayarzagüena, Andrés Eloy Seijas

Implementation of a crocodile management plan for Santos Luzardo National Park, Venezuela. This newly declared park contains one of the last remaining sizeable populations of crocodile remaining in a natural state. Although it is now a park, little has been done to protect the crocodile population. Collection of eggs and hatchlings by Indians represents a grave threat to the future of this population. Work needs to be done to initiate a release program based on the collection of wild-produced eggs and/or hatchlings, as well as continued population monitoring.

Contact: Dr. John Thorbjarnarson

Moderate Priority

Conduct surveys in peripheral parts of the species range in Venezuela. Population surveys have covered much of the llanos region looking for remnant crocodile populations. Recent survey work has found surviving populations in isolated areas outside of typical crocodile habitat, including small rivers in the foothills of the Andes, and in forested regions in the south of the country. Additional surveys need to be conducted to look for unknown populations.

Contact: Dr. John Thorbjarnarson, Dr. José Ayarzagüena, Andrés Eloy Seijas

Analysis of genetic diversity within and among populations. Many of the conservation plans for this species depend on restocking and reintroduction programs. However, nothing is known about genetic variation among populations. Since many of the remaining populations exist in peripheral habitats, the possibility of genetic differentiation should be explored as part of an overall conservation plan.

Contact: Dr. John Thorbjarnarson

Improvement of captive breeding and rearing facilities in Venezuela. Crocodiles for the restocking and reintroduction programs are being produced and reared at two centers in Venezuela. Financial support for these programs has been inadequate and improvements and expansion are needed.

Contact: Andrés Eloy Seijas, Dr. John Thorbjarnarson

Australian Freshwater Crocodile (*Crocodylus johnsoni*)

Range: Australia

Conservation Overview
CITES: Appendix II
IUCN Red List 1990: Not listed
CSG Action Plan: Availability of Survey Data: Good
Need for Wild Population Recovery: Low
Potential for Sustainable-yield Management: High

Principal Threats: HD-Habitat destruction
Availability of Survey Data: (1 country)
No survey data: 0 countries 0%)
Surveys planned: 0 countries (0%)
Basic survey data: 0 countries (0%)
Widespread survey data: 1 country (100%)

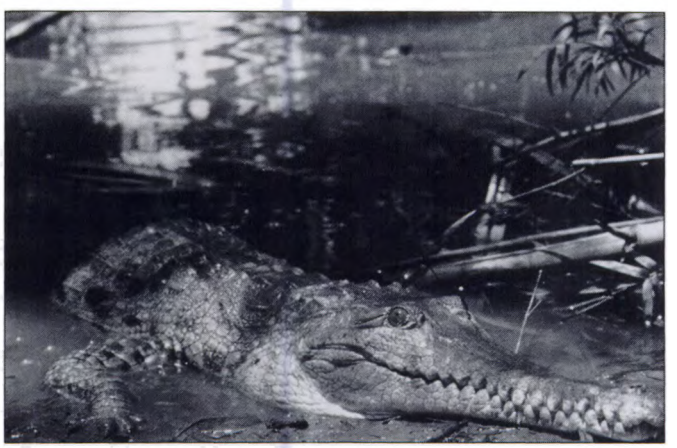
Status of Wild Populations: (1 country)
Extirpated: 0 countries (0%)
Severely depleted: 0 countries (0%)
Depleted: 0 countries (0%)
Not depleted: 1 country (100%)
Unknown: 0 countries (0%)

Existing Management Programs: (1 country)
No management plan: 0 countries
Complete protection: 0 countries
Reintroduction or restocking: 0 countries
Cropping: 0 countries
Ranching: 1 country
Farming: 1 country

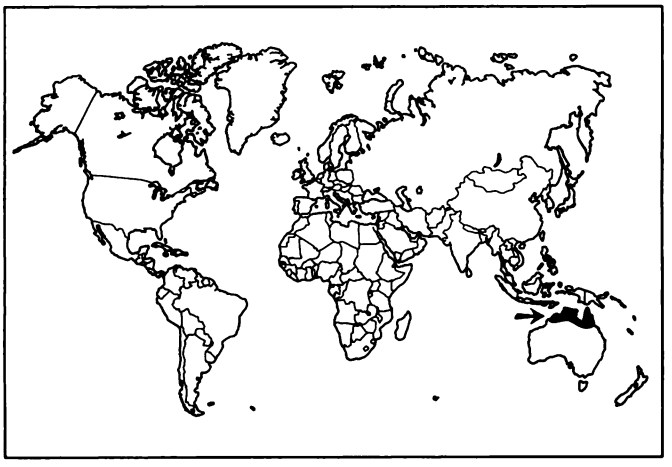
Ecology and Natural History: The Australian freshwater crocodile is one of the small to medium-sized freshwater crocodiles from the Australo-Asian region. The "freshy" however, is morphologically distinct because of its unusually narrow snout. Maximum size of males approaches 3 m, and the species is generally restricted to freshwater habitats upstream of tidal areas (Webb et al. 1987) in northern Australia (Western Australia, Northern Territory, and Queensland). This includes almost any type of permanent freshwater habitat including rivers, creeks, swamps, and floodplain lakes, and ponds ("billabongs"). Because of the past reduction in populations of the sympatric *C. porosus*, some freshies have moved into some tidal areas (Messel et al. 1981).

Although it has a narrow snout, the diet of this species is very catholic and includes a wide variety of invertebrates and small vertebrates (Webb et al. 1982). Females lay eggs in holes dug in seasonally exposed sand bars. Clutch size averages 13, and predation by monitor lizards (*Varanus*) is high. Incubation normally lasts 75-85 days (Webb et al. 1983).

A great deal of information is available on the status of this species and indicates that populations of *C. johnsoni* throughout northern Australia are in good shape. Mature *C. johnsoni* have ventral osteoderms, so commercial exploitation, from 1959-1972, was less intensive than with the sympatric *C.*



Australian freshwater crocodile, *Crocodylus johnsoni* (Photo by G.J.W. Webb).



Distribution of Australian freshwater crocodile, *Crocodylus johnsoni*.

porosus. Webb and Manolis (1988) suggest that population densities of this species have returned to near their former abundance in Western Australia and in the Northern Territories, and are recovering in Queensland. A large-scale research and management program was undertaken in the late 1970s. Sustainable use management of this species began in 1983, with the collection of hatchlings for a ranching program. A small-scale farming program has also begun at one site in the Northern Territory.

Priority Projects:

Moderate Priority

Investigation of population dynamics. Little conservation action is needed for this species, but *C. johnsoni* offers superb potential for conducting research on crocodilian population dynamics. An intensive research effort was begun by the Conservation Commission of the Northern Territory in the late 1970s and continues to this day. The continuance of this long-term research program will yield much-needed data for management programs for this and other species of crocodilians.

Contact: Dr. Grahame J.W. Webb

Philippine Crocodile (*Crocodylus mindorensis*)

Range: Philippines

Conservation Overview

CITES: Appendix I
IUCN Red List 1990: Endangered
CSG Action Plan: Availability of Survey Data: Adequate
Need for Wild Population Recovery: Highest
Potential for Sustainable-yield Management: Low

Principal Threats: HD-Habitat destruction, LD-Limited distribution

Availability of Survey Data: (1 country)
No survey data: 0 countries (0%)
Surveys planned: 0 countries (0%)
Basic survey data: 1 country (100%)
Widespread survey data: 0 countries (0%)

Status of Wild Populations: (1 country)
Extirpated: 0 countries (0%)
Severely depleted: 1 country (100%)
Depleted: 0 countries (0%)
Not depleted: 0 countries (0%)
Unknown: 0 countries (0%)

Existing Management Programs: (1 country)
No management plan: 0 countries
Complete protection: 1 country
Reintroduction or restocking: 0 countries
Cropping: 0 countries
Ranching: 0 countries
Farming: 1 country

Ecology and Natural History: The Philippine crocodile is another relatively small, little-known freshwater Asian crocodile. Maximum size in males reportedly does not exceed 3 m (Brazaitis 1973). Until fairly recently the Philippine crocodile was considered to be a subspecies of the New Guinea crocodile (*Crocodylus novaeguineae*).

Philippine crocodiles were at one time widely distributed throughout the archipelago, but are now restricted to the islands of Luzon, Mindoro, Masbate, Samar, Negros, Busuanga, and Mindanao. Messel and King (1991) indicate that the species does not occur in Palau, where it is reported that some escaped from a Japanese crocodile farm in the early 1940s. Its preferred habitat includes freshwater marshes, the tributaries of large rivers, small lakes, and ponds (Ross 1982). Very little else is known about the ecology of wild populations. In captivity females are known to make mound nests and lay 10-20 eggs.

The Philippine crocodile is one of the most severely threatened crocodile species. The survey work by Ross and Alcala (Ross 1982, Ross and Alcala 1983), has shown that wild populations are extremely depleted, with perhaps no more than 500-1,000 individuals remaining. Crocodiles have apparently disappeared from a number of islands where they formerly occurred. Initial population decline was associated with commercial overexploitation. Currently, the principal threats are habitat loss and killing by local people. A small captive propagation program is being conducted by Silliman University, but it does not have adequate financial support. Another farm, operated by jointly by the Philippine and Japanese governments, hopes to breed *C. porosus* and *C. mindorensis* for commercial and conservation purposes. However, the extremely small number of specimens currently in captivity does not offer much promise for extensive future captive breeding. The current human pressures on the remaining habitat, continued crocodile killing, limited captive breeding, and the lack of government concern for crocodile conservation programs are all cause for grave concern about the future of this species.

Priority Projects:

High Priority

Support for the Silliman University and CFI-Palawan breeding programs. These projects have achieved successful captive breeding. Today they have 21 breeding pairs but lack adequate financial support. Because of the poor situation of wild popu-

Distribution of Philippine crocodile, *Crocodylus mindorensis.*

lations and the low probability of establishing active conservation programs in the near future, the best chance for the survival of this species may be through captive breeding. If feasible these programs could also be expanded to collect eggs from the wild for future restocking efforts. The breeding programs need to be expanded and facilities improved.

Additionally, a breeding program should be established at the Gladys Porter Zoo, Brownsville, Texas U.S.A. in cooperation with the Silliman program.

Contact: Prof. A.C. Alcala, Dr. C.A. Ross

Development of a national crocodile management program. Philippine crocodiles are presently found in only one officially protected area, the Lake Naujan National Park. However, effective protection of crocodiles is not evident at this site, and better enforcement is needed. A national management plan for *C. mindorensis* and *C. porosus* needs to be drawn up outlining a conservation policy. Areas should be identified where the protection of crocodiles could be reasonably certain, and the feasibility of declaring them as reserves determined. Crocodile conservation is not a popular topic in the Philippines and efforts to enlist more public support, through educational campaigns or through sustainable-yield management, should be encouraged.

Contact: Prof. A.C. Alcala

Moderate Priority

Continued surveys of the status and distribution of the species. Although relatively good survey data are available, most were conducted in the early 1980s and need to be repeated. Many unsurveyed areas are suspected to have crocodiles, but many of these areas are suffering from civil disturbance problems resulting from the operations of insurgent groups.

