

Venezuela's Caiman Harvest Program

An Historical Perspective and
Analysis of its Conservation Benefits

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Overview

A spectacled caiman commercial management program was initiated in Venezuela beginning in 1983. The Venezuelan management program has been viewed as a model attempt to manage wildlife resources, with broad applicability to other Latin American countries that share the same, or similar species. From 1983 to 1995 over 1 million caiman were legally harvested. This document reviews the historical development of this program, provides an overview of how the harvest functions, and evaluates how the program has benefited caiman conservation in Venezuela.

Since its inception, the program has been based on the harvest of adult male caiman during the annual dry season. Salted skins are sold to tanners who export them in a semi-tanned (crust) state. While the program is founded on good biological information, it has suffered from a series of programmatic failures that have included establishing unsustainable harvest levels, inadequate implementation of control mechanisms to prevent illegal hunting and the sale of illegal skins, the failure to design a long-term strategy for population monitoring, and a lack of program transparency. The history of the program has been one of identifying, and correcting these problems. One of the principal factors contributing to the programmatic difficulties was the rapid, early growth of the harvest which outstripped the administrative and technical resources of the government agency (MARNR-PROFAUNA) that ran it. As a result of programmatic changes, there were modifications in regulations, including when documents could be submitted, the annual timetable of hunting, methods for marking skins and meat and how they were transported from the ranches, as well as fees charged and control measures taken to reduce illegal hunting and sale of skins. Among the control problems that need to be addressed to reduce illegal hunting, the most important is to require identifying tags remain on the skins from the point of harvest through tanning and exportation.

One of the most significant developments was the creation in 1989 of PROFAUNA, an autonomous branch of the Ministerio de Ambiente (MARNR) charged with the conservation and management of the country's wildlife and fish. PROFAUNA manages the caiman harvest, and since its inception, PROFAUNA's operations have been largely bankrolled by taxes and fees levied on participants in the caiman program.

Hunting was banned for two years (1986 and 1996) due to concerns about the effects of hunting on wild populations. A sharp decline in international demand for caiman skins 1991 resulted in a major adjustment in the size of the harvest. Following a series of regional surveys of caiman populations in 1991-1992, a sustainable level of harvesting was estimated to be 50,000-75,000 caiman annually over the entire area. However, as not all land is being harvested, the overall quota should be reduced by an amount proportional to the lands that are not participating in the program.

The program has changed from one where a small number of participants were given large hunting quotas, to one where a large number of participants are given relatively smaller quotas. Caiman hunting is a money-making activity for land owners, and provides significant income for skin tanners and buyers. The total export value of skins between 1983 and 1994 is estimated to be nearly \$US116 million. Nevertheless, the income from caiman harvesting is small compared to cattle ranching, the dominant

economic activity in the region. The harvest provides no economic incentive for habitat protection, but is very compatible with cattle ranching as habitat alterations that benefit cattle (creating artificial dry-season stock ponds) also benefit caiman.

Due to the large number of ranches and vast areas involved in the harvest, adequate censusing for setting hunting quotas and monitoring caiman populations has been especially problematic. Harvest quotas were initially based on surveys of private landholdings by government staff. When MARNR-PROFAUNA resources proved inadequate to survey all the ranches requesting hunting permits, trained professionals were certified to conduct censuses for landowners beginning in 1988. However, the low quality of the data from many of these technical reports submitted to the government led in 1993 to a quota-assigning system based on mean regional values of caiman density and population size-class structure. This system, while much simpler, removes some of the economic incentives for landowners to protect caiman populations on their property.

A number of specific recommendations are made for the Venezuelan program along with general guidelines for the development of similar programs in other countries.

RESUMEN

El programa de manejo comercial de la baba (*Caiman crocodilus*) de Venezuela se implementa a partir del año 1983, siendo visto como modelo tentativo para manejar la fauna silvestre y ser aplicado en otros países de Latinoamérica que presenten la misma especie o una semejante. Entre 1983 y 1995 se han cosechado legalmente un poco mas de 1 millón babas. El presente trabajo es una revisión del desarrollo histórico e intenta evaluar cómo la cosecha ha beneficiado la conservación de la especie en Venezuela.

Desde su inicio, el programa ha sido basado en la cosecha durante el verano de individuos machos adultos (clase IV) con una longitud total mayor de 1,80 m, obteniéndose pieles saladas para vender a teneros, quienes posteriormente las exportan en forma de costra o semicurtidas y la carne es salada y consumida en el país. El programa esta basado en una amplia información sobre la biología de la especie. Sin embargo, como un programa pionero, ha sufrido de una serie de fallas a nivel de implementación, involucrando el establecimiento de cuotas de cosecha no sostenible a su inicio, caza ilegal, falta de un programa de monitoreo, y carecía transparente en la operación del programa. La historia del programa ha sido un proceso de identificar y corregir dichas fallas. Muchos de los problemas vienen del hecho del programa al principio creció muy rápido y sobrepaso la capacidad del gobierno de manejarla adecuadamente. Como un resultado de cambios en el programa, hubo una serie de reformas a nivel de las regulaciones que permiten su implementación, en términos de cambios en los lapsos de recepción de documentos, período de la cosecha, marcaje de las pieles y carne, movilización de los productos, así como también de los impuestos y controles para evitar la cacería ilegal y la ventas de dichos productos. Sin embargo, todavía existen problemas a nivel de control, lo mas importante es la falta de un mecanismo que garantice que las marcas de identificación quedan puestas en las pieles desde su punto de origen hasta la exportación.

En el año de 1989 se crea el Servicio Autónomo de Fauna (PROFAUNA), adscrito al Ministerio del Ambiente y de los Recursos Naturales Renovables (MARNR), y entre sus funciones esta la protección, restauración, fomento y aprovechamiento de la fauna silvestre y acuática de país. PROFAUNA es la encargada de ejecutar e implementar el programa de aprovechamiento de la baba, y sus actividades (con babas y otras especies) han sido financiado principalmente a través de impuestos de los varios sectores que participan en el programa de baba.

El programa ha sufrido dos pausas, una en 1986 y la otra en 1996, que han permitido evaluar el impacto o los efectos de la cosecha en las poblaciones naturales. En el año de 1991, una disminución en demanda internacional para pieles de baba trajo como consecuencia un ajuste en la cosecha. Posteriormente, entre 1991 y 1992 se realizó un monitoreo de las poblaciones definiendo siete regiones ecológicas y estimando una cosecha nacional entre 50.000 y 75.000 de babas anuales en el área de implementación del programa. Sin embargo, como no todos los dueños de tierra solicitan permiso de aprovechamiento, la cuota anual debe ser menor. Otro de los cambios es que ahora se otorgan mas licencias de caza con cuotas de extracción pequeñas. El programa es una actividad lucrativa para propietarios de las fincas que aprovechan el recurso, proveyendo una renta significativa a los dueños de tierra, intermediarios y teneros. Los ingresos por exportación total de las pieles semicurtidas entre 1983 y 1994 es estimada en aproximadamente 116 millones de dólares norteamericanos. Sin embargo, la ganancia

producto de la cosecha de baba es pequeña comparada con lo que produce una finca ganadera, que es la actividad dominante en las fincas que aprovechan el recurso. La cosecha no provee incentivo económico para la protección del hábitat, pero es muy compatible con una finca ganadera que realiza modificaciones en el hábitat que benefician al ganado vacuno, tales como la construcción de préstamos que benefician indirectamente a la población de babas.

Debido a la gran extensión del área y alto número de hatos participando, censos poblacionales y el establecimiento de cuotas de cosechas han sido problemática. El monitoreo de las poblaciones ha cambiado en el tiempo; al inicio, se realizaban censos en las fincas que solicitaban una licencia de caza, al aumentar el número de las solicitudes y la imposibilidad del personal de PROFAUNA para monitorear toda el área, se entrenaron profesionales de libre ejercicio, quienes eran los encargados de realizar los estudios de abundancia de la población en aquellas que solicitaban aprovechar el recurso. Sin embargo, la calidad baja de los datos reportados trajo como consecuencia otro cambio en el sistema de asignación de cosechas y monitoreo. Sobre la base de estudios efectuados por PROFAUNA, hoy en día la asignación de la cosecha se realiza basado en los datos de abundancia y estructura de tamaños por región y tipo de finca. Este sistema podría afectar algunos de los incentivos económicos de los dueños de fincas para proteger las poblaciones de baba en su propiedad, ya que independientemente de la población que contengan, la cosecha se basa en valores regionales.

En base de las lecciones del programa venezolano, realizamos una serie de recomendaciones que pensamos que pueden ser útiles en el desarrollo e implementación de programas semejantes en otros países.

Introduction

The commercial use of wildlife has been conducted largely on a non-sustainable basis for the purpose of short-term economic gain. However, in recent years attempts have been made to harvest wildlife on a sustainable basis as part of species management programs, and the sustainable use (SU) of wildlife has been promoted as a tool for conservation based on the premise that economic incentives will bolster support for conservation efforts. The ideas surrounding the "use it or lose it" approach have reverberated throughout the field of wildlife conservation in recent years, generating considerable debate and much skepticism (Geist 1988, Noss 1991). Proponents argue that having wildlife pay for its own conservation is the most practical approach given the accelerating pressures on wildlife populations and the limited funds available for their conservation. Nevertheless, simply instilling wildlife populations with commercial value will not lead to their conservation unless certain conditions are met (Robinson 1993), overcoming the chronic shortsightedness that has characterized the human history of natural resource use (Caughley and Gunn 1995).

The successful development of SU harvest programs involves a delicate balance of many factors, biological, social and economic. Due to economic factors, commercial use programs have been limited largely to species with significant market value. However, high financial rewards can also promote illegal hunting and in some cases excessive commercial value can also be an impediment to sustainable use (Bolze 1992). At the same time biological factors play an important role in determining the rate at which a species can be sustainably harvested, with a direct correlation between a population's intrinsic rate of increase and the rate of potential harvest (Caughley 1977). The species with the greatest potential for commercial harvest are those with high rates of increase and substantial market value.

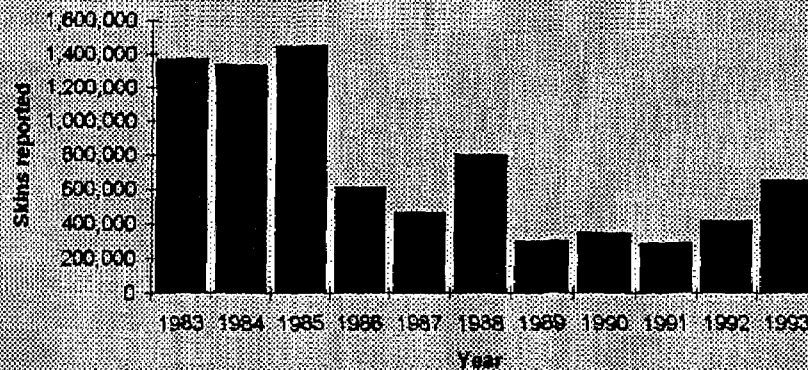
Crocodilians, with high reproductive rates and valuable skins qualify as animals for which SU management has considerable potential, and over the last 20 years the use of SU management programs for crocodilians has been widespread. Crocodilian skins are tanned and used for the production of luxury leather items that command a high price on the international market. Crocodilians are typically long-lived, fecund animals, and have proven to respond in a robust fashion to certain harvesting regimes (Woodward *et al.* 1992). Claims for the usefulness of SU as a wildlife management strategy have often used species such as the Nile crocodile and American alligator as examples (Messel 1991, Messel and Ross 1992).

Since the late 1960's, the great majority of crocodilian skins traded worldwide have come from South American caiman. Reported numbers of caiman skins in trade (derived from CITES reports, and so representing minimum values) since the 1980's has varied from just under 300,000/yr over 1.4 million/yr (Fig. 1)(IACS 1996). While past harvests have been largely unregulated, over the last 10 years sustained use management of two species of caiman (*Caiman crocodilus* and *C. yacare*) has been goal of several programs. The first of these SU programs was initiated by Venezuela in 1983, and as the first attempt to develop a managed commercial harvest for this species it has received a great deal of scrutiny both at the national and international level.

In its current form the program in Venezuela consists of three components, a commercial harvest of adults on private land in the central Llanos region of the country, a

small ranching (captive rearing of wild produced hatchlings) program, and a small harvest of adults on public lands in the delta of the Orinoco river. Here, we review the development of the Venezuelan Llanos caiman program, by far the largest and most important of these components.

Figure 1. Worldwide number of caiman skins reported in trade based on CITES statistics, 1983-91. Data from IACTS 1996.



History of crocodilian exploitation in Venezuela

Historically, crocodiles were killed by indigenous groups and early European settlers who feared them as a danger to people and their livestock (Gumilla 1741, Humboldt 1860, Paez 1868). Crocodiles or their by-products were frequently used for food and medicinal purposes. During the early dry season Indians would, and in some areas still do, excavate crocodile nests and eat the eggs. Eggs (and the crocodile penis) were widely sought as a cure for asthma. Crocodile fat was used to produce an oil used in lamps, to treat bruises or cutaneous diseases of horses, or as a cure for colds and respiratory problems. Crocodile teeth were often taken and worn in a necklace to protect the wearer from danger (especially snakes), or as a collar by teething babies to bring health throughout life. The meat was apparently never eaten much by settlers or Indians, who paradoxically would regularly eat *Caiman* and *Paleosuchus*. Crocodiles were also killed for "sport" by Europeans, and at times ranch owners would offer a bounty (Paez 1868).

According to T. Blohm (pers. comm.), the first commercial utilization of Orinoco crocodile skins began in the early 1800's, when they were sought to make industrial machine belts for certain heavy machinery in England. The first actual hide hunting for producing leather goods was started in 1894 by a North American company in El Yagual (Apure State) (Medem 1983, citing Verstraelen 1939). Crocodiles in the Apure and Arauca rivers were killed during daylight hours using firearms. However, this venture was apparently less than a commercial success and soon shut down. Andre (1900) reported that Orinoco crocodiles were killed at night in the Apure and Arauca rivers by plume hunters after egrets.

Beginning in the early 1930's, commercial exploitation of crocodile hides became a lucrative, widespread industry in the Llanos of Colombia and Venezuela. The principal rivers in Venezuela from whence crocodile skins were obtained were the Orinoco, Apure,

Arauca, Guarico, Portuguesa, Cunaviche, Capanaparo, Cinaruco and the Meta. The major centers for crocodile skin commerce in Venezuela were San Fernando, Caicara, and La Urbana. In these towns, buyers would purchase skins, then ship them downstream to Ciudad Bolivar (formerly Angostura) for export. The major importing countries were Germany, France, and the United States, with lesser numbers going to England, Italy, Holland and Japan. In addition to the crocodiles killed in Venezuela, crocodiles killed in the Colombian sections of the Arauca, Capanaparo and Cinaruco rivers were brought downstream and sold in Venezuela. Crocodile skins from the Rio Meta, Casanare, Vichada and Guayabero-Guaviare systems were sold in Villavicencio, Colombia (Medem 1983).

As crocodiles became scarce the commercial trade in Venezuela shifted to the smaller spectacled caiman. Hunting began in the 1950's but reached its peak in the 1960's. Between 1960 and 1971, official Venezuelan statistics indicate that a total of 311,400 caiman skins were exported from the country (Medem 1983). However, these figures represent a gross underestimation of the real number of caiman exported during this period. Seijas (1984) reviewed documents from the Ministerio de Agricultura y Cria and found that 206,165 skins were exported in 1968 and 139,629 in 1969. During the period 1965-69 Venezuelans involved in the crocodilian skin trade reported that 2.6 million caiman skins had left the country (Medem 1983). The owner of the largest tannery in Venezuela at the time (Bernardo Jomaron) indicated that during the 1960's his business alone had tanned more than 500,000 skins (Seijas 1984).