Contact: Dr. C.A. Ross, Prof. A.C. Alcala

Morelet's Crocodile (*Crocodylus moreletii*)

Range: Belize, Mexico, Guatamala

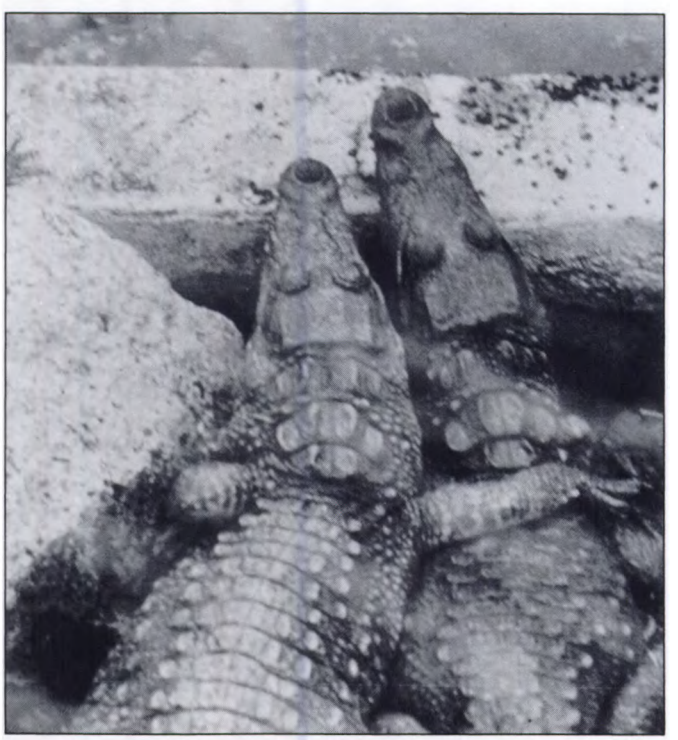
Conservation Overview
CITES: Appendix I
IUCN Red List 1990: Endangered
CSG Action Plan: Availability of Survey Data: Poor
Need for Wild Population Recovery: Moderate
Potential for Sustainable-yield Management: Moderate

Principal Threats: HD-Habitat destruction, IH-Illegal hunting
Availability of Survey Data: (3 countries)
No survey data: 0 countries (0%)
Surveys planned: 1 country (33%)
Basic survey data: 2 countries (67%)
Widespread survey data: 0 countries (0%)

Status of Wild Populations: (3 countries)
Extirpated: 0 countries (0%)
Severely depleted: 0 countries (0%)
Depleted: 3 countries (100%)
Not depleted: 0 countries (0%)
Unknown: 0 countries (0%)

Existing Management Programs: (3 countries)
No management plan: 0 countries
Complete protection: 2 countries
Reintroduction or restocking: 0 countries
Cropping:
Ranching: 0 countries
Farming: 1 country

Ecology and Natural History: The Morelet's crocodile is a relatively little-known species from the Atlantic coast of Mexico



Morelet's crocodile, *Crocodylus moreletii*, Lago de Catemaco, Veracruz, Mexico (Photo by H.W. Campbell).

and northern Central America. This species was confused with *C. rhombifer* and *C. acutus* until it was shown to be a distinct species by Schmidt (1924). It is a moderately small species, today rarely exceeding 3 m in length, with a relatively broad snout. The habitat of *C. moreletii* is primarily in freshwater habitats, particularly marshes, swamps, ponds, and lagoons, but in some areas this species can be found in brackish water. This species overlaps with *C. acutus* throughout the southern portion of its range, but the habitat relationships between these two species are not completely known. A good general account of many aspects of the behavior and ecology of this species was given by Alvarez del Toro (1974).

Morelet's crocodile is the only New World crocodile that is a fully mound-nesting species. Normally, a clutch consists of 20-40 eggs, and oviposition occurs in Chiapas in April-June before the annual rainy season (Pérez-Higareda 1980). Observations of captive animals reveal that females will respond to hatchling vocalizations and open the nests, and will also defend hatchlings against larger juveniles of subadult conspecifics (Hunt 1975, 1977)

Populations of Morelet's crocodile were greatly reduced in many areas due to uncontrolled hide hunting, which took place principally in the 1940s and 1950s. A limited amount of survey work is available over most of the range of the species, and a number of surveys are being conducted at present. Some survey data are available from Belize and, to a lesser extent, Guatemala. Survey work and ecological studies are currently being conducted in the Mexican Yucatan by Lazcano-Barrera. In Belize, a country-wide survey is planned by F.W. King for 1992.

Populations of *C. moreletii* are considered to be depleted in all three countries within the species' distribution. However, in some areas, such as the Lacandon forest and the Sian Kaán Biosphere Preserve in Mexico, healthy populations exist. Although wild populations are protected in all three countries, some movement toward the development of sustainable-yield management has been made. In Mexico, a number of commercial farming operations have started, including some on the Pacific coast, outside the species' natural range. One problem that has resulted from farming this species outside its natural range is that individuals have escaped and established breeding populations, presenting a threat to native populations of *C. acutus*. Interest in initiating sustainable-yield management programs in Belize and Guatemala has been expressed as well.

Priority Projects:

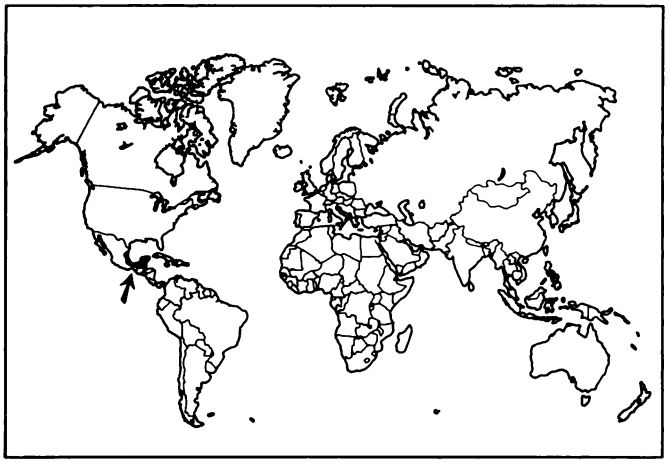
High Priority

Surveys of status and distribution in Guatemala. Little is known about this species in Guatemala, where, however, interest in its commercial management is developing. Status surveys and ecological studies need to be completed.

Contact: Oscar Lara, Dr. Leonel Rosales Loesener

Surveys of status and distribution in Mexico. Work with *C. moreletii* has been done by Lazcano-Barrero in the Lacandon and the Yucatan regions. However, little is known about populations along the Gulf of Mexico. In addition to expanded surveys, ecological work in the Sian Kaán Biosphere reserve should be continued, and a management plan developed for the species there.

Contact: Marco Lazcano-Barrero



Distribution of Morelet's crocodile, *Crocodylus moreletii*.

Moderate Priority

Development of a management plan for Belize. A survey by Prof. F. Wayne King will provide baseline data for the development of a management program in Belize. A population monitoring project and long-term ecological studies need to be implemented.

Contact: Prof. F. Wayne King

Nile Crocodile (*Crocodylus niloticus*)

Range: Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo, Egypt, Ethiopia, Equatorial Guinea, Gabon, Gambia, Ghana, Guinea, Guinea Bissau, Ivory Coast, Kenya, Liberia, Madagascar, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, South Africa, Sudan, Swaziland, Tanzania, Togo, Uganda, Zaire, Zambia, Zimbabwe

Conservation Overview

CITES: Appendix II in Zimbabwe, Botswana, Malawi, Mozambique, and Zambia (ranching criterion)
Appendix II in Ethiopia, Kenya, Madagascar, Somalia, Sudan, and Tanzania (annual quota criterion)
Appendix I in all other countries
IUCN Red List 1990: Vulnerable
CSG Action Plan: Availability of Survey Data: Very Poor
Need for Wild Population Recovery: Moderate
Potential for Sustainable-yield Management: Highest

Principal Threats: IH-Illegal hunting, HD-Habitat destruction
Availability of Survey Data: (40 countries)
No survey data: 23 countries (56%)
Surveys planned: 3 countries (7%)

Nile crocodile, *Crocodylus niloticus*, Spencer Creek Crocodile Farm, Zimbabwe (Photo by F.W. King).

Basic survey data: 14 countries (36%)
Widespread survey data: 0 countries (0%)

Status of Wild Populations: (44 countries)
Extirpated: 4 countries (7%)
Severely depleted: 6 countries (14%)
Depleted: 13 countries (31%)
Not depleted: 2 countries (5%)
Unknown: 19 countries (43%)

Existing Management Programs: (40 countries)
No management plan: 1 country
Complete protection: 16 countries
Reintroduction or restocking: 0 countries
Cropping: 15 countries
Ranching: 9 countries
Farming: 8 countries

Ecology and Natural History: The Nile crocodile is among the largest and biologically best-known of all the crocodilians. Nile crocodiles are widely distributed throughout sub-Saharan Africa, and historical records indicate its range extended into southern Israel and Jordan. The species was also established on the Seychelles and Comoros Islands, and still exists on Madagascar. As with all crocodilians, size among Nile crocodiles is sexually dimorphic, with the larger males reaching lengths of up to 6 m in exceptional cases. A large volume of published information exists on topics such as diet, thermoregulation, reproduction, social behavior, habitat preference, and population dynamics. The first modern monograph on the ecology of a crocodilian was that of Cott (1961) on Nile crocodiles.

Nile crocodiles may be found in a wide variety of habitat types including large lakes, rivers, and freshwater swamps. In some areas they extend down into brackish water environments. Cott (1961) demonstrated that, as is generally true among crocodilians, there is an ontogenetic shift in diet, from insects and small aquatic invertebrates when young to predominantly vertebrate prey among larger crocodiles. Hutton (1989b) demonstrated differences in habitat utilization between juveniles, subadults, and adults at Ngezi, Zimbabwe, and noted that animals entered a dispersal phase when approximately 1.2 m long. Modha (1967) described some aspects of the social behavior, including the establishment of breeding hierarchies.

Nesting is done in holes excavated in sandy banks during the annual dry season. Females become sexually mature when approximately 2.5 m long, and lay an average of 50-60 eggs, although this varies considerably among populations. Incubation lasts 80-90 days, and the females open the nest and guard the young for a period after hatching.

The availability of survey data for the Nile crocodile is quite variable. In southern and eastern Africa a number of surveys for Nile crocodiles have been conducted in recent years, and information on crocodile status is good. Most of this work has been part of a CITES sponsored initiative to implement sustainable-yield management programs in countries that wish to harvest crocodiles. However, in central and western Africa very few survey data exist. In this region only the work of Behra (1987) in Gabon, Congo, and the CAR, and the studies of Waitkuwait (1988, 1989) in the Ivory Coast provide information on Nile crocodile status. Overall, for the majority of African countries (25 out of 39), essentially nothing is known regarding the status of Nile crocodile populations.

Among the 20 countries where we have some indication of the status of *C. niloticus*, crocodiles are considered to be severely depleted in six (30.0%), somewhat depleted in 12 (60.0%), and not depleted in two (10.0%) countries (see Appendix 1). Nile crocodiles have been extirpated from four countries: Israel, Algeria, Comoros, and the Seychelles. However, the disappearance of crocodiles from the former two countries may be partially related to climate change and the resulting loss of wetland habitats. As with all of the other large, commercially valuable species, hide hunting (1940s-1960s) resulted in dramatic declines in population size throughout most of its range. However, protection given by national laws and international trading regulations has resulted in a recovery in many parts of the species range. As a whole, Nile crocodiles are not threatened, and locally large populations exist. Because of the species' good status in east Africa and the lack of information throughout most of west and central Africa, the Nile crocodile was given a "moderate" rating for the need for the recovery of wild populations. In some areas human-crocodile conflicts have become a major problem, and this is one of the driving forces behind the implementation of sustainable-yield management programs. Nevertheless, in some west and central African countries populations of this species do not appear to be doing well. Behra (1987), for instance, surveyed Gabon without seeing a single Nile crocodile. However, it is possible that Nile crocodiles in west Africa may tend to be found naturally at lower densities due to habitat factors and the presence of two sympatric crocodilians. More survey and ecological studies in central and western Africa need to be undertaken to resolve the question of Nile crocodile status.

The Nile crocodile is one of the most commercially utilized species of crocodilians producing a "classic" hide. The types of management programs vary widely and are based on direct cropping, ranching, and farming. In recent years the CITES Nile crocodile program has played an important role in developing sustainable yield programs, and has tried to emphasize

ranching as the preferred means of obtaining conservation benefits from crocodile utilization. Zimbabwe, Botswana, Malawi, Mozambique, and Zambia have ranching programs, permitted under the CITES ranching criteria (Res. Conf. 3.15), and no limitations on exports. Six other countries (Ethiopia, Kenya, Madagascar, Somalia, Sudan, and Tanzania) have had their crocodile populations transferred to CITES Appendix II under the quota system (Res. Conf. 5.21). The direct cropping of crocodiles is discouraged under CITES ranching criteria, but still exists in certain countries: Malawi, Mozambique, and Zambia. Most countries given quotas under Res. Conf. 5.21 are permitted to export cropped skins (excluding Madagascar) with the understanding that the future development of crocodile management programs will move towards ranching. Cropping of crocodiles is still legal in other African nations (Sudan, Chad, Sierra Leone, Togo, Cameroon, Congo, Zaire), but legal exports under CITES are not permitted.

No central or west African countries have implemented sustainable-yield management programs as yet.

Priority Projects:

High Priority

Surveys of wild crocodile populations in western and central Africa. Survey data are badly needed for this region, not only for Nile crocodiles but also for the two other African crocodilians, *C. cataphractus* and *Osteolaemus tetraspis*. Country by country surveys of crocodile status and distribution are a prerequisite for developing conservation and management programs.

Contact: Dr. Ekke Waitkuwait, Olivier Behra, E.F. Brewer (Gambia), Gerald A. Punguse (Ghana)

Moderate Priority

Development and implementation of management programs for those countries planning sustainable-yield utilization. A number of African nations are developing fledgling management programs based on sustainable-yield harvesting. Population surveys and monitoring, training, and program support are needed to foster these programs. A recent prioritization of countries to receive such support listed: Kenya, Tanzania, Sudan, Ethiopia, Somalia, and Congo (Hutton 1990a).