In 1972, the Venezuelan wildlife authority (then MAC- Ministerio de Agricultura y Cria) banned commercial hunting for a period of 5 years, a ban that was extended indefinitely in 1974 (Medem 1983). The final result was a ban for 10 years (1972-83). In some areas the hunting ban proves very effective (Gorzula 1978), but Medem (1983) reported illegal hunting with transshipment of skins across the border, especially into Colombia but also into the Netherland Antilles or even directly to Europe. Hemley and Caldwell (1986) noted that 74,477 caiman skins were in trade in 1979-80 with the reported origin of Venezuela. Medem (1983) also relates accounts of two shipments of caiman skins being confiscated at Venezuelan airports in 1978-79. Following the ban, King (1978) reported that hides were shipped to Leticia, Colombia, for sale. When Leticia lost its free port status, illegal Venezuelan hides were shipped to Asunción, Paraguay, and then to the United States and Europe.

However, despite the continued hunting, by the early 1980's the Venezuelan government reported that caiman populations in the central Llanos region of the country were quite large (>5 million; Mendez-Arocha and Medina 1982). Interest in commercial harvesting of caiman was fueled by the apparent success of crocodilian commercial use programs in other countries (USA, Papua New Guinea, Zimbabwe).

Venezuelan Caiman Management Programs

Since 1980, the Venezuelan government has initiated several programs to manage wild populations of caiman. The first, which began in 1983 was based on a harvest of adult caiman from several states in the central Venezuelan Llanos. This program is the one that is reviewed in this document. Nevertheless, the other programs are briefly

summarized here, along with a short overview of the basic structure of the Llanos program.

Ranching Program. Ranching is the collection of eggs or neonates from the wild and the subsequent captive rearing of juveniles for sale of their skins or other by-products. Due to the worldwide growth of ranching and captive breeding programs for crocodilians, including in neighboring Colombia, interest in a ranching program in Venezuela grew in the late 1980's. Egg collecting was first permitted in 1990 (Resolution 79). Permit requests to harvest eggs were to include a technical report with a census of the number of nests on the property to be harvested. Permits allowed the collection of up to 50% of the egg production. During the period 1991-1994 a total of 121 permits were authorized for the collection of 388,150 eggs and 10,487 neonates (Velasco *et al.* 1995; collecting neonates was prohibited after 1992). PROFAUNA reserved the right to release 2-10% of the animals hatched for release when they attained harvestable size (>60 cm TL), and many were released (ca. 40,000- M. Silva, Pers. comm.).

Interest in developing caiman ranches originated in the private sector. By 1991, there were 21 registered ranches with 13 in operation (Baquero de Pedret and Quero de Peña 1993). The first skin exports were in 1991, but poor growth of hatchlings and disappointing sales of skins led to exports as pets in 1992. By 1995, total exports from ranches was 13,949 crude skins, 10,497 tanned skins, and 69,600 pets (M. Silva, pers. comm.). However, meager sales of the small-sized skins, high prices of rearing, and disappointing growth rates and high mortality, most caiman ranches closed. By 1996 only 2 ranches remained in operation but high fees charged by PROFAUNA was making ranching unprofitable.

Other Harvest Programs. In 1991, the Venezuelan government became interested in initiating a caiman harvest in the Ciénega Juan Manuel de Aguas Blancas y Aguas Negras, in the northwestern state of Zulia (MARNR 1992b). However, subsequent surveys found the caiman population to be inadequate to support a harvest (E.J. Espinoza, pers. comm.).

In 1993 PROFAUNA began a small-scale harvest of adult caiman in the delta of the Orinoco River. Based on surveys conducted in 1992-3, a sustainable annual harvest of 12,500-25,000 adult male caiman was estimated (Velasco and Blanco 1996). The harvest program is very different from the one in the Llanos because of the absence of large tracts of privately owned land. The Orinoco Delta harvest is managed by PROFAUNA, who purchases skins directly from Warau Indians. Harvests totaled 274 in 1993, 911 in 1994, and 2,853 in 1995 (Velasco and Blanco 1996). PROFAUNA provides the Indians with hunting permits and free salt for the preparation of the skins. Warau are paid for the skins and are allowed to keep all the meat.

Overview of the Llanos Harvest Program. A description of the Llanos harvest program is the objective of this review; here we will provide a brief overview. Although the nature of the Venezuelan Llanos caiman harvest program has evolved considerably since its inception, the core organization has changed little. Harvests are restricted to private lands in several states in the central Llanos. Landowners apply to the Venezuelan management authority (now called PROFAUNA) for permits to harvest. A measure of the caiman

population size is used by PROFAUNA to 1) decide if harvesting is feasible, and if so to 2) determine the number of caiman to be taken. The manner in which the caiman population is surveyed and the quota determined has changed substantially during the life of the program. Only caiman ≥ 1.8 m total length (TL) can be legally hunted. Very few female caiman reach this size so the harvest is almost entirely adult males.

After the quota has been established by PROFAUNA, and permits issued, the landowners may begin to harvest. Hunting is restricted to a period of several months during the annual dry season, when caiman are easily located, prior to the initiation of the annual breeding season. Caiman are taken from streams, natural ponds or borrow pits where they concentrate during the dry season. In most areas, the caiman are captured at night with a harpoon, lassoed and pulled out of the water where they are killed, usually by clubbing. The following morning the caiman are skinned and the meat removed. During the skinning process virtually the entire skin is removed from the caiman, but only the lateral body scales (flanks), leg, and lateral tail sections are used. The rest of the skin is discarded. The skin is preserved by salting. The meat is taken off the carcass in one piece called a "salon", and, after washing is preserved by salting.

Prior to being transported off the property where they were hunted, caiman hides are marked with uniquely numbered plastic tags that remain attached until the skins reach the tanners. To prevent the sale or use of illegal caiman skins, the hides are checked by representatives of PROFAUNA and the National Guard. All skins are exported in a semi-tanned (crust) state.

Legal Basis of the Program

The Venezuelan program is based on a series of legal resolutions that have been published in the government's official gazette. As of 1995, a total of 28 resolutions had been published. Nine of these resolutions contained regulations for program operations while the remaining 19 dealt with temporary changes in the program timetable. The principal resolutions are summarized below:

The legal foundation of the caiman harvest program was first created through MARNR (Ministerio del Ambiente y de los Recursos Naturales Renovables) resolution DGSAA No. 445 of 14/12/82, establishing the following guidelines:

- Hunting permitted from 1 Jan to 30 April each year in the states of Apure, Barinas, Portuguesa, Cojedes and Bolivar.
- License granted based on population census and evaluation by MARNR personnel
- A harvest quota of 7-12% of the estimated population
- Defines terms of commerce of products
- Minimum caiman size limit of 1.8 m TL, but allows 10% to be 1.2-1.7 m TL error factor
- Tax of Bs 2 (\$US 0.47) per animal
- Requires use of tags on skins to be mobilized and humid seal on skins in tanneries
- Prohibits export of raw or semi-tanned skins

Following the experience of the first year of harvesting, the program was modified through another MARNR resolution: No. 122 of 21/12/84 which specified

- Bolivar State to be excluded from the program (although hunting did not take place in Bolivar in 1983)
- April eliminated as a month for hunting
- Requires a minimum population of 2,000 caiman as a condition for receiving a permit

- A maximum hunting quota of 7% of the estimated population
- No license to be granted if the estimated population is less than 93% of previous census
- No hunting with guns or within 150 m of public roads
- Requires that meat be tagged prior to transport from the ranch
- Increases tax to Bs 20 (SUS 3.59)/caiman on the permit
- Eliminates the tax for those who develop captive rearing centers for caiman

MARNR resolution No. 33 of 3/6/85 specified the need to transport all skins within 15 days of publication of a notification. Due to concerns arising over the effects of the large 1985 harvest, MARNR Resolution No. 61 of 23/10/85 suspended the program for one year, and required the evaluation of the exploitation program, including its effects on wild populations, the results of the commercialization of the skins, the social and economic benefits of the program.

Resolution 73 of 1987 provided further modifications in the program; particularly:

- No license granted if property has fewer than 2,000 caiman, or the population is <75% of the previous census
- At least 95% of hunted caiman must be ≥ 1.8 m total length (skin ≥ 90 cm long) and remainder must be ≥ 1.6 m TL (skin ≥ 80 cm long).
- Requires that after leaving the ranch, skins must be stored in a "centro de acopio" under the supervision of the MARNR where skins are inspected
- Skins tags cannot be removed in the tanneries until the skins have been inspected by MARNR

A major reorganization of the program took place in 1988 under MARNR resolution No. 60 of 12 September 1988. The resolution deals with aspects of land ownership, censusing techniques and control measures to combat illegal hunting:

- In permit application documents are required showing ownership of land for >20 years
- Training courses are established for accrediting individuals to census ranches and prepare technical reports to be submitted to MARNR
- Requires that each landowner hire accredited individuals to prepare a technical report on the caiman population and outline a 5 year management plan for the landholding.
- Defines criteria for the analysis of technical reports:
 1. The report must include a population size-class structure based on the census of at least 50% of the property's bodies of water
 2. Requires a map (scale 1:25,000) showing all bodies of water, and also indicates the property's boundaries
 3. A minimum of 15% of censused caiman must be size-class IV (>1.8 m TL).
 4. The censused population must be at least 75% of that of the previous year
 5. Counts are not to be done in navigable rivers or bodies of water <150 m from public roads
 6. If censuses reveal that >32% of the caiman are size-class IV, this figure is adjusted to 32%
 7. Requires that 90% of the meat of hunted caiman be kept on the ranch until inspection.
- Rescinds the requirement that skins be inspected in the tanneries prior to removing tags

As a further measure to evaluate the program, Decreto No 607 of 28 Nov. 1989 created a national committee (Comité Nacional Asesor del Programa Baba -CONABABA) to review and make recommendations on program.

In 1989, the wildlife management agency of the Environment Ministry was reorganized, creating the Servicio Autónomo para la Protección, Restauración, Fomento y Racional Aprovechamiento de la Fauna Silvestre y Acuática (PROFAUNA) (Presidential Decree 277). Under PROFAUNA, further modifications were made in the caiman harvest program with MARNR resolution No. 138 of 6 Dec. 1989. The biggest change was changing the program timetable and permitting census figures to be used for estimating the harvest during the following year:

- Established an agreement whereby land held by government under agrarian reform could be included in the caiman program
- Initiated additional control measures by requiring that all the skeletal remains of harvested caiman must remain within the boundaries of the property where they were hunted.
- Limits the harvest to a maximum of 5% of the censused population or 25% of size-class IV population.
- Altered the program timetable to use census data to set harvest quotas for the following year, and requested that landowners notify MARNR when harvesting begins
- Designates that a PROFAUNA representative will serve as coordinator of the Centro de Acopio
- Prohibits the removal of skin tags by tanners without the permission of MARNR, and take measures so that the tags do not come off during the tanning process

The most recent program changes have been:

Resolution 144 published on 9 January 1991.:

- Modifications of the harvest timetable
 1. Census Jan-May, prior to hunting
 2. Receipt of permit requests, technical reports and management plans by June of the year prior to harvesting
 3. Hunting occurs Jan-Mar
 4. Skins transported Jan-15 April
 5. Meat transported all year
- Conditions for landowners to receive a permit to transport his skins to the centro de acopio
- Prior to receiving a permits, landowners must publish, in a national newspaper, the name of the person requesting the permit, the name of the ranch and its boundaries.
- Regulations for individuals with land disputes

Resolution 139 of 13 Dec. 1991):

- Limits the harvest to a maximum of 5% of the total population
- Considers a property to be overexploited, and ineligible for a hunting permit, when the percentage of SC IV caiman is below 15%
- Removes Guárico state from the area where hunting is permitted.
- Reduces national harvest to a maximum of 30,000

Resolution 177-A of 1993:

- Landowners had to preserve only 70% of the meat from harvested caiman
- Harvest quotas based on results of regional surveys, dividing area into 6 ecological zones

Resolution 1 of 1994:

- The division of the llanos into 7 (previously 6) ecological regions which are: Alto Apure, Bajo Apure, Cajón del Arauca, Aguas Claras, Llanos Boscosos, Guárico, and Arismendi.
- Tanned skins must bear MARNR tags prior to being sold
- In addition to payments for each caiman authorized for hunting, landowners must pay PROFAUNA an amount based on the size of the property- funds to be used to establish a monitoring program.

Resolution 1 of 1997:

- Elimination of the requirement of 20 years of land-tenure for land owners
- Licenses not given to ranches in ecological sectors whose composition of SC IV caiman is less than 15%.
- Landowners must keep 50% of the meat of hunted caiman
- Landowners must keep 95% of the bones of hunted caiman in the area where the skins will be given their tags.

Program's Scientific Basis

Without doubt the spectacled caiman is one of the best studied members of the Venezuelan fauna. The ecology of the caiman has been particularly well studied in the Llanos region of Venezuela (Rivero-Blanco 1974; Staton and Dixon 1975, 1977; Marcellini 1979; Seijas and Ramos 1980; Ayarzagüena 1983; Thorbjarnarson, 1991a,b, 1993a,b, 1994, 1995). The spectacled caiman is a small to medium-sized species with a maximum reported length of 2.5 m (ca. 1.9 m in females) (Brazaitis 1973; Medem 1981; Thorbjarnarson, pers. obs.). Despite a relatively slow growth rate (Gorzula 1978; Ayarzagüena 1983), in the wild sexual maturity in females may be reached in as little as 4 years (ca. 60 cm snout-vent length-SVL). This is in contrast to the larger species of crocodilians that may require 10 years or more before attaining maturity. Smaller individuals consume small aquatic or terrestrial invertebrates (mostly insects), and larger caiman feed more on vertebrate prey (Staton and Dixon 1975; Ayarzagüena 1983; Thorbjarnarson 1993a). Nevertheless, two of the principal prey items of Llanos caiman over 40 cm SVL are freshwater snails (*Pomacea* sp.) and crabs (*Dilocarcinus dentatus*) (Ayarzagüena 1983; Thorbjarnarson 1993a).

In the Llanos, patterns of movement and habitat use by the caiman are closely tied to the annual flooding regime (Staton and Dixon 1977; Ayarzagüena 1983; Thorbjarnarson 1991b). Caiman disperse from dense dry season concentrations with the arrival of the first significant rains. Adult males establish territories in more deeply flooded "estero" habitats, and it is here that most courtship and mating takes place during the early wet season (Thorbjarnarson 1991b). Adult females begin nesting in late July, and the peak period of oviposition is in mid to late August (Staton and Dixon 1977, Ayarzagüena 1983). Nests are constructed from a mixture of live or dead vegetation scraped together with soil and shaped into a mound approximately 40 cm high and 110 cm in diameter. Nests are located in a variety of raised microhabitats to minimize the probability of flooding mortality. An average of 20-30 eggs are laid in a hole dug into the top of the nest mound, then covered up and left to incubate. The duration of incubation is temperature dependent and may last from 70 to 90 days. The females will generally remain in the vicinity of the nest, which they will open to free the young at the end of the incubation

period (October-November). The young caiman hatch towards the end of the wet season and, if they are to survive, must find permanent water habitats for the duration of the dry season. In this respect the female plays a crucial role and will lead the young, sometimes over several kilometers of open savanna, to permanent water sites. By December, the dry season concentrations of caiman re-form (Ayarzagüena 1983; Thorbjarnarson 1991). Although the female is aggressively protective of the young, first year mortality from predation, cannibalism and desiccation is extremely high (Staton and Dixon 1975; Ayarzagüena 1983, Escalona 1991). Mortality likely remains high for the first few years of life, then decreases in the subadult and adult age classes. Nevertheless, during the stressful dry season mortality of larger individuals may be significant.