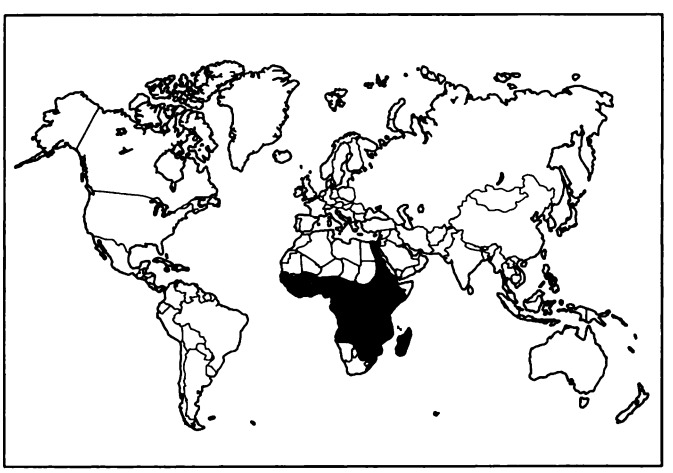
Hutton (1990b) outlines priority areas that need to be addressed for the development of SYU programs in these countries:

1. Pre-feasibility studies (e.g., harvest potential).
2. Policy and legislation to provide the management framework.
3. Feasibility studies (identification of potential production sites, evaluation, and quantification of factors inherent in SYU programs).
4. International requirements for trade (CITES submissions, documentation, and tagging of hides).
5. Population census and monitoring (technical support and training).
6. Technical support for developing ranching/farming programs.
7. Marketing.

Contact: Dr. Jon Hutton

Comparative studies of population dynamics. The development of good management programs should include a significant research program. Sustainable-yield management offers tremendous opportunities for collecting ecological data. Information on population dynamics is valuable from an empirical standpoint, and also for the improvement of the management program. A considerable amount of ecological research has been done in east Africa, but long-term comparative studies need to be established in different parts of the continent.

Contact: Dr. Jon Hutton, A.C. Pooley



Distribution of Nile crocodile, *Crocodylus niloticus*.

New Guinea Crocodile (*Crocodylus novaeguineae*)

Range: Indonesia, Papua New Guinea

Conservation Overview
CITES: Appendix II
IUCN Red List 1990: Not listed
CSG Action Plan: Availability of Survey Data: Adequate
Need for Wild Population Recovery: Moderate
Potential for Sustainable-yield Management: Highest

Principal Threats: IH-Illegal hunting
Availability of Survey Data: (2 countries)
No survey data: 0 countries (0%)
Surveys planned: 0 countries (0%)
Basic survey data: 2 countries (100%)
Widespread survey data: 0 countries (0%)

Status of Wild Populations: (2 countries)
Extirpated: 0 countries (0%)
Severely depleted: 0 countries (0%)
Depleted: 2 countries (100%)
Not depleted: 0 countries (0%)
Unknown: 0 countries (0%)

Large female New Guinea crocodile, *Crocodylus novaeguineae*, over three meters long at Pagwi government crocodile farm, Papua New Guinea (Photo by D. Jelden).

Existing Management Programs: (2 countries)
- No management plan: 0 countries
- Complete protection: 0 countries
- Reintroduction or restocking: 0 countries
- Cropping: 2 countries
- Ranching: 2 countries
- Farming: 0 countries

Ecology and Natural History: The New Guinea crocodile is a small to medium-sized crocodile found only on the island of New Guinea. Maximum adult size is approximately 3.5 m, with a 3.47 m male being the largest recorded to date (Frazier 1988). Recent work suggests that the southern (Papuan) population is a distinct, and as yet undescribed, taxon (Ross 1986). Northern and southern populations differ from one another morphologically, as well as in a number of aspects of reproduction (Cox 1985). New Guinea crocodiles prefer freshwater habitats, and are found throughout most of New Guinea's vast system of freshwater swamps and marshes.

Females become sexually mature at lengths from 1.8 to 2.0 m, and lay eggs in mound nests. The northern population oviposits during the annual dry period, whereas the southern population nests during the wet season. Northern crocodiles also lay larger clutches of smaller eggs than do southern animals. Among northern animals nests are usually found on floating mats of vegetation, frequently in densely overgrown channels and river tributaries (Cox 1984). Nests in the southern populations are more frequently located on land (Hall and Johnson 1987).

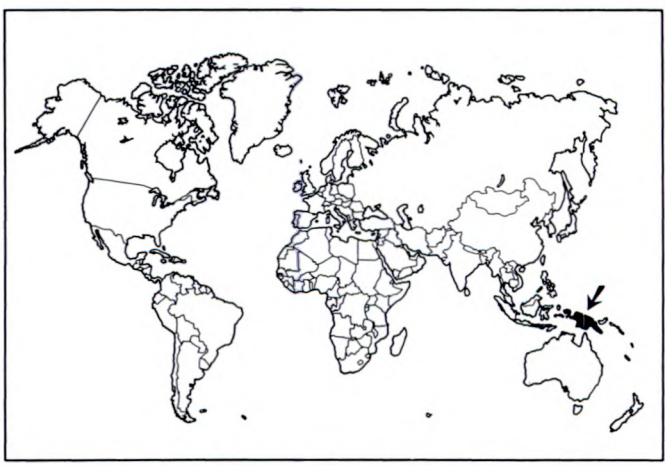
Populations of *C. novaeguineae* have benefitted from the large amounts of wetland habitat and the low human population density on the island of New Guinea. Adequate survey data indicate the presence of good populations in both Irian Jaya (Indonesia) and Papua New Guinea. Commercial hunting of this species did not begin until the 1950s and peaked in the 1960s. In Papua New Guinea, the recognition of inefficient harvesting led to legislative controls in the late 1960s and the establishment of a regulated sustainable-yield program in the 1970s based on cropping and ranching. A similar program is now being established in Irian Jaya. In both countries hunting of wild animals is controlled by an upper legal size limit that protects the adult breeding population. However, illegal hunting is still a major problem in Irian Jaya, with most of the hides being shipped to dealers in Singapore. The aim of the management programs in both countries is to reduce the amount of direct hunting, and rely principally on ranching programs.

Priority Projects:

High Priority
Eliminate illegal trade of skins from adult animals. This has been a particularly difficult problem in Irian Jaya where well-entrenched smuggling rings are involved, with support from local military authorities. Restrictions on upper size limits need to be strictly enforced and all illegal trade with Singapore shut down. This would not only strengthen the management program, it would also increase the earnings of the legal ranchers and hide dealers.

Contact: Dr. Effendy Sumardja, Dr. Grahame J.W. Webb

Moderate Priority
Continued population monitoring of exploited crocodile populations. The crocodile management program in Papua New Guinea has been a success and has served as a model for countries around the world regarding the conservation benefits of sustainable utilization. The program in Indonesia also holds great promise. However, the success of these programs will depend on the health of the wild crocodile populations. In order to ensure the long-term success of these programs, crocodile monitoring programs must be continued.



Distribution of New Guinea crocodile, *Crocodylus novaeguineae*.

Contact: Jack Cox, John M. Wilmot, John-Mark Genolagani

Mugger Crocodile (*Crocodylus palustris*)

Range: Bangladesh, Iran, India, Nepal, Pakistan, Sri Lanka

Conservation Overview
CITES: Appendix I
IUCN Red List 1990: Vulnerable

CSG Action Plan: Availability of Survey Data: Very Poor
Need for Wild Population Recovery: High
Potential for Sustainable-yield Management: Moderate

Principal Threats: HD-Habitat destruction, IH-Illegal hunting

Availability of Survey Data: (6 countries)
No survey data: 4 countries (67%)
Surveys planned: 0 countries (0%)
Basic survey data: 2 countries (33%)
Widespread survey data: 0 countries (0%)

Status of Wild Populations: (6 countries)
Extirpated: 0 countries (0%)
Severely depleted: 2 countries (33%)
Depleted: 3 countries (50%)
Not depleted: 0 countries (0%)
Unknown: 1 country (17%)

Existing Management Programs: (6 countries)
No management plan: 0 countries
Complete protection: 5 countries
Reintroduction or restocking: 1 country
Cropping: 0 countries
Ranching: 0 countries
Farming: 0 countries

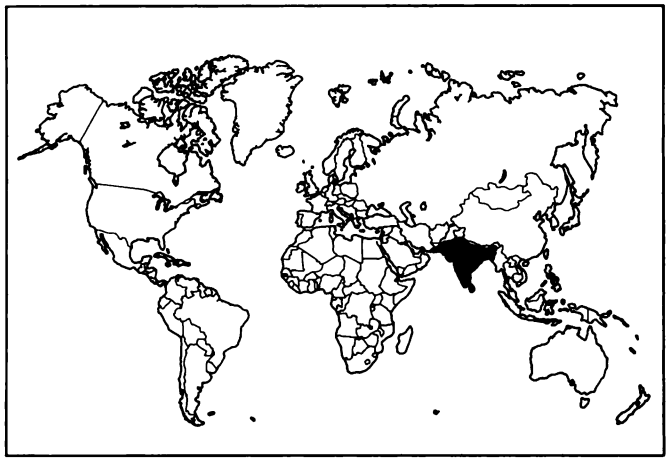
Captive-bred muggers, *Crocodylus palustris*, at Madras Crocodile Bank, India. Shortage of locations for wild release is causing crowding in captive rearing facilities (Photo by H. Andrews).

Ecology and Natural History: The mugger is a medium to large crocodile (maximum length ca. 4-5 m), and has the broadest snout of any living member of the genus *Crocodylus*. Muggers are principally restricted to the Indian subcontinent where they may be found in a number of freshwater habitat types including rivers, lakes, and marshes. In India and Sri Lanka, mugger crocodiles have adapted well to reservoirs, irrigation canals, and manmade ponds, and in some areas may even be found in coastal saltwater lagoons (Whitaker 1987, Whitaker and Whitaker 1989a). In some areas of northern India and Nepal, mugger populations are sympatric with gharial, but the two species tend to be segregated by habitat. Where found together with gharial, muggers tend to bask in midstream on rocks or muddy banks (Groombridge 1982). This species, like a number of other crocodilians, is known to dig burrows.

Mugger crocodiles are a hole-nesting species. As with other hole-nesters, egg laying takes place during the annual dry season. Females become sexually mature at a length of approximately 1.8-2.0 m, and lay 25-30 eggs (Whitaker and Whitaker 1989a). Nests are located in a wide variety of habitats, and females have even been known to nest at the opening of, or inside, the burrow (B.C. Choudhury, pers. comm.). In captivity, some mugger crocodiles are known to lay two clutches in a single year (Whitaker and Whitaker 1984), but this has not been observed in the wild. Incubation is relatively short, typically lasting 55-75 days (Whitaker 1987). Whitaker and Whitaker (1989a) provide a good review of the behavior and ecology of this species.

While illegal skin trade was a major problem in the past (1950s-1960s), the current threats to the mugger crocodile are principally drowning in fish nets, egg predation by people, habitat destruction, and the use of crocodile parts for medicinal purposes (Groombridge 1982). Adequate survey data exist only for India and Sri Lanka, and indicate that populations, while generally small and isolated, are widespread. Sri Lanka has the largest remaining populations, but they are concentrated in only two National Parks, Wilpattu and Yala (Whitaker and Whitaker 1979). In other areas muggers are being threatened by rapid agricultural and industrial development (Whitaker and Whitaker 1989a). In Pakistan, the mugger crocodile population in the Sind has reportedly recovered to a significant extent, but some recent hunting has been reported in Baluchistan. No good survey data are available for Nepal, but *C. palustris* is known to inhabit the Royal Chitwan National Park, and was reported to be relatively common throughout the country in marshy lakes, ponds, and small rivers (Groombridge 1982). Population status in Bangladesh is extremely poor, possibly extinct. A small population was known from southeastern Iran in the early 1970s, but no recent information is available for this country.

Management of mugger crocodiles is based principally on the legal protection of wild populations. In India, a large-scale captive rearing program was initiated in 1975. The project has collected eggs from the wild, as well as produced young in captivity from captive adult breeding stock. The resulting juveniles have been used to restock natural populations in 28 national parks, wildlife reserves, and crocodile sanctuaries



Distribution of mugger crocodile, *Crocodylus palustris*.

throughout the country. Pakistan is planning a similar restocking program.

Restocking in India has declined in recent years and this has resulted in a large excess of mugger crocodiles in the rearing centers. This excess has led to an increased interest in commercial rearing, but as yet no plans for sustainable-yield management have been developed.

Priority Projects:

High Priority

Establishment of a conservation/management program in Pakistan. Recent reports suggest that mugger crocodile populations in the Sind have recovered significantly after being severely depleted by commercial hunting. However, no formal surveys have been conducted, and in other parts of the country continued killing has been reported. Interest has been expressed in initiating a restocking program similar to the one in India. However, surveys of population status and a biological research program are a prerequisite to establishing a management program.

Contact: Ashiq Ahmad

Conservation and management in Sri Lanka. Since the surveys by Whitaker and Whitaker (1979) no work has been done in Sri Lanka, which at that time had the best remaining mugger populations. New surveys are required to reassess the current status of the species, and as a prerequisite to developing a conservation program.

Contact: Romulus Whitaker, Dr. Sarath Kotogama

Moderate Priority

Expansion of restocking program in India. Restocking efforts have declined in recent years, in part due to a lack of suitable release sites. This has been attributed to the lack of field investigations and positive public-relations programs (Whitaker and Whitaker 1989a). In some areas local opposition to crocodile releases has blocked restocking proposals. New areas appropriate for crocodile releases need to be identified and included in the crocodile reserve system. Appropriate public relations efforts also need to be undertaken to ameliorate local opposition based on misinformation.

Contact: B.C. Choudhury, Romulus Whitaker

Potential for sustainable-yield management in India. The surplus of captive animals and recent human-crocodile conflicts have made the sustainable-yield utilization (ranching or farming) of this species a potential alternative management strategy. The feasibility of limited commercial utilization needs to be examined as a means to invigorate the Indian crocodile conservation program.

Contact: Romulus Whitaker, B.C. Choudhury

Saltwater Crocodile (*Crocodylus porosus*)

Range: Australia, Bangladesh, Brunei, Burma, Cambodia, China, India, Indonesia, Malaysia, Palau, Papua New Guinea, Philippines, Singapore, Sri Lanka, Solomon Islands, Thailand, Vanuatu, Vietnam

Conservation Overview

CITES: Appendix II in Australia, Appendix II in Papua New Guinea (ranching criterion), Appendix II in Indonesia (annual quota criterion), Appendix I in all other countries
IUCN Red List 1990: Vulnerable
CSG Action Plan: Availability of Survey Data: Very Poor
Need for Wild Population Recovery: High
Potential for Sustainable-yield Management: High

Principal Threats: IH-Illegal hunting, HD-Habitat destruction
Availability of Survey Data: (18 countries)
No survey data: 8 countries (44%)
Surveys planned: 0 countries (0%)
Basic survey data: 9 countries (50%)
Widespread survey data: 1 country (6%)

Status of Wild Populations: (18 countries)
Extirpated: 1 country (6%)
Severely depleted: 10 countries (56%)
Depleted: 3 countries (17%)
Not depleted: 0 countries (0%)
Unknown: 4 countries (21%)

Existing Management Programs: (18 countries)
No management plan: 7 countries
Complete protection: 3 countries
Reintroduction or restocking: 1 country
Cropping: 3 countries
Ranching: 4 countries
Farming: 5 countries

Ecology and Natural History: The saltwater crocodile, along with the gharial, is the largest of the living crocodilians, with reported lengths of up to 6-7 m. Noted for its large size and fierce disposition, the saltwater crocodile has a reputation as a man-eater. Saltwater crocodiles are the most widely distributed

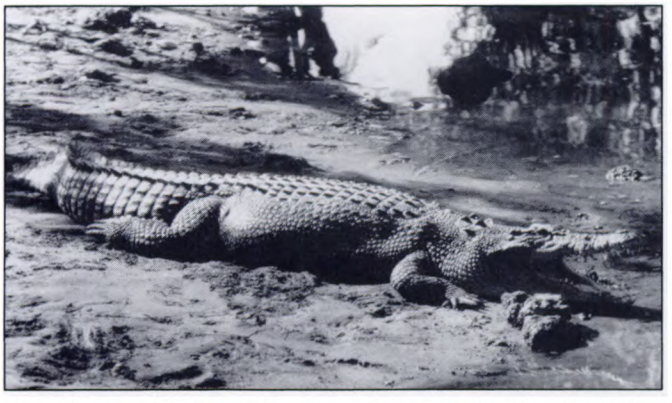
of the crocodilians, ranging from India and Sri Lanka, throughout southeast Asia and the Indo-Malay Archipelago, to the Philippines, New Guinea, and northern Australia. Isolated populations are also known from the Solomon Islands, the Banks Islands (Vanuatu), and Palau (Caroline Islands).

A great deal of ecological work has been done on this crocodile in Australia and New Guinea. As the common name implies, in many areas this species is found in coastal brackish water habitats and the tidal sections of rivers. However, the saltwater crocodile is also well known from the freshwater sections of rivers, and also frequents inland swamps and marshes (Webb et al. 1987, Messel and Vorlicek 1989a).

In the tidal waterways of northern Australia the movement of crocodiles between river systems appears to be related to ontogenetic changes in social status as well as the nature of the river's salinity profile (Messel et al. 1981). Breeding and recruitment take place principally in rivers with significant freshwater input, or in freshwater swamps. As crocodiles grow they encounter larger territorial animals, and many subadult crocodiles appear to be excluded from the breeding areas and are forced to occupy marginal habitats, such as higher salinity rivers. Mortality among these intermediate-sized crocodiles also appears to be very high.

Females become mature at lengths of approximately 2.2-2.5 m and about 12 years of age, and make mound nests during the annual rainy period (Webb et al. 1987). Clutch size is typically 40-60, and incubation normally lasts some 90 days. Nesting is a wet season activity, and in northern Australia nest loss due to flooding is very high. Nest predators include monitor lizards and humans.

The saltwater crocodile presents a number of challenging problems for the development of conservation programs. It is widely distributed over an area including thousands of islands where trade has been historically difficult to monitor and control. The saltwater crocodile is one of the largest extant crocodilians, has a well-known reputation as a man-eater, and has perhaps the most commercially valuable hide of any crocodilian. Habitat loss associated with coastal development, and intensive hide-hunting (from the late 1940s through the 1970s) depleted populations throughout much of the species' range. Habitat loss continues to be a major problem, and illegal hunting also persists in some areas.



Saltwater crocodile, *Crocodylus porosus*, Northern Territory, Australia. This species has recovered substantially from earlier exploitation in Australia, and is the subject of an intensive monitoring and management program (Photo by G.J.W. Webb).

Adequate survey data are only available from nine of the 18 (50.0%) countries in which this species is found. By far the best information on population status comes from the work by Messel and his co-workers in Australia, which has a long-standing tradition of research, and has recently developed a model management program. Surveys on the island of New Guinea have been undertaken as part of a cropping/ranching management program which was initiated in Papua New Guinea (PNG) in the 1970s. Surveys for a similar program are presently being conducted in Irian Jaya (Indonesia). Populations in both Australia and Papua New Guinea are still somewhat depleted, but survey data indicate that the populations are recovering. Crocodile populations in Irian Jaya are depleted, and illegal hunting continues to be a major problem. Recent steps taken by the Indonesian government to control the poaching of crocodiles have met with mixed success.

In India, saltwater crocodiles remain only in the northeastern coastal regions, and in the Andaman Islands. A restocking program in the Bhitarkanika National Park in Orissa has been quite successful, with over 1,000 crocodiles being released prior to 1989, and some of these crocodiles have started breeding. However, at present other areas need to be included in the restocking program.

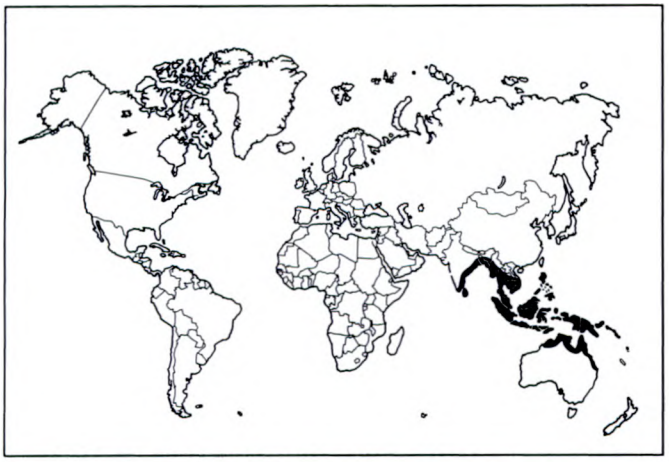
Outside of these areas, very little is known about wild populations of saltwater crocodiles. Surveys in the Philippines and Sri Lanka, Sarawak, and the Solomon Islands indicate that populations are very low. No information whatsoever is available throughout large parts of its range, especially in southeast Asia. Stray crocodiles have been encountered as far north as the Sea of Japan. Takashima (1955) reports three crocodiles from Japanese territory: one from Iwo Jima (in 1744), one from Amami-Oshima at the northern end of the Ryukyu Islands (in 1800), and a third from Toyama Bay, on the main Japanese island of Honshu. All three were presumably specimens of *C. porosus*.

Populations of the saltwater crocodile are legally protected in many countries, but rarely is this protection effective. Illegal trade continues, mainly with skins from Indonesia being shipped to Singapore. Sustainable utilization management programs have been successfully implemented in Papua New Guinea and Australia. The establishment of the management program in Papua New Guinea was a milestone in crocodilian conservation, and a similar project is now being attempted in Indonesia. In both countries, utilization is based principally on the direct cropping of wild animals, but ranching forms an important, and growing, component. Farming of *C. porosus* is being done on a large scale in Thailand and Australia, and on a smaller scale in Papua New Guinea.

Priority Projects:

High Priority

Population censuses in unsurveyed countries. Little or no information on the status of *C. porosus* populations is available for 8 of the 17 countries where this species occurs, and within most of the other countries large areas remain unsurveyed. As



Distribution of saltwater crocodile, *Crocodylus porosus*.

a first step towards developing conservation and management programs, population surveys need to be initiated in these countries. Target countries would include Thailand, Burma, Malaysia, Indonesia, Vietnam, Brunei, Sri Lanka, and Philippines.

Contact: Prof. Harry Messel, Prof. F. Wayne King, Jack Cox, Romulus Whitaker, Dr. Grahame J.W. Webb

Control of illegal trade. Illegal hunting of crocodiles in Indonesia, and the sale to Singapore is one of the greatest threats to this species. Efforts are needed to reduce this trade, which could be done most effectively by shutting down the imports into Singapore. Singapore has recently removed its CITES reservation on *C. porosus*, an important step towards eliminating the illegal trade.

Contact: Jaques Berney (CITES Secretariat)

Moderate Priority

Indian management problems. As with the mugger crocodile, the saltwater crocodile captive breeding program has been a victim of its own success. Additional release sites need to be identified and included in the crocodile conservation program to relieve some of the excess of animals that are now in captivity. A program needs to be developed to deal with "nuisance" crocodiles in the Bhitarkanika Park and other areas.

Contact: Dr. Sudhakar Kar

Implementation of the Indonesian management program. A sustainable utilization management program similar to the one in Papua New Guinea is currently being set up by Indonesian wildlife and FAO personnel in Irian Jaya. A crocodile monitoring program is being established and technical support for ranching and farming activities is being offered. Cox (1990) outlines five main points that need to be addressed:

1. More intensive population surveys in areas already initially censused and initiation of surveys in new areas.
2. Identification of principal nesting habitats.
3. Selective promotion of captive breeding.
4. Implementation of a conservation awareness campaign at the village level.
5. Examination of the potential for developing a restocking program.

Contact: Dr. Effendy A. Sumardja, Jack Cox

Development of sustainable-yield management programs in Malaysia. Whitaker (1984) recommended the establishment of a conservation program based on SYU for East Malaysia, and Sabah in particular. The program would be based on the establishment of a government demonstration farm, the encouragement of private sector involvement in farming, establishment of an egg collecting/nest monitoring program involving local villagers, the trapping of nuisance crocodiles for farm breeding stock, the protection of crocodile breeding habitat, and a public education program.