Caiman are remarkably adaptable in terms of habitat requirements and have been reported from virtually every major class of low altitude wetlands in the Neotropics (Gorzula and Seijas 1989). Caiman are frequently found in man-made, or altered habitats such as reservoirs and borrow pits, and in certain locations breeding populations can even be found in urban environments. In the Venezuelan Llanos, caiman populations have greatly expanded over the last 50 years. Early explorers to the Llanos (Gumilla 1741; Humboldt 1860; Paez 1868) universally commented on the abundance of crocodiles and made only fleeting references to caiman. Prior to the beginning of this century, the majority of the permanent water habitats in the Llanos were rivers or large caños, both of which were the habitat of Orinoco crocodiles. With the virtual extirpation of crocodiles, the caños and rivers provided new dry season habitat for the caiman. Settlement of the Llanos was also accompanied by the construction of borrow pits along roads, and the use of windmills or damming of caños to provide dry season drinking water for cattle. The result of these activities was to greatly expand the amount of dry season wetland habitat in the Llanos, which has benefited the populations of caiman.

The Venezuelan management program targets adult males for harvest. The basis of the male-only harvest is two-fold: 1) a reproductive surplus of males due to a presumed polygynous mating system, and 2) larger males size and consequently a larger and more valuable flank hide. Surveys of caiman populations in the Llanos reveal that large adult caiman (over 90 cm SVL = size-class IV) normally comprise 10-30% of the total non-hatchling population (average value of 17.4%; Seijas 1984; range of 7.0-24.4%; Velasco and Ayarzagüena 1995; table 3). Caiman populations annually pass through a dry season bottleneck, during which time mortality rates peak and somatic growth slows or even stops (Staton and Dixon 1975; Thorbjarnarson 1991b). Large caiman assume dominant social positions in the dry season habitats, and presumably act as a density dependent check on population growth. This would occur through competition for limited resources (food, space), increased susceptibility to disease caused by high densities and stressful conditions, or via cannibalism of juvenile or subadult animals (Staton and Dixon 1975).

Area Included in Program

Geographic area

The Llanos is a large, low-lying savanna region that comprises much of the northern and eastern sections of the Orinoco river drainage basin in Venezuela and Colombia. Within Venezuela, some 252,530 km² of the states of Apure, Barinas, Portuguesa, Cojedes and Guarico form the heart of the Llanos habitat. The region is

characterized by a hyperseasonal climate with well defined wet (May-November) and dry (December-April) seasons. Total precipitation is only 1500-2000 mm annually, but the extreme seasonality, low-lying topography and relatively water-impermeable soil combine to cause widespread flooding from June to October. During the extended dry season, aquatic habitat is reduced to a few small lagoons, streams (caños) or rivers. In many parts of the Llanos the reduction in wetlands habitat during the dry season results in extremely dense concentrations of caiman. Reported dry season concentrations of 50-300 per hectare are not unusual (Staton and Dixon 1975; Marcellini 1979; Ayarzagüena 1983; Woodward and David 1985).

For purposes of monitoring populations of caimans, the central Llanos was classified into 6 ecological regions by Velasco and Ayarzagüena (1995). Classifications were based on the nature of the forest cover, soil characteristics, annual patterns of inundation, and nutrient levels. These regions were used to stratify characterizations of caiman populations based on the assumption of relatively homogeneous habitat (and, by inference, caiman density) within ecological regions. Subsequently, a total of 7 ecological regions were defined and used for analysis of caiman populations.

Land tenure

Since colonial times the grasslands of the Llanos have been cattle country. The principal economic activity of the Llanos in the area of the caiman harvest is cattle ranching on private land and these ranches have been the principal management unit for caiman harvesting throughout most of the history of the harvest program. Properties are classified into one of several types depending on size. While some Llanos ranches exceed 80,000 hectares in size, most are considerably smaller. Properties over 12,500 ha are usually referred to as "Hatos", "Fundos" are between 3,500 ha and 12,500 ha, while "Funditos" are less than 3,500 ha. Although most ranches have a long established tradition, in many cases the boundaries of properties are poorly defined and this has led to considerable problems for assigning hunting permits.

Venezuelan harvest program- mechanics of harvesting

Harvest Permitting Process

Landowners wishing to harvest caiman on their properties must request permits from the government's wildlife management authority (now PROFAUNA). Once received, permits are evaluated and authorized only in the event that all the legal documents were in order and that the request meets the technical guidelines for permitting a harvest. Both the legal and technical requirements for obtaining a permit have changed during the evolution of the program. When initially established (under resolution 445 of 1982) no legal or technical criteria were established. Guidelines were provided for the first time in resolution 123 of 1984.

Legal requirements for authorization. The initial guidelines for obtaining a caiman hunting permit required that a request be made to MARNR between 1 June and 30 October of the year prior to hunting. The request had to contain proof of ownership of the property, and a 1:25,000 map of the property indicating roads, bodies of water and the property boundaries. Because of irregularities including different parties claiming

ownership of the same parcels of land, more stringent requirements were subsequently established. In 1988 additional proof of land ownership was required, as well as a minimum of 20 years of prior land tenure, and in cases where several parties owned the same land the written authorization of all parties involved was required. As a result of chronic problems concerning the determination of land-tenure, in 1989 MARNR also required that parties requesting a license must publish their request in one of several newspapers, providing others that claim rights over the land to make a written petition to MARNR within 10 days of the publication of the announcement. In the cases where land ownership could not be resolved, permits were not issued.

In 1997 PROFAUNA first began applying the regulations of Decreto 3022 of 1993. This decree requires landowners who exploit natural resources to set aside a fraction of their land in the form of a reserve that must remain essentially unaltered. While the decree was first to be applied to ranches applying for logging permits from the Forestry Service (SEFORVEN), it was adapted to wildlife harvesting. The amount of land to be declared as a reserve ranged from 10-20% of the total landholding, depending on the size of the ranch. The degree to which this decree will be applied is not yet certain as many landowners indicated they would pull out of the program if it were enforced.

Technical requirements for authorization. Initially, the program had few technical requirements for participating in the harvest program. In 1984, permits were denied if the caiman population was estimated to be below 2,000, or if the population was less than 93% of the value for the previous census (implying that the population had declined). The rationale for the 93% figure appears to have been a concern that no more than 7% of the population be harvested in any one year.

In 1988, the value of 93% was replaced by a figure of 75%. Additional criteria included denying permits to properties where the caiman population contained less than 15% animals ≥ 90 cm SVL (size-class IV, or SC IV). This was also the first year requiring technical reports and management plans, and criteria for these were established. At the same time the permits requests had to be accompanied by a 5 year management plan, including information on:

1. research planned or undertaken to support the management plan
2. measures taken to promote the conservation of caiman populations and their habitat including preventing illegal hunting, the creation of new wetlands habitats, and increasing the availability of food for caiman.
3. prediction of future harvest trends
4. personnel that will participate in each aspect of the management plan, and
5. an economic analysis of the management plan.

Setting of harvest quotas.

Harvest quotas were based on information concerning the population of caiman on the property requesting a harvest permit. The census techniques have varied considerably and are summarized in the section on Population Censusing and Monitoring.

The percentage of caiman population harvested changed several times during the course of the program. Initial quotas were based on the estimated caiman population and a sliding scale of harvest rates (Table 1), which was a function of the size of the property.

Table 1. Sliding scale of harvest rates for caiman, 1983 and 1984 harvests.

Size of property (hectares)	Harvest rate
>40,000 ha	8%
30,000-39,000 ha	9%
20,000-29,000 ha	10%
10,000-19,000 ha	11%
5,000-9,000 ha	12%
1,400-4,900 ha	15%
<1,400 ha	50 caiman

During 1985 and 1987 the harvest rate was not to exceed 7% of the total non-hatchling population. In 1987, for the first time harvests were calculated not on the estimated total population, but on the number of size-class IV caiman, using a figure of 25% (FUNDAFAUNA 1989). De Sola and Quero de Peña (1991) note that at this time PROFAUNA would set a national quota for the number of skins to be produced, and would assign a harvest quota to each ranch depending on the number of size-class IV caiman censused. In no case was this to exceed 25% of the SC IV caiman (Quero de Peña 1993) or 7% of the total population.

Beginning in 1989, harvest quotas on ranches were based on the results of technical reports submitted to PROFAUNA. Reports contained information on the population size and size-class structure of the property, and were conducted by individuals who were trained, and certified by PROFAUNA (see Population Censusing and Monitoring). Technical reports were evaluated by PROFAUNA. Maximum allowable densities for properties were 1.0 caiman/ha for ranches less than 1,000 ha and 0.5 caiman/ha for those greater than 1,000 ha. The maximum allowable percentage of SC IV caiman was 32%. If technical reports contained values in excess of these figures they were reduced to the maximum allowable values. Harvest quotas were based on a maximum of 25% of the SC IV population for each ranch.

In 1992 the maximum allowable percentage of SC IV caiman was reduced to 23.3% and quotas were based on 15% of the estimated SC IV population for each ranch. In 1992, a ban on hunting was proposed by some elements within PROFAUNA, but this was not approved, and export quotas were reduced to an overall level of 30,000 in response to the drop in international demand for skins (Quero de Peña 1994). As the total harvest based on technical assessment of participating ranches would have been 48,000, the individual quotas were reduced to reach a total harvest of 30,000 (R. de Sola, pers. comm.). The national quota was increased to nearly 50,000 in 1995 before the 1996 ban on hunting.

As a result of the 1991-1992 caiman population evaluation, in 1993, PROFAUNA significantly changed the way hunting quotas were assigned. Although each ranch seeking a hunting permit was still required to submit a technical report, quotas were based to a large degree on the results of the regional census using the following procedure (De Sola and Velasco 1995, Velasco and De Sola 1997):

1. Each property seeking a permit was placed within its corresponding ecological region (the census defined a total of 7)
2. The information in the technical report was analyzed

3. The technical report information was compared to that of the regional survey for that ecological region, and if necessary, adjusted downward to the mean density and the percent of size-class IV caiman in that particular ecological region (Table 2). Values for ranches <3,500 ha in size were taken directly from the technical report without modification.
4. Harvest quotas were assigned on the basis of 20% of the SC IV population.

Table 2. Values of caiman density and percentage of size-class IV individuals by ecological region. Values determined by MARNR-CITES survey 1991-2 and used for determination of harvest quotas since 1993. (From Velasco and Ayarzagüena 1995, Velasco and De Sola 1997). Large ranches were >12,500 ha, small ranches 3,500-12,500 ha.

Region	Density (ha ⁻¹)		% SC IV
	Large Ranches	Small Ranches	
Alto Apure	0.22	0.66	24.0
Bajo Apure	0.39	0.58	23.3
Cajón de Arauca	0.19	0.66	24.4
Aguas Claras	0.10	0.42	20.0
Llanos Boscosos	0.15	0.40	18.0
Arismendi	0.35	0.55	23.0

It is important to note that under these guidelines quotas are established largely based on the size of the property, and the mean values for caiman population density and population structure for the ecological region where the property is located. In many cases the density of caiman on small properties was considerably greater than on the large Hatos (due to a tendency to have a greater percentage of wetland habitat). In 1994, this was compensated for by using higher mean values of caiman density for Fundos (1,000-12,500 ha in size; density=0.5/ha) and small Fundos (<1,000 ha; density=1.0/ha). Under these conditions it was felt that the overall harvest rate would not exceed 5% of the non-hatchling caiman population, which was considered to be the recruitment rate and annual rate of increase of the populations (Velasco and Ayarzagüena 1995).

In 1995, the requirement of the technical report was completely eliminated and harvest quotas were based entirely on the size of the ranch and the mean values of density and population size-class structure for each ecological region. Harvests were calculated based on 20% of the SC IV population.

Establishing harvest quotas: The current system. To illustrate how harvest quotas are presently established, we present a detailed analysis of the 1997 season (Table 3). After property owners in the seven ecological regions apply for harvest permits, quotas are established based on three factors: 1) the average density of caiman in that ecological region, 2) the average percentage of SC IV caiman in that ecological region, and 3) the size of the ranch.

Table 3. Summary of 1997 harvest quotas assigned to ranches, by ecological region and ranch size-category.

Region	Type of Property	Number	Area (ha.)	Harvest Quota
Alto Apure	Large Hatos	9	446,786	4,718
	Hatos	22	398,184	4,205
	Fundos	61	353,144	8,473
	Funditos	108	229,417	5,522
	Small Funditos	29	20,531	983
Bajo Apure	Large Hatos	2	70,795	1,287
	Hatos	4	58,817	1,068
	Fundos	15	110,566	2,578
	Funditos	19	43,122	1,003
	Small Funditos	5	2,523	116
Cajón de Arauca	Large Hatos	2	73,296	679
	Hatos	1	12,615	117
	Fundos	5	36,243	885
	Funditos	6	21,498	524
	Small Funditos	1	1,000	49
Aguas Claras	Large Hatos	7	404,809	1,618
	Hatos	4	63,022	252
	Fundos	24	183,479	3,671
	Funditos	18	42,492	851
	Small Funditos	1	1,000	40
Llanos Boscosos	Large Hatos	10	432,342	2,334
	Hatos	9	150,832	814
	Fundos	51	335,133	6,033
	Funditos	31	66,670	1,202
	Small Funditos	9	7,567	274
Hoya de Arismendi	Large Hatos	2	182,194	857
	Hatos	2	41,065	193
	Fundos	31	214,877	3,610
	Funditos	73	134,351	2,257
	Small Funditos	31	25,161	849
Guárico	Large Hatos	6	682,723	3,372
	Hatos	1	17,000	84
	Fundos	12	91,617	2,263
	Funditos	19	42,318	1,045
	Small Funditos	10	7,998	394
Total		640	5,005,187	64,220

In 1997, harvest quotas for large ranches (Large Hatos, Hatos) had a mean harvest density of 0.0081 caiman/ha over all ecological regions. The corresponding figure for medium-size properties (Fundos, Funditos) was 0.0216 caiman harvested/ha, and for small properties (Small Funditos) was 0.0432 caiman harvested/ha. Overall, quotas on medium-

size properties are 2.65 times greater than on large ranches, and small ranches have quotas 5.3 times greater than large properties.

To understand the significance of including ranch size as a variable for establishing hunting quotas, we must look at the total amount of land in each of the various property-size categories. For the 1997 season, the total area of Large Hatos, Hatos, Fundos, Funditos, and Small Funditos is shown in table 4. After Large Hatos, the Fundos comprise the largest total area of properties in the program. Altogether, medium- and small-sized ranches comprise 39.37% of the total area under harvest in 1997. Because of the higher values of caiman densities used for calculating hunting quotas on these ranches, the overall harvest rate is raised significantly. If all calculations were done using the mean values of caiman density for each ecological region (i.e., the values used for Large Hatos and Hatos), the overall hunting quota would be much smaller. Using the higher harvest quota rates for the medium and small ranches had the effect of increasing the total harvest (in 1997) by 1.68 times. The end result is that in the areas being hunted, harvest quotas will exceed the target values of 5% of the total non-hatchling population, or 20% of the SC IV population.

Table 4. The number, mean size, total area and percent total area for each of the six major property size categories.

Category	Number	Mean Size (ha)	Total Area	Percent Total
Large Hatos	38	53,455	2,292,945	45.81
Hatos	43	16,495	741,535	14.82
Fundos	199	7,027	1,325,059	26.47
Funditos	274	2,365	579,868	11.59
Small Funditos	86	809	65,780	1.31
Total	640		5,005,187	

Other factors. Aside from the technical criteria, other factors including the economics of the skin trade and critiques of the program have been important in establishing hunting quotas. After the large 1985 harvest quota the program received a great deal of criticism. The CITES Secretariat, which has played an important mediating role in the development of crocodilian SU programs worldwide, consulted with the Venezuelan management authority and recommended that future harvests be kept under a cap of 150,000 (F.W. King, pers. comm.). The result was a period of high, but relatively stable harvests during the late 1980's and early 1990's. At the same time the CITES Secretariat assisted (by providing funding and guidelines) the Venezuelan government in establishing a monitoring program to assess the impact of the harvest on the population.