Contact: Romulus Whitaker, Dr. John Sale

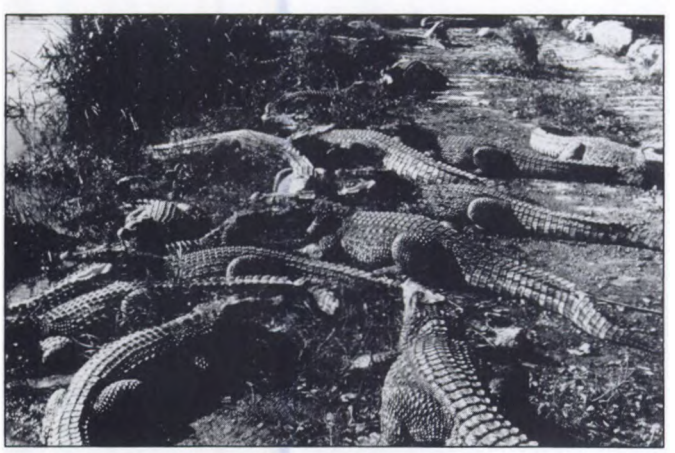
Cuban Crocodile (*Crocodylus rhombifer*)

Range: Cuba

Conservation Overview
CITES: Appendix I
IUCN Red List 1990: Endangered
CSG Action Plan: Availability of Survey Data: Very Poor
Need for Wild Population Recovery: Highest
Potential for Sustainable-yield Management: Moderate

Principal Threats: LD-Limited distribution, HD-Habitat destruction, IE-Introduced Exotics
Availability of Survey Data: (1 country)
No survey data: 0 countries (0%)
Surveys planned: 1 country (100%)
Basic survey data: 0 countries (0%)
Widespread survey data: 0 countries (0%)

Status of Wild Populations: (2 countries)
Extirpated: 1 country (50%)
Severely depleted: 1 country (50%)



Cuban crocodile, *Crocodylus rhombifer*, Cayo Potrero crocodile farm, Lanier Swamp, Isla de Juventud, Cuba (Photo by J.P. Ross).

Depleted: 0 countries (0%)
Not depleted: 0 countries (0%)
Unknown: 0 countries (0%)

Existing Management Programs: (1 country)
No management plan: 0 countries
Complete protection: 0 countries
Reintroduction or restocking: 0 countries
Cropping: 0 countries
Ranching: 1 country
Farming: 1 country

Ecology and Natural History: The Cuban crocodile has the smallest known natural distribution of any extant crocodilian. Its present distribution is restricted to the Zapata Swamp in southwestern Cuba, and a small remnant population may still be found in the Lanier Swamp on the Isle of Pines (Isla de Juventud). However, in the recent past this species was more widely distributed on the main island of Cuba (Varona 1966). Skeletal material shows that this species was found on the Cayman Islands as well (G. Morgan, pers. comm.).

The Cuban crocodile is a medium-sized species whose maximum reported length is 4.9 m, but normally does not exceed 3.5 m (Varona 1966). This species is normally restricted to freshwater habitats, but its distribution indicates that it can be tolerant of brackish or saltwater. The Zapata Swamp, currently supporting the species' only known wild population, is an extensive freshwater marsh not unlike the Everglades region in southern Florida, United States.

Although *C. rhombifer* is smaller than *C. acutus*, when the two are maintained together the Cuban crocodile is almost always the behaviorally dominant species (Varona 1966). The Cuban crocodile has a pugnacious disposition and a well-deserved reputation as a good jumper.

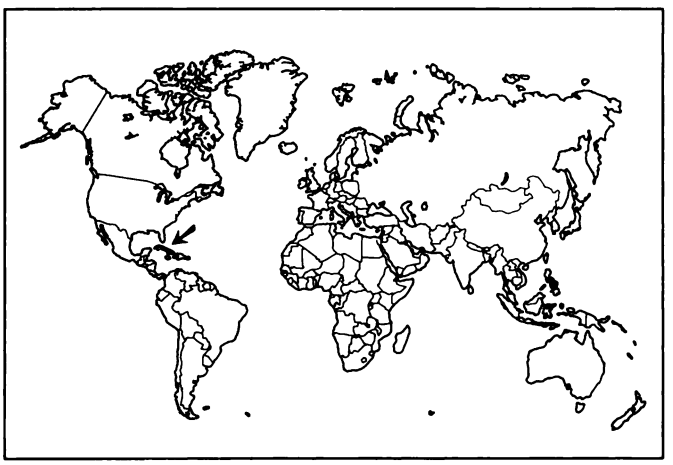
A great deal of confusion has existed over the nesting mode for this species. Varona (1986) states that nests always consist of holes excavated into the substrate, usually peat or soil with plants mixed in. However, in captivity in the United States this species will construct mound nests (K. Earnest, pers. comm.). Clutch size is typically 30-40 eggs.

Cases of hybridization of this species with *C. acutus* have been reported under captive conditions in Cuba, but it apparently occurs in the wild as well (Varona 1966).

The Cuban crocodile is without doubt the most threatened species of New World crocodilian. Wild populations have been greatly reduced and little or no work appears to have been done on surveys of wild populations, or studies of the species' behavior and ecology. Part of the problem has been the lack of communication between the scientists and wildlife personnel of Cuba and the Western world.

An historic trend in the reduction of the species' distribution has been evident. At one time the Cuban crocodile was more widely distributed on Cuba and surrounding islands. Today, its range in the wild appears to be restricted to the Zapata Swamp. Cuban crocodiles were, until recently, also found in the Lanier Swamp on the Isle of Pines. However, this population has apparently been extirpated, with the introduction of the common caiman apparently playing a significant role. The number of wild animals remaining in the Zapata Swamp is not known with any certainty. Plans are being made to conduct a survey of Cuban crocodiles, but as yet nothing is underway.

Nearly all the remaining wild animals were collected and placed in pens during the late 1950s and early 1960s. The largest "farm" at Laguna del Tesoro has about 800 adults. Some of the animals are harvested for meat (sold locally) or skins (exported). When the crocodiles were first placed in the pens in 1959, *C. rhombifer* were mixed with *C. acutus*. This resulted in hybridization between the two species and presented a grave threat to the genetic integrity of the *C. rhombifer* population. Since that time a stock of pure *C. rhombifer* has been isolated.



Distribution of Cuban crocodile, *Crocodylus rhombifer*.

Priority Projects:

High Priority

Status of the Cuban crocodile in the Zapata Swamp. This is apparently the last remaining wild population of Cuban crocodiles. A thorough survey of the status of this population is of the utmost necessity. Funds should also be sought for initiating a long-term ecological study of this species.

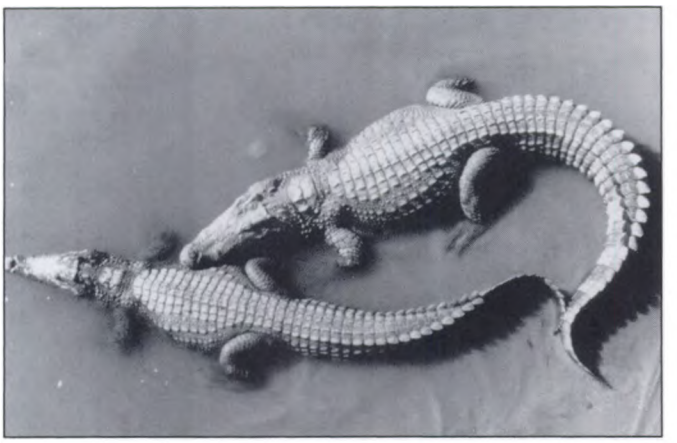
Contact: Roberto Ramos Targarona, Jose Alberto Ottenwalder

Status of the Cuban crocodile in the Lanier Swamp, Isla de Juventud. Until recently, Cuban crocodiles were also found in the Lanier Swamp. Recent reports suggest they have been extirpated, and that the introduction of the common caiman played a significant role. Surveys need to be conducted to determine that status of crocodilian populations on this island and plan active management alternatives such as the reintroduction of Cuban crocodiles.

Contact: Roberto Ramos Targarona, Jose Alberto Ottenwalder

Moderate Priority

Ecological interactions between Cuban crocodiles and the introduced Caiman crocodilus *in the Lanier Swamp.* The introduction of the common caiman into the Lanier Swamp is thought to have played an important role in the apparent extirpation of *C. rhombifer* from this area. If any Cuban



Siamese crocodile, *Crocodylus siamensis*, probably the most endangered crocodilian. Conservation action is the highest priority (Photo by G.J.W. Webb).

crocodiles remain in the swamp, investigations of *Caiman-C. rhombifer* interactions should be undertaken and immediate plans made to restock with Cuban crocodiles.

Contact: Roberto Ramos Targarona, Jose Alberto Ottenwalder

Siamese Crocodile (*Crocodylus siamensis*)

Range: Thailand, Cambodia, Vietnam, Indonesia, Laos, Malaysia

Conservation Overview
CITES: Appendix I
IUCN Red List 1990: Endangered
CSG Action Plan: Availability of Survey Data: Extremely Poor
Need for Wild Population Recovery: Highest
Potential for Sustainable-yield Management: Low

Principal Threats: HD-Habitat destruction, IH-Illegal hunting
Availability of Survey Data: (6 countries)
No survey data: 5 countries (80%)
Surveys planned: 1 country (20%)
Basic survey data: 0 countries (0%)
Widespread survey data: 0 countries (0%)

Status of Wild Populations: (6 countries)
Extirpated: 0 countries (0%)
Severely depleted: 1 country (20%)
Depleted: 0 countries (0%)
Not depleted: 0 countries (0%)
Unknown: 5 countries (80%)

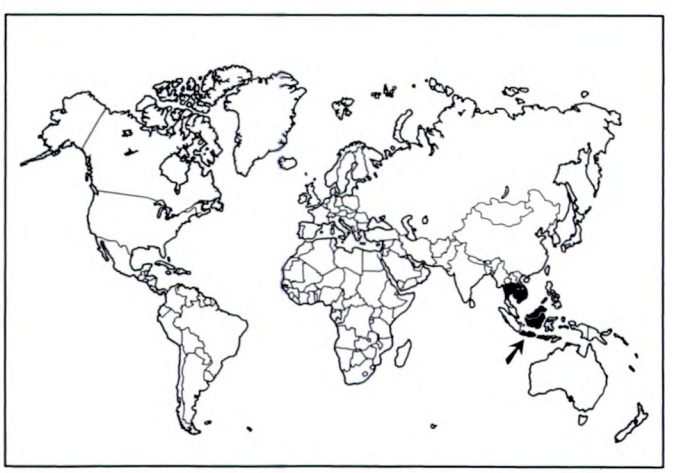
Existing Management Programs: (6 countries)
No management plan: 3 countries
Complete protection: 2 countries
Reintroduction or restocking: 0 countries
Cropping:
Ranching: 0 countries
Farming: 1 country

Ecology and Natural History: The ecology of the Siamese crocodile in the wild is virtually unknown. According to Smith (1919, 1931), the preferred habitat of this species was freshwater swamps and slow-moving sections of streams and rivers, but it is also known to have been found in lakes and rivers. Maximum size of males has been reported to be up to 4 m (Brazaitis 1973), but most individuals do not exceed 3 m. All our information on reproduction in this species has come from captive individuals. Females construct a mound nest during the annual wet season and lay 20-50 eggs (Yangpraprakorn et al. 1971).

Individuals of this species are attributed to a number of the Indonesian islands, including Borneo (Kalimantan) and Java. Preliminary surveys and observations on the crocodiles and their resource potential in Kalimantan have been made by Scott Frazier (in prep 11/90) who reports that *C. siamensis* are held in farms there and may occur in the wild. Crocodile specimens from Java are true *C. siamensis*. Nothing is known about the behavior or ecology of the Borneo freshwater crocodiles. Ross (1991) has proposed resurrecting the name *Crocodylus raninus* for a species of lacustrine crocodile restricted to Borneo, but the paucity of specimens from that region make its identity and taxonomic status difficult to evaluate.

The Siamese crocodile is one of the world's most endangered crocodilians. The only known wild population was located in the Bung Boraphet Reservoir in Thailand; however, no recent sightings of crocodiles have been made at this site. Survey data for this species are particularly incomplete, due in part to the recent civil unrest that has been experienced throughout much of southeast Asia. No adequate survey data are available from any part of the Siamese crocodile's range. The situation is further complicated by the uncertain taxonomic status of freshwater crocodiles from the Greater Sunda Islands. The recent indication that some 2,000-3,000 live crocodiles are being exported from Cambodia is very intriguing and may suggest that wild *C. siamensis* populations still exist in that country.

No active conservation or management programs are underway. Because of the extremely poor status of wild populations, captive breeding groups are of great importance. Captive breeding is being done on a large scale in one farm in Thailand,



Distribution of Siamese crocodile, *Crocodylus siamensis*.

and specimens are not uncommon in zoos in North America (132 specimens) and Europe (7 specimens). Captive breeding has also been accomplished in the Soviet Union (Moscow, Rostov zoos) and in Japan (Higashi-Izu zoo) (Honegger and Hunt 1990).

Priority Projects:

High Priority

Status surveys in southeast Asia. The status and distribution of mainland populations is completely unknown. It is vitally important to begin surveys to clarify the status of wild populations in this area. Particularly important are Thailand, Laos, and Vietnam. A survey of Bung Boraphet, Thailand, the location of the last known wild population, is essential. Civil unrest still plagues Cambodia, but attempts should be made to locate the source and specific identity of the crocodiles being exported to Thailand.

Contact: Dr. Grahame J.W. Webb, Xaisida Bounthong (Laos), Phairot Suvanakorn (Thailand), Prof. Vo Quy (Vietnam)

Status surveys in the Greater Sunda Islands. Recent work by Ross (1991) proposes new species of freshwater *Crocodylus* in Indonesia including New Guinea, Java, Borneo, and Sumatra. Survey and systematic work is needed to verify the presence of these crocodiles and to clarify their taxonomic status.

Contact: Jack Cox, Romulus Whitaker

Maintain a stock of pure C. siamensis *in crocodile farms.* The bulk of the captive *C. siamensis* worldwide are maintained in the Samutprakan farm, where extensive interbreeding with *C. porosus* has taken place. Hybrids are preferred for their superior commercial qualities, but the hybridization threatens the genetic integrity of one of the most imminently threatened species of crocodilians. Efforts need to be made to separate a pure stock of *C. siamensis* which could be used for future conservation activities. There is no reason why the farm cannot segregate a group of pure blood *C. siamensis*, in addition to the hybrids they are promoting for hide production.

Contact: Charoon Youngprapakorn, Dr. Parntep Ratanakorn

Creation of protected areas in Thailand. The last known wild population of Siamese crocodiles was located in Thailand. Habitat surveys need to be conducted and the feasibility of creating protected areas determined. The Samutprakan farm has a long-standing pledge to supply crocodiles for restocking programs. Once protected habitats are established planning for crocodile release programs can begin.

Contact: Dr. Grahame J.W. Webb, Charoon Youngprapakorn, Phairot Suvanakorn, Parntep Ratanakorn

Moderate Priority

Investigation of the taxonomy of the freshwater crocodiles in southeast Asia and the Indo-Malaysian Archipelago. The relationships among the freshwater crocodiles in the Indo-Malaysian Archipelago are poorly understood. A new species of crocodile is being described from Borneo, and evidence suggests that others may exist. The clarification of these relationships is not only of scientific interest but also has important implications for conservation.

Contact: Dr. C.A. Ross

Dwarf Crocodile (*Osteolaemus tetraspis*)

Range: Angola, Benin, Burkina Faso, Cameroon, Central African Republic, Congo, Equatorial Guinea, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Ivory Coast, Liberia, Mali, Nigeria, Senegal, Sierra Leone, Togo, Zaire

Dwarf crocodile, *Osteolaemus tetraspis*, Kpandu, Ghana (specimen now in the National Natuurhistorisch Museum, Leiden (Photo by M. Hoogmoed).

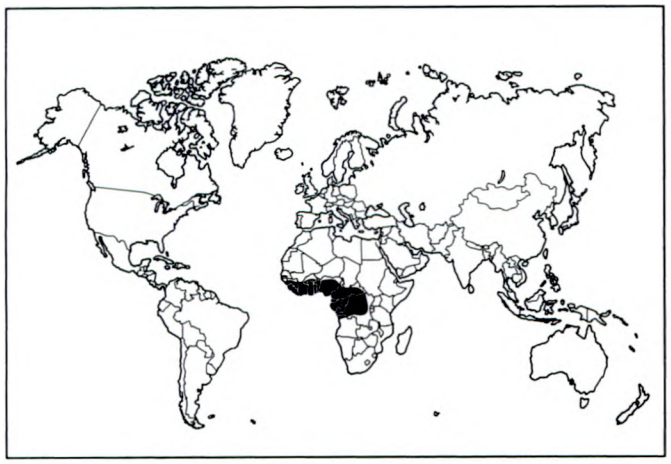
Conservation Overview

CITES: Appendix I
IUCN Red List 1990: Not listed
CSG Action Plan: Availability of Survey Data: Extremely Poor
Need for Wild Population Recovery: Moderate
Potential for Sustainable-yield Management: Low

Principal Threats: IH-Illegal hunting, HD-Habitat destruction
Availability of Survey Data: (20 countries)
No survey data: 15 countries (75%)
Surveys planned: 1 country (5%)
Basic survey data: 4 countries (20%)
Widespread survey data: 0 countries (0%)

Status of Wild Populations: (20 countries)
Extirpated: 0 countries (0%)
Severely depleted: 1 country (5%)
Depleted: 4 countries (20%)
Not depleted: 0 countries (0%)
Unknown: 15 countries (75%)

Existing Management Programs: (20 countries)
No management plan: 1 country



Distribution of dwarf crocodile, *Osteolaemus tetraspis*.

Complete protection: 13 countries
Reintroduction or restocking: 0 countries
Cropping: 1 country
Ranching: 0 countries
Farming: 0 countries
Unknown: 5 countries

Ecology and Natural History: This is another little-known, diminutive species of crocodilian. Dwarf crocodiles range throughout the lowland regions of west and central Africa and Congo, although specimens from the upper Congo in Zaire were described by Schmidt (1919) as a separate genus (*Osteoblepharon osborni*). This difference was later reduced to the species level (*Osteolaemus osborni*) by Inger (1948), and subsequently to a subspecies (*O. tetraspis osborni*) by Wermuth and Mertens (1961). Maximum size probably rarely exceeds 2 m (Brazaitis 1973).

Waitkuwait (1989) indicates that the dwarf crocodile is primarily a denizen of swamps and swamp forests. It apparently prefers slow-moving, calm bodies of water, and frequently utilizes burrows. Some individuals, however, have been reported from isolated pools in savannah habitat, spending the dry season in burrows (Waitkuwait 1989). In forested areas dwarf crocodiles are known to make extensive nocturnal terrestrial forays, especially following rains. In many aspects of its ecology this species is very similar to the genus *Paleosuchus* in the New World.

Dwarf crocodiles are mound nesters, with nesting beginning in the early wet season. Females lay small clutches (mean 10) of small eggs, which require approximately 100 days for incubation (Waitkuwait 1989).

Very little survey work has been done on this species. Adequate information is only available from four of the 20 (20.0%) countries where it is found: the Ivory Coast, Gabon, the Central African Republic, and Congo. Because of the lack of systematic surveys, good information on population status of the dwarf crocodile is lacking and in most countries the status is unknown. Where survey data are available, populations appear to be somewhat depleted. Populations in Gambia, on the northern edge of the species' distribution where only anecdotal information exists, are reported to be severely depleted.

Hide hunting and, in certain areas, habitat destruction are the principal threats to this species. Most commercial hunting is done for the local production of poor quality leather products. Habitat destruction or alteration have been reported in Nigeria, Gambia, Ghana, and Liberia (Pooley 1982).

Because of the relatively poor quality of the hide of dwarf crocodiles, intensive commercial hunting has not been a serious problem, and there has not been much of a push for establishing management programs based on sustainable utilization. Only Togo is reported to have a legal harvest system but this program does not appear to be in effect. Congo had a CITES approved quota of 500 in 1987 but did not renew its request for a quota in 1989.

Priority Projects:

High Priority

Surveys of the status and distribution throughout west and central Africa. Very few survey data are available from west and central Africa, so the status of this species, although it is widely distributed, remains mostly unknown. Because of the low quality of the hide of *Osteolaemus*, there is not much incentive for establishing a sustainable-yield management program. Yet surveys need to be undertaken in order to determine population status and whether or not appropriate conservation measures should be taken. Because this species is broadly sympatric with *C. cataphractus*, census work for both species could be combined. Surveys need to be conducted throughout west and central Africa, with priority given to the countries where the species status appears to be most threatened (e.g., Nigeria).

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Tomistoma (*Tomistoma schlegelii*)

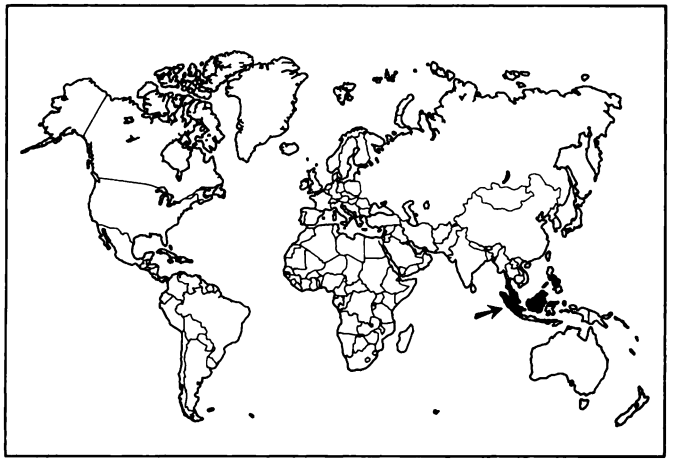
Range: Thailand, Malaysia, Indonesia

Conservation Overview
CITES: Appendix I
IUCN Red List 1990: Endangered

Captive tomistoma, *Tomistoma schlegelii*, in Singapore (Photo by G.J.W. Webb).

CSG Action Plan: Availability of Survey Data: Very Poor
Need for Wild Population Recovery: Highest
Potential for Sustainable-yield Management: Low

Principal Threats: HD-Habitat destruction
Availability of Survey Data: (3 countries)
No survey data: 1 country (33%)
Survey planned: 1 country (33%)
Basic survey data: 1 country (33%)
Widespread survey data: 0 countries (0%)



Distribution of tomistoma, *Tomistoma schlegelii*.

Status of Wild Populations: (3 countries)
Extirpated: 0 countries (0%)
Severely depleted: 3 countries (100%)
Depleted: 0 countries (0%)
Not depleted: 0 countries (0%)
Unknown: 0 countries (0%)

Existing Management Programs: (3 countries)
No management plan: 0 countries
Complete protection: 3 countries
Reintroduction or restocking: 0 countries
Cropping: 0 countries
Ranching: 0 countries
Farming: 0 countries

Ecology and Natural History: The tomistoma, or "false gharial", is one of the most unusual and little-known of the crocodilians. It is a large species, with males attaining sizes of up to 5 m, and has a distinctive narrow snout marked with dark blotches (Brazaitis 1973). The current range of the species includes the Malay Peninsula (southern Thailand and Malaysia), Sumatra, and Borneo (Indonesia, Malaysia). Some recent reports indicate that the species may also be found in Sulawesi (Groombridge 1982).

Almost nothing is known about the ecology of this species in the wild. *Tomistoma* appears to be restricted primarily to freshwater swamps, rivers, and lakes and is said to utilize burrows. Females are mound nesters, and lay clutches of 20-60 very large eggs. Sexual maturity is attained among females at a length of 2.5-3.0 m (Groombridge 1982).

The evolutionary relationship of *Tomistoma* with other crocodilians has been a subject of recent debate, and no consensus has been reached. Traditionally, *Tomistoma* has been closely aligned with the true crocodiles (Crocodylidae) based on morphological evidence (Tarsitano et al. 1989). Biochemical and immunological studies, however, suggest that *Tomistoma* is more closely related to the gharial (Gavialidae) (Densmore and Owen 1989).

Very little information is available concerning the status of wild populations of *Tomistoma*. The only surveys that have been done to date were in Sarawak, where numbers were extremely low. Whitaker (1984) surveyed Sabah, East Malaysia but considers this area to be outside of the natural distribution of *Tomistoma*. No surveys have been done in West Malaysia or in other parts of the species' range, but populations are assumed to similarly low. No conservation or management programs of any sort have been initiated for this species.

Priority Projects:

High Priority

Status surveys in Thailand, Malaysia, and Indonesia. Virtually nothing is known about the status of this species in the wild, and even the distribution of the *Tomistoma* is not completely understood. The most urgent need at present is to conduct population surveys as a first step towards developing conservation and management programs. In particular, census work is needed in Sumatra and Borneo.

Contact: Jack Cox, Romulus Whitaker, Dr. Grahame J.W. Webb, Mohd. Khan b. Momin Khan, John Sale

Development and implementation of conservation and research programs. Following initial survey work, conservation plans for this species need to be drawn, particularly in Indonesia and Malaysia, where *Tomistoma* is most widely distributed. If viable populations are located, habitat protection measures should be undertaken and ecological investigations and population monitoring initiated.