The reduction in the number of skins exported in the early 1990's was principally a result of a sharp drop in international demand. Also, following the decline in caiman skin prices in the early 1990's, the Venezuelan government established a self-imposed limit on the number of caiman to be harvested (30,000) which was observed for 3 years. Although censuses of caiman populations on ranches continued, hunting permits were reduced to keep within this limit. Finally, one of the major factors involved in the decision to not harvest in 1996 was the fact that skins had been stockpiled in Venezuela due to poor sales.

In 1995, a total of 110,000 crust-tanned skins were in the country, as well as the nearly 50,000 additional skins harvested that year.

Harvest Timetable

Under resolution 60 of 1988, the program timetable was: 1) reception of hunting permit request- 1 June-31 October; 2) reception of technical report and landowner's management plan- prior to 28 February; 3) issuance of hunting permits- to 15 March; 4) hunting- to 30 April; 5) transport of skins- to 15 May. However, this necessitated that all census work, quota determination, harvesting and transport of skins all be done within a short period of a few months (Robert 1990). As a result, censuses were done at the beginning of the dry season (January-February) when environmental conditions are not as favorable (too much water), and hunting was hurried in order to meet program deadlines. The timetable did not allow adequate time for the preparation of technical reports or landowners management plans. Due to the large number of technical reports to be analyzed, it was not uncommon for MARNR to issue hunting licenses well after the 15 March deadline. Because the price of caiman meat drops quickly after the Easter holy week (when caiman meat is traditionally consumed in Venezuela) a financial consequence of late hunting is reduced income from the sale of meat.

As a result of the criticisms concerning the program timetable, changes were made in resolution 138 of 1989 which required: 1) MARNR receive permit requests by 31 January of the year before hunting is to occur, 2) population estimates to be conducted during March and April, 3) technical reports and landowners management plans received in May and June of the year prior to hunting, 4) issuance of hunting permits until 15 December, 5) hunting during the months of January-February, 6) transport of skins in February-March, and 7) transport of meat throughout the entire year. This was altered slightly in following years; the current timetable allows censusing from January-May, permit requests received by 1 June for ranches participating in the program for the first time, hunting is allowed during January, February and March, five days after finishing hunting a transport permit can requested for skins (Jan-Mar), which cannot be transported after 30 April.

Size Limits and Skin Grading

Due to the bony osteoderms in the belly scutes of caiman, only the soft skin of the flanks is used commercially. The skins from both flanks, the ventral surface of the throat, the region around the cloaca, and from along the front and hind limbs is cut in one piece called the *chaleco*. The minimum length of the *chaleco* (from the tip of the throat section to the posterior edge of the cloaca) was set at 0.9 m, roughly equivalent to an animal 1.8 m total length (TL). Under the terms of the 1982 regulations, the minimum size of caiman hunted is 1.8 m TL. However, in a provision for allowing an error factor for taking slightly smaller animals, up to 10% of the quota total could be comprised of caiman between 1.2 and 1.7 m TL. In 1988 (Res. 60) this was changed slightly by requiring that 95% of the *chalecos* be over 90 cm in length.

Skins are graded entirely by their size. This is in contrast to virtually every other commercial use program where grading is done based on the quality of the hide (e.g., state of preservation, absence of cuts and holes, etc....; King and Wilson 1989). The

Venezuelan size categories are: super or extra (≥ 140 cm), first ($140 >$ and ≤ 130 cm), second ($130 >$ and ≤ 120 cm), third ($120 >$ and ≤ 110 cm), fourth ($110 >$ and ≤ 100 cm) and fifth (< 100 cm).

Harvesting techniques and the preparation of skins and meat

In most ranches teams of hunters are contracted to fill the quotas assigned by MARNR. Caiman are hunted using the traditional technique of harpooning. Under some circumstances animals can be captured during the day, however most hunting takes place at night using flashlights to locate caiman (by their reflected eyeshine) and approach them on foot or from a boat. Rivero-Blanco (1985) reported several variations on standard harpooning including lassoing animals prior to using the harpoon, herding animals together by beating the water with wooden poles, and using harpoon tips to locate animals in the mud. After being pulled to shore caiman are usually killed by clubbing. The use of firearms for hunting caiman has been prohibited since the initiation of the program.

After a night of hunting the team processes the caiman the following day. A machete or knife is used to cut the skin and remove the chaleco in one piece. The meat from the tail, legs, back and sides of the caiman is also removed in one piece called a salon. Rivero-Blanco (1985) notes that on some ranches the initial cuts were made using a powered chainsaw. Shortly after being removed from the carcass both the skin and meat are salted and usually left covered in a shaded area. Conditions for the preservation of both skin and meat in the field are generally poor. Early in the program this was reflected in the large number of skins damaged by "red heat" a *Halobacterium* infection that results from poor salting and preservation of raw skins (David 1987). Poor preservation of the meat limits its commercial potential. Most meat is sold locally or to markets in the industrialized north of the country for consumption during the Easter Holy Week. At this time the Roman Catholic church forbids the consumption of meat, but caiman is classified as a fish by the church and caiman meat is traditionally consumed at this time. Following Easter the price of caiman meat drops substantially.

The sale of vacuum-packed frozen meat was initiated in 1991 by the tannery Crocoven in the town of Arismendi (Barinas State). Annually approximately 25 tons of frozen meat are exported to the United States.

After the harvest the landowner requests a permit to transport the skins. At this time the skins and meat are inspected to verify the number and sizes of caiman harvested (see section on Control). Skins and meat are tagged by MARNR personnel prior to being transported to a warehouse (Centro de Acopio) for storage and subsequently sold to a tanner.

As the price of skins increased during the 1980's competition among tanners for skins was intense. To attract and hold landowners as customers, Espinoza (1994) reported that tanners began to assume responsibility for many of the routine tasks that landowners needed to complete in order to get a license. Some tanners hired personnel to recruit landowners and offer them deals for purchasing skins, some also assisted in hiring teams of caiman hunters and/or transporting skins. Today, these intermediaries continue to handle most of the business associated with obtaining licenses, harvesting and transport of the skins. After the requirement of technical reports was introduced by MARNR, tanners hired biologists and formed companies to conduct censuses and write the technical

reports. However, the requirement of technical reports also meant that tanners had to be more careful in choosing their clients as properties now had to have suitable caiman habitat (Espinoza 1994).

Tanning and export

Under Venezuelan law, skins cannot be exported in a raw, or untanned state. After the tanners take possession of the salted skins in the Centro de Acopio, they are transported, under permit, to a tannery for processing. In the tanneries the skins are subjected to a complex procedure that converts the skin proteins susceptible to rotting into leather, a product that is soft and flexible and does not rot when rewetted (Fuchs *et al.* 1989). Tanning of reptile skins is a complicated, delicate process, and prior to 1990, Venezuelan tanners only tanned skins through the crust stage, that is skins that are tanned but not dyed or polished (King and Brazaitis 1971). At this time 5 tanneries were operating in Venezuela (Ipaca, Crocoven, Tenerco, Delta, and Dos Leones). In 1989 a wealthy entrepreneur entered the tanning business in Venezuela, opening a new tannery in 1990 (Teveex, operated by the company Inversiones Bactra) with the capability of finish tanning caiman skins. While some interest was demonstrated in producing manufactured products made of caiman skins, and the use of other caiman by-products (bones, fat, musk) (MARNR/FUNDAFAUNA 1989) this has not yet been realized.

Under resolution 30 of 1988 it was required that all crust tanned skins be marked with a seal of MARNR. Under the latest regulations skins must be tagged in compliance with the CITES Universal Tagging resolution.

Importing countries

Espinoza (1994) cited figures from OCEI (Oficina Central de Estadística e Informática) showing that over the period 1984-91 the majority of Venezuelan skins were exported to Europe (67%, principally Italy, Table 5), followed by Asia (17%) and the United States (17%)(figures based on weight of skins).

Table 5. Principal importing countries of Venezuelan caiman skins, 1984-1991, by weight

Country	Percentage of Skins
Italy	40
Japan	17
USA	17
France	14
Switzerland	9
Others	3

Control Measures and Illegal Trade

Control measures focus on a variety of levels within the program. First, ranches are inspected to count and tag skins and, starting in 1984, meat. Storing skins and meat in a centralized warehouse (Centro de Acopio) prior to sale is another control measure. Skins transported to and from the Centro de Acopio are accompanied by permits which

are checked at road check stations (alcabalas) maintained by the National Guard. Finally, control measures are conducted through occasional inspections of tanneries and remarking of skins prior to export.