Contact: Jack Cox, Romulus Whitaker, Patrick Andau

Gharial (*Gavialis gangeticus*)

Range: Bangladesh, Bhutan, Burma, India, Nepal, Pakistan

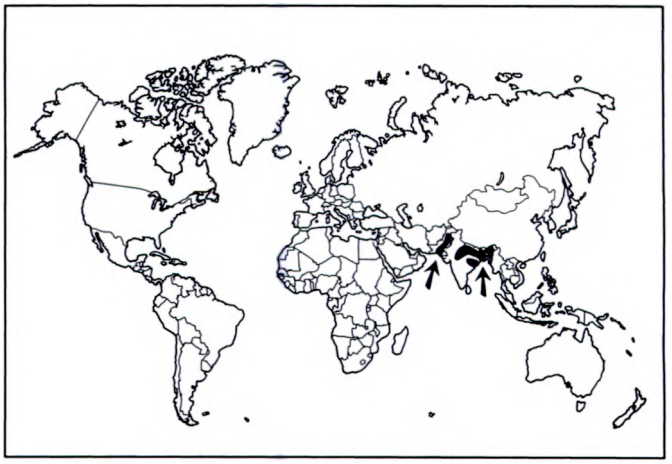
Conservation Overview
CITES: Appendix I
IUCN Red List 1990: Endangered
CSG Action Plan: Availability of Survey Data: Very Poor
Need for Wild Population Recovery: Highest
Potential for Sustainable-yield Management: Low

Principal Threats: HD-Habitat destruction, LD-Limited distribution
Availability of Survey Data: (6 countries)
No survey data: 3 countries (50%)
Surveys planned: 1 country (17%)
Basic survey data: 1 country (17%)

Widespread survey data: 1 country (17%)

Status of Wild Populations: (6 countries)
- Extirpated: 2 countries (33%)
- Severely depleted: 4 countries (67%)
- Depleted: 0 countries (0%)
- Not depleted: 0 countries (0%)
- Unknown: 0 countries (0%)

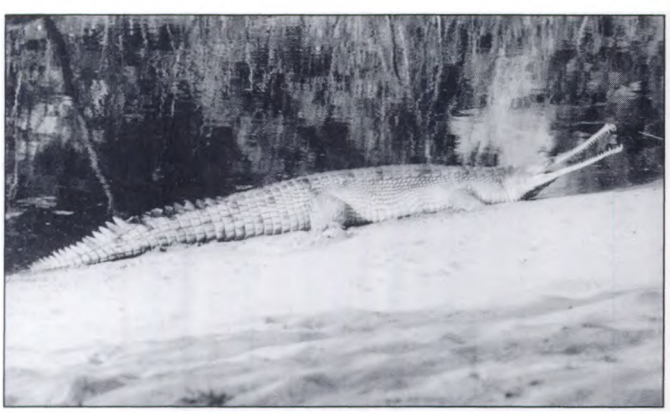
Existing Management Programs: (5 countries)
- No management plan: 0 countries
- Complete protection: 3 countries
- Reintroduction or restocking: 2 countries
- Cropping: 0 countries
- Ranching: 0 countries
- Farming: 0 countries



Distribution of gharial, *Gavialis gangeticus*.

Ecology and Natural History: The gharial is the most long-snouted and, with the saltwater crocodile, the largest of the living crocodilians (males up to 6-7 m). Placed in a family by itself, the Gavialidae, the gharial has long been separated from the rest of the crocodilian stock, with the possible exception of *Tomistoma* (Densmore 1983). Gharial are arguably the most thoroughly aquatic of the extant crocodilians, and adults apparently do not have the ability to walk in a semi-upright stance as other crocodilians do (Bustard and Singh 1978). Adult males grow a bulbous nasal appendage, which resembles an Indian pot called a ghara, from which the species derives its name. Gharial are restricted to the northern part of the Indian subcontinent where they are found in four river systems: the Indus (Pakistan), the Ganges (India and Nepal), the Mahanadi (India), and the Brahmaputra (Bangladesh, India, and Bhutan). The presence of the species in the Kaladan and Irrawaddy Rivers in Burma has also been reported (Smith 1931).

The gharial is typically a resident of deep fast-flowing rivers, but within these rivers prefers areas where the current is reduced (Whitaker and Basu 1983). Exposed sand banks are used for nesting. Although the function of the ghara is not well understood, it is apparently used as a visual sex indicator, as a sound resonator, or for bubbling or other associated sexual behaviors (Martin and Bellairs 1977).



Gharial, *Gavialis gangeticus*, breeding stock at Madras Crocodile Bank, India (Photo by H. Andrews).

The gharial appears to be primarily a fish-eating species, but very large individuals are known to eat other prey. Females may not reach sexual maturity until they are nearly 3 m long. Nesting is done during the annual dry season in holes excavated in river sand banks (Whitaker and Basu 1983). Unlike most other crocodilians, who carry their young from the nest in the mouth, gharial appear not to do this because of the unusual morphology of their jaws (Singh and Bustard 1977). However, post-natal maternal care has been observed. Female gharial typically lay 30-50 eggs, and the eggs are the largest of any crocodilian (average 160 g).

The gharial is one of the most critically endangered of the crocodilians. However, unlike the other seven most endangered crocodilians, good conservation programs are now in place over much of the species' range. The species was literally brought back from the brink of extinction by restocking programs initiated first in India in 1975, and in Nepal in 1978. Since that time over one thousand captive-reared juveniles have been released in India, and over 300 in Nepal. In India, eight protected areas have been designated for gharial management, with varying degrees of success. The program has been particularly successful in the Chambal River, where a demonstrated recovery has taken place. However, in other areas such as the Satkoshia Gorge (Mahanadi River) the restocking program has been less successful. In Nepal, most releases have been into the Narayani and its tributaries in central Nepal, with a few releases in the eastern region of the country. The Pakistan government is currently planning a similar restocking effort.

Despite these efforts, the gharial is still very much endangered. Gharial are still extremely rare in both India and Nepal, virtually extinct in Pakistan and Bangladesh, and probably extinct in Bhutan and Myanmar (Burma).

Priority Projects:

High Priority

Survey of status and distribution in Pakistan. The government of Pakistan is interested in implementing a restocking program similar to the ones in Nepal and India. However, other than one recent sighting nothing is known about the status of the gharial. Surveys of the Indus River and Nara Canal are needed. Based

on the results of the survey action should be taken to set aside land for crocodile sanctuaries as a first step towards restocking.

Contact: Ashiq Ahmad

Survey of status and distribution in eastern India and Bangladesh. No recent surveys have been done in this region. Information is needed on the status of gharial in the Brahamaputra River system, as well as in the Padma and Jamuna rivers in Bangladesh, as a first step towards establishing protected areas for gharial management.

Contact: B. C. Choudhury, Dr. R. J. Rao, Dr. Lala A.K. Singh, Md. Mokhlesur Rahman, Mod. A. Reza Khan

Establishment of a captive rearing center in Pakistan. A captive rearing center similar to those in India and Nepal is needed to supply animals for restocking protected areas.

Contact: Ashiq Ahmad

Establishment of captive rearing center in Bangladesh and northeastern India. Rearing centers are needed to initiate reintroduction programs in these areas.

Contact: B. C. Choudhury, Dr. R.J. Rao, Dr. Lala A.K. Singh, Md. Mokhlesur Rahman, Mod. A. Reza Khan

Moderate Priority

Establishment of additional gharial reserves for restocking in India. Additional sites need to be identified for inclusion within the current restocking program. Sites that have been initially identified include the Hirakud Reservoir and the Braham River.

Contact: B.C. Choudhury, Dr. R.J. Rao, Dr. Lala A.K. Singh, Md. Mokhlesur Rahman, Mod. A. Reza Khan

Improve management of the gharial in the Satkoshia Gorge Sanctuary, India. The release program for gharial in the Satkoshia Gorge has met with mixed success owing to a series of problems (see Rath et al. 1990). A proposed plan to include the sanctuary as an elephant reserve will significantly improve the ability to control and manage the riverine environment. Research on the significance of the wetland ecosystems associated with the Mahanadi River is needed.

Contact: R.L. Rath, Dr. L.A.K. Singh

Survey of status in the Irrawaddy and Kaladan River systems in Burma. Although the gharial is considered to be extinct in Myanmar (Burma), small populations may still exist in isolated areas. Surveys need to be conducted to assess the current status of gharial in Myanmar.

Contact: K. Fuchs

Expansion of restocking program in Nepal. The vast majority of the releases of gharial in Nepal have been into the Narayani River system. Additional sites in eastern and western Nepal need to be identified and included in the restocking program.

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Tabular summary of the quality of available survey data, the status of wild populations, and the type of management program in effect for each country on a species by species basis. Species are presented alphabetically by genus and species in the standard taxonomic sequence.

American alligator (*Alligator mississippiensis*)

Summary of Survey Data
No survey data:
Surveys not planned:
Surveys planned:
Basic survey data:
Widespread survey data: United States

Summary of Status
Extirpated:
Severely depleted:
Depleted:
Not Depleted: United States
Unknown:

Summary of Management Programs
No management plan:
Protection only:
Reintroduction/restocking: United States
Cropping: United States
Ranching: United States
Farming: United States

Chinese alligator (*Alligator sinensis*)

Summary of Survey Data
No survey data:
Surveys not planned: People's Republic of China
Surveys planned:
Basic survey data:
Widespread survey data:

Summary of Status
Extirpated:
Severely depleted: People's Republic of China
Depleted:
Not Depleted:
Unknown:

Summary of Management Programs
No management plan:
Protection only:
Reintroduction/restocking:
Cropping:
Ranching: People's Republic of China
Farming: People's Republic of China

Common caiman (*Caiman crocodilus*)

Summary of Survey Data
No survey data:
Surveys not planned: Mexico, El Salvador, Guatemala, French Guiana, Cuba, Trinidad, and Tobago
Surveys planned: Nicaragua, Panama, Colombia
Basic survey data: Honduras, Costa Rica, Venezuela, Suriname, Ecuador, Peru, Brazil
Widespread survey data:

Summary of Status
Extirpated:
Severely depleted: El Salvador
Depleted: Mexico, Nicaragua, Colombia, Guyana, Ecuador, Peru
Not Depleted: Honduras, Costa Rica, Panama, Venezuela, French Guiana, Brazil, Suriname, Trinidad, and Tobago
Unknown: Guatemala

Summary of Management Programs
No management plan: El Salvador, Suriname
Protection only: Mexico, Costa Rica, French Guyana, Ecuador, Peru, Brazil, Trinidad, and Tobago
Reintroduction/restocking:
Cropping: Guatemala, Honduras, Nicaragua, Venezuela, Guyana
Ranching: Venezuela, Guyana
Farming: Guatemala, Panama, Colombia, Guyana

Broad-snouted caiman (*Caiman latirostris*)

Summary of Survey Data
No survey data:
Surveys not planned: Uruguay
Surveys planned: Brazil
Basic survey data: Bolivia, Paraguay, Argentina
Widespread survey data:

Summary of Status
Extirpated:
Severely depleted: Bolivia
Depleted: Brazil, Uruguay, Paraguay, Argentina
Not Depleted:
Unknown:

Summary of Management Programs
No management plan:
Protection only: Bolivia, Uruguay, Paraguay
Reintroduction/restocking: Argentina, Brazil
Cropping:
Ranching: Brazil
Farming: Argentina

Yacare (*Caiman yacare*)

Summary of Survey Data
No survey data:
Surveys not planned:
Surveys planned:
Basic survey data: Bolivia, Brazil, Paraguay, Argentina
Widespread survey data:

Summary of Status
Extirpated:
Severely depleted:
Depleted: Bolivia, Brazil, Paraguay, Argentina
Not Depleted:
Unknown:

Summary of Management Programs
No management plan:
Protection only: Paraguay
Reintroduction/restocking: Argentina
Cropping: Bolivia
Ranching: Brazil
Farming: Argentina

Black caiman (*Melanosuchus niger*)

Summary of Survey Data
No survey data:
Surveys not planned:
Surveys planned: Colombia
Basic survey data: Guyana, French Guiana, Ecuador, Peru, Bolivia, Brazil
Widespread survey data:

Summary of Status
Extirpated:
Severely depleted: Colombia, French Guiana, Bolivia, Brazil
Depleted: Guyana, Ecuador, Peru
Not Depleted:
Unknown:

Summary of Management Programs
No management plan:
Protection only: Colombia, Guyana, French Guiana, Ecuador, Peru, Brazil
Reintroduction/restocking: Bolivia
Cropping:
Ranching:
Farming:

Dwarf caiman (*Paleosuchus palpebrosus*)

Summary of Survey Data
No survey data:
Surveys not planned: French Guiana
Surveys planned: Colombia
Basic survey data: Venezuela, Guyana, Suriname, Ecuador, Peru, Bolivia, Brazil, Paraguay
Widespread survey data:

Summary of Status
Extirpated:
Severely depleted:
Depleted: Paraguay
Not Depleted: Colombia, Venezuela, Guyana, Suriname, French Guiana, Ecuador, Peru, Bolivia, Brazil
Unknown:

Summary of Management Programs
No management plan:
Protection only: Colombia, Venezuela, Suriname, French Guiana, Ecuador, Peru, Bolivia, Brazil, Paraguay
Reintroduction/restocking:
Cropping: Guyana
Ranching:
Farming:

Smooth-fronted caiman (*Paleosuchus trigonatus*)

Summary of Survey Data
No survey data:
Surveys not planned: French Guiana
Surveys planned: Colombia
Basic survey data: Venezuela, Guyana, Suriname, Ecuador, Peru, Bolivia, Brazil
Widespread survey data:

Summary of Status
Extirpated:
Severely depleted:
Depleted:
Not Depleted: Colombia, Venezuela, Guyana, Suriname, French Guiana, Ecuador, Peru, Bolivia, Brazil
Unknown:

Summary of Management Programs
No management plan:
Protection only: Colombia, Venezuela, French Guiana, Suriname, Ecuador, Peru, Bolivia, Brazil
Reintroduction/restocking:
Cropping: Guyana
Ranching:
Farming:

American crocodile (*Crocodylus acutus*)

Summary of Survey Data
No survey data:
Surveys not planned: El Salvador, Nicaragua
Surveys planned: Mexico, Belize, Guatemala, Panama, Colombia, Cuba
Basic survey data: Honduras, Costa Rica, Venezuela, Ecuador, Peru, Jamaica, Dominican Republic, Haiti
Widespread survey data: United States

Summary of Status
Extirpated: Cayman Islands
Severely depleted: Mexico, El Salvador, Guatemala, Colombia, Peru
Depleted: United States, Belize, Honduras, Nicaragua, Costa Rica, Panama, Venezuela, Ecuador, Cuba, Jamaica, Dominican Republic, Haiti
Not Depleted:
Unknown:

Summary of Management Programs
No management plan: El Salvador, Haiti
Protection only: United States, Belize, Guatemala, Nicaragua, Costa Rica, Ecuador, Peru, Dominican Republic, Jamaica
Reintroduction/restocking: Venezuela
Cropping:
Ranching: Cuba
Farming: Mexico, Honduras, Panama, Colombia, Cuba

Slender-snouted crocodile (*Crocodylus cataphractus*)

Summary of Survey Data
No survey data:
Surveys not planned: Chad, Mali, Liberia, Senegal, Gambia, Guinea-Bissau, Guinea, Sierra Leon, Burkina Faso, Ghana,

Togo, Benin, Nigeria, Cameroon, Equitorial Guinea, Zaire, Tanzania, Angola, Zambia, Mauritania
Surveys planned:
Basic survey data: Ivory Coast, Gabon, Central African Republic, Congo
Widespread survey data:

Summary of Status
Extirpated:
Severely depleted: Chad, Senegal, Gambia, Angola
Depleted: Liberia, Ivory Coast, Gabon, Central African Republic, Congo
Not Depleted:
Unknown: Mali, Guinea-Bissau, Guinea, Sierra Leon, Burkina Faso, Ghana, Togo, Benin, Nigeria, Cameroon, Equitorial Guinea, Zaire, Tanzania, Zambia, Mauritania

Summary of Management Programs
No management plan: Guinea-Bissau
Protection only: Mali, Senegal, Gambia, Liberia, Ivory Coast, Burkina Faso, Ghana, Benin, Nigeria, Gabon, Central African Republic, Tanzania, Angola, Zambia
Reintroduction/restocking:
Cropping: Chad, Sierra Leon, Togo, Cameroon, Congo, Zaire
Ranching:
Farming:
Unknown: Mauritania, Equitorial Guinea, Guinea

Orinoco crocodile (*Crocodylus intermedius*)

Summary of Survey Data
No survey data:
Surveys not planned:
Surveys planned: Colombia
Basic survey data: Venezuela
Widespread survey data:

Summary of Status
Extirpated:
Severely depleted: Colombia, Venezuela
Depleted:
Not Depleted:
Unknown:

Summary of Management Programs
No management plan:
Protection only: Colombia
Reintroduction/restocking: Venezuela
Cropping:
Ranching:
Farming:

Australian freshwater crocodile (*Crocodylus johnsoni*)

Summary of Survey Data
No survey data:
Surveys not planned:
Surveys planned:
Basic survey data:
Widespread survey data: Australia

Summary of Status
Extirpated:
Severely depleted:
Depleted:
Not Depleted: Australia
Unknown:

Summary of Management Programs
No management plan:
Protection only:
Reintroduction/restocking:
Cropping:
Ranching: Australia
Farming: Australia

Philippine crocodile (*Crocodylus mindorensis*)

Summary of Survey Data
No survey data:
Surveys not planned:
Surveys planned:
Basic survey data: Philippines
Widespread survey data:

Summary of Status
Extirpated:
Severely depleted: Philippines
Depleted:
Not Depleted:
Unknown:

Summary of Management Programs
No management plan:
Protection only: Philippines
Reintroduction/restocking:
Cropping:
Ranching:
Farming:

Morelet's crocodile (*Crocodylus moreletii*)

Summary of Survey Data
No survey data:
Surveys not planned:
Surveys planned: Mexico
Basic survey data: Belize, Guatemala
Widespread survey data:

Summary of Status
Extirpated:
Severely depleted:
Depleted: Belize, Guatemala, Mexico
Not Depleted:
Unknown:

Summary of Management Programs
No management plan:
Protection only: Belize, Guatemala
Reintroduction/restocking:
Cropping:
Ranching:
Farming: Mexico

Nile crocodile (*Crocodylus niloticus*)

Summary of Survey Data
No survey data:
Surveys not planned: Chad, Niger, Mali, Senegal, Gambia, Guinea-Bissau, Guinea, Sierra Leon, Liberia, Burkina Faso, Ghana, Togo, Benin, Nigeria, Cameroon, Equitorial Guinea, Zaire, Uganda, Burundi, Rwanda, Angola, Namibia, Swaziland
Surveys planned: Egypt, Sudan, Somalia
Basic survey data: Ivory Coast, Gabon, Central African Republic, Congo, Kenya, Ethiopia, Tanzania, Zambia, Malawi, Mozambique, Zimbabwe, Botswana, South Africa, Madagascar
Widespread survey data:

Summary of Status
Extirpated: Israel, Algeria, Seychelles, Comoros
Severely depleted: Egypt, Chad, Niger, Senegal, Gabon, Madagascar
Depleted: Sudan, Gambia, Ivory Coast, Central African Republic, Congo, Kenya, Ethiopia, Tanzania, Zambia, Malawi, Angola, Botswana, South Africa
Not Depleted: Mozambique, Zimbabwe
Unknown: Mali, Guinea-Bissau, Guinea, Sierra Leon, Liberia, Burkina Faso, Ghana, Togo, Benin, Nigeria, Cameroon, Equitorial Guinea, Zaire, Uganda, Somalia, Burundi, Rwanda, Namibia, Swaziland

Summary of Management Programs
No management plan: Guinea-Bissau
Protection only: Egypt, Niger, Mali, Senegal, Gambia, Liberia, Ivory Coast, Burkina Faso, Ghana, Benin, Nigeria, Gabon, Central African Republic, Uganda, Burundi, Angola
Reintroduction/restocking:
Cropping: Sudan, Chad, Sierra Leon, Togo, Cameroon, Congo, Zaire, Kenya, Somalia, Tanzania, Zambia, Rwanda, Malawi, Mozambique, Madagascar
Ranching: Kenya, Ethiopia, Tanzania, Zambia, Malawi, Mozambique, Zimbabwe, Botswana, Madagascar
Farming: Israel, Kenya, Rwanda, Malawi, Zimbabwe, Botswana, Namibia, South Africa
Unknown: Swaziland, Equitorial Guinea, Guinea

New Guinea crocodile (*Crocodylus novaeguineae*)

Summary of Survey Data
No survey data:
Surveys not planned:
Surveys planned:
Basic survey data: Indonesia, Papua New Guinea
Widespread survey data:

Summary of Status
Extirpated:
Severely depleted:
Depleted: Indonesia, Papua New Guinea
Not Depleted:
Unknown:

Summary of Management Programs
No management plan:
Protection only:
Reintroduction/restocking:
Cropping: Indonesia, Papua New Guinea
Ranching: Indonesia, Papua New Guinea
Farming:

Mugger crocodile (*Crocodylus palustris*)

Summary of Survey Data
No survey data:
Surveys not planned: Iran, Pakistan, Nepal, Bangladesh
Surveys planned:
Basic survey data: India, Sri Lanka
Widespread survey data:

Summary of Status
Extirpated:
Severely depleted: Nepal, Bangladesh
Depleted: Pakistan, India, Sri Lanka
Not Depleted:
Unknown: Iran

Summary of Management Programs
No management plan:
Protection only: Iran, Pakistan, Nepal, Bangladesh, Sri Lanka
Reintroduction/restocking: India
Cropping:
Ranching:
Farming:

Saltwater crocodile (*Crocodylus porosus*)

Summary of Survey Data
No survey data:
Surveys not planned: Bangladesh, Burma, Thailand, Cambodia, Vietnam, China, Brunei, Singapore
Surveys planned:
Basic survey data: India, Sri Lanka, Malaysia, Indonesia, Papua New Guinea, Philippines, Solomon Islands, Vanuatu, Palau
Widespread survey data: Australia

Summary of Status
Extirpated: Singapore
Severely depleted: India, Bangladesh, Burma, Sri Lanka, Thailand, Malaysia, Indonesia, Philippines, Solomon Islands, Palau
Depleted: Papua New Guinea, Australia, Vanuatu
Not Depleted:
Unknown: Cambodia, Vietnam, China, Brunei

Summary of Management Programs
No management plan: Cambodia, Vietnam, China, Brunei, Philippines, Palau, Vanuatu
Protection only: Bangladesh, Burma, Sri Lanka
Reintroduction/restocking: India
Cropping: Indonesia, Papua New Guinea, Solomon Islands
Ranching: Malaysia, Indonesia, Papua New Guinea, Australia
Farming: Thailand, Malaysia, Australia, Papua New Guinea, Singapore

Cuban crocodile (*Crocodylus rhombifer*)

Summary of Survey Data
No survey data:
Surveys not planned:

Surveys planned: Cuba
Basic survey data:
Widespread survey data:

Summary of Status
Extirpated: Cayman Islands
Severely depleted: Cuba
Depleted:
Not Depleted:
Unknown:

Summary of Management Programs
No management plan:
Protection only:
Reintroduction/restocking:
Cropping:
Ranching: Cuba
Farming: Cuba

Siamese crocodile (*Crocodylus siamensis*)

Summary of Survey Data
No survey data:
Surveys not planned: Thailand, Cambodia, Laos, Vietnam, Malaysia
Surveys planned: Indonesia
Basic survey data:
Widespread survey data:

Summary of Status
Extirpated:
Severely depleted: Thailand
Depleted:
Not Depleted:
Unknown: Cambodia, Laos, Vietnam, Indonesia, Malaysia

Summary of Management Programs
No management plan: Cambodia, Laos, Vietnam
Protection only: Malaysia, Indonesia
Reintroduction/restocking:
Cropping:
Ranching:
Farming: Thailand

Dwarf crocodile (*Osteolaemus tetraspis*)

Summary of Survey Data
No survey data:
Surveys not planned: Mali, Senegal, Guinea-Bissau, Guinea, Sierra Leon, Liberia, Burkina Faso, Ghana, Togo, Benin, Nigeria, Cameroon, Equitorial Guinea, Zaire, Angola
Surveys planned: Gambia
Basic survey data: Ivory Coast, Gabon, Central African Republic, Congo
Widespread survey data:

Summary of Status
Extirpated:
Severely depleted: Gambia
Depleted: Senegal, Ivory Coast, Gabon, Congo

Summary of Management Programs
No management plan: Guinea-Bissau
Protection only: Mali, Senegal, Gambia, Liberia, Ivory Coast, Burkina Faso, Ghana, Benin, Nigeria, Gabon, Congo, Central African Republic, Angola
Reintroduction/restocking:
Cropping: Togo
Ranching:
Farming:

Tomistoma (*Tomistoma schlegelii*)

Summary of Survey Data
No survey data:
Surveys not planned: Thailand
Surveys planned: Indonesia
Basic survey data: Malaysia
Widespread survey data:

Summary of Status
Extirpated:
Severely depleted: Thailand, Malaysia, Indonesia
Depleted:
Not Depleted:
Unknown:

Summary of Management Programs
No management plan:
Protection only: Thailand, Malaysia, Indonesia
Reintroduction/restocking:
Cropping:
Ranching:
Farming:

Gharial (*Gavialis gangeticus*)

Summary of Survey Data
No survey data:
Surveys not planned: Bhutan, Bangladesh, Burma
Surveys planned: Pakistan
Basic survey data: India
Widespread survey data: Nepal

Summary of Status
Extirpated: Bhutan, Burma
Severely depleted: Pakistan, India, Nepal, Bangladesh
Depleted:
Not Depleted:
Unknown:

Summary of Management Programs
No management plan:
Protection only: Bangladesh, Burma, Pakistan
Reintroduction/restocking: India, Nepal
Cropping:
Ranching:
Farming:

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