Inspections of ranches

Control at the level of the producer is carried out by inspecting ranches once the caiman had been hunted, and marking skins and meat prior to transport to the Centro de Acopio. During the first years of the program inspections were made by MARNR or the Venezuelan National Guard. This was later changed to joint inspections by the National Guard and MARNR representatives to reduce the likelihood of bribing single inspectors.

Initially, inspections were made to count and mark skins using individually numbered plastic tags provided by MARNR to the inspection team at the Centro de Acopio. Under resolution 60 of 1988 inspections were also to verify that skins met the minimum size requirements. However, during the first years of the program concerns were expressed that inadequate censusing and control measures were being implemented (CSG 1986). Few personnel were available to inspect the large number of ranches in the program, particularly in the late 1980's and early 1990's when >500 ranches participated. Matheus (1990) reported that at that time the National Guard had only 8 officials and 90 soldiers to cover area of over 2 million hectares.

Presently, ranch owners are required to keep 50% of the meat, and 95% of the bones and skin remains at the site where the skins are tagged prior to being moved to the Centro de Acopio. This measure is designed to insure that that caiman skins being tagged were hunted on the ranch in question.

Use of Centros de Acopio

Based on the recommendations of a programmatic review conducted in 1987 (MARNR 1987), the use of Centros de Acopio (a centralized warehouse to temporarily store all skins prior to being delivered to tanners), was implemented in 1988. Once skins and meat were tagged they were transported to a Centro de Acopio (CA) for storage. To receive a transport permit for skins to the CA, the owner or legal representative of the ranch must present a written request, his identity card as well as the original and a copy of the hunting permit. The transportation permits indicate the number of skins to be moved, as well as the numbers of the plastic tags fixed to each hide. For most of the program two CA were used, in San Fernando de Apure and a smaller one in Arismendi (Barinas state). All the skins were held in the CA until after the close of the official date for transporting skins to the CA, at which time the tanners were allowed to take possession.

Operations at the CA were run jointly by the National Guard and MARNR. Prior to 1989 a criticisms of the operation was a lack of clearly defined authority between MARNR and the National Guard. This was resolved in 1989 under resolution 138 where a representative of PROFAUNA was declared to be the CA coordinator.

Control Problems.

The initiation of the harvest management program led to a considerable increase in illegal hunting. Gorzula (1989) estimated that 30-90% of the skins in the program were illegal. Espinoza (1994) commented that "illegal hunting occurs year round without any

consideration for the size or length of the animals". Reports also indicate that caiman were being hunted in Venezuela to supply skins in Colombia (El Universal; 16 July 1991). The relative lack of control during the early years of the program was due in large degree to the lack of personnel and adequate mechanisms to assure that hunting was being done on authorized ranches (Colomine 1991), lax controls in the tanneries (Fergusson 1991), and the absence of penal sanctions for infractions (Robert 1990). Illegal activities included killing caiman out of season or on unauthorized properties, and the buying and selling of permits. Other problems were the same land being claimed by more than one ranch, the failure to remove infringing ranches from the program in subsequent years, and the lack of adequate monitoring at tanneries. The difficulties peaked in 1985 when an exceptionally large quota was established, and reports indicated that even more tags were issued than were authorized under the quota (Anonymous 1986).

The most widely reported problem was that of the "pata quebradas", or caiman hunted outside of legally authorized ranches and outside of the normal hunting season (Matheus 1990, Medina 1990, Colomine 1991), and then sold to landowners possessing hunting permits. In some cases, after re-inspection it was apparent that ranches did not support caiman populations that were in the application for permits, to the point of even inventing imaginary water bodies which were reported to hold large caiman populations. While the hunting of caiman as "pata quebradas" is clearly illegal, on a regional level this type of illegal hunting may not significantly increase the number of caiman killed, simply the area from which they are harvested. In fact, Velasco and Ayarzagüena (1995) stated that the trade in "pata quebrada" skins was unimportant for the program from a regional standpoint. Nevertheless, illegal hunting has most likely resulted in the tendency to overexploit certain areas.

The government undertook a number of measures to combat illegal hunting. Improvements were made in how ranches were censused (see Population Censuses and Monitoring). In 1989 and 1990 specific skinning requirements ("contraseñas"; to prevent skins being stockpiled prior to the hunting season being sold) were issued just before the start of the legal hunting period; these measures continued through 1994 when they were eliminated. Also, PROFAUNA began requiring that 90% of the meat (in 1988) and the all of the bones and excess skin (in 1989) of harvested caiman remain on the ranch for inspection. As caiman skins are much easier to illegally transport than entire caiman, the meat/bone requirements made it more difficult for landowners to purchase skins hunted outside their ranches. One of the functions of the government inspection of ranches then became to verify the presence of meat (which was tagged) and bones. However, by 1989 the 90% requirement for meat was deemed excessive and the figure was dropped to 70%, then again to 50% in 1997. These reductions were a recognition of the fact that both hunters and landowners used caiman meat for their own consumption during the harvesting period.

Inspection of ranches were made by joint commissions of the National Guard and PROFAUNA staff, reducing the likelihood of bribing inspectors. These procedures appear to have had an effect on reducing the sale of illegal skins: in 1989, 27,476 skins of doubtful origin were confiscated by the Venezuelan National Guard (Matheus 1990).

During the inspection of ranches after the caiman quota had been met, skins were individually marked using numbered plastic tags. Tagging each skin with a unique number

provides a powerful technique for controlling the traffic of skins. However, under current regulations a major loophole exists. Tags are required to remain on skins only until they reach the tanneries, where they can be removed. Tanners claim that the tags pull out, or damage skins during the tanning process, so tags are removed and skins are re-tagged after tanning and prior to export. Although PROFAUNA makes inspections of tanneries, the removal or loss of tags creates a potential mechanism whereby illegal skins (larger or in better condition) could replace legally tagged skins, and greatly complicates control efforts by PROFAUNA.

Few controls exist over the export of skin scraps ("retasos"). The combination of allowing tags to be removed from skins, and lack of mechanisms to regulate trade in skin scraps opens a large loophole in the control procedure whereby small legal skins can be cut into pieces and exported as scraps. The tags to be used for these smaller skins could then be applied to larger, illegal hides.

Contrary to the hunting of "pata quebrada" caiman, the replacement of legal, tagged skins with illegal skins at this level could result in a significant increase in the number of caiman killed above that established by MARNR. The number of skins "replaced" by larger ones in tanneries can be roughly estimated by looking at the number of small legal skins that enter the Centros de Acopio. According to the few published data, approximately 5% of the skins are less than 110 cm (this also compares well with unpublished PROFAUNA data for the last 6 years). Using a value of 5% of the annual harvest, the number of illegally replaced skins since 1988 is approximately 31,600 (total harvest of 632,339). However, this assumes that only small skins are being cut up and sold as retasos. If mid-size skins are also treated this way the number of illegal skins, and the increase in the number of caiman killed, would be significantly larger.

Size of the Harvest

Number of requests and permits

The harvest began in 1983 as a relatively small, experimental program. Few landowners applied for permits (Fig. 2). A large increase in the number of requests resulted in correspondingly larger numbers of ranches obtaining hunting permits. From the initial figure of 50 hunting permits in 1983 the program peaked in 1989 when a total of 560 permits were issued. However, the number of requests for permits did not peak until two years later when 1006 landowners sought permission to hunt.

In the first year of the program a record 89% of the permit requests were granted. Subsequently the fraction of requests granted fell but has shown a tendency to increase (Fig. 3). Since 1992, 76-85% of the requests have been granted by PROFAUNA. Most of the denied requests were simply a result of not submitting all the documents or information requested (Table 6), while an additional 11% were turned down for technical reasons.

Figure 2. The number of hunting permits requested by landowners and the number authorized by MARNR.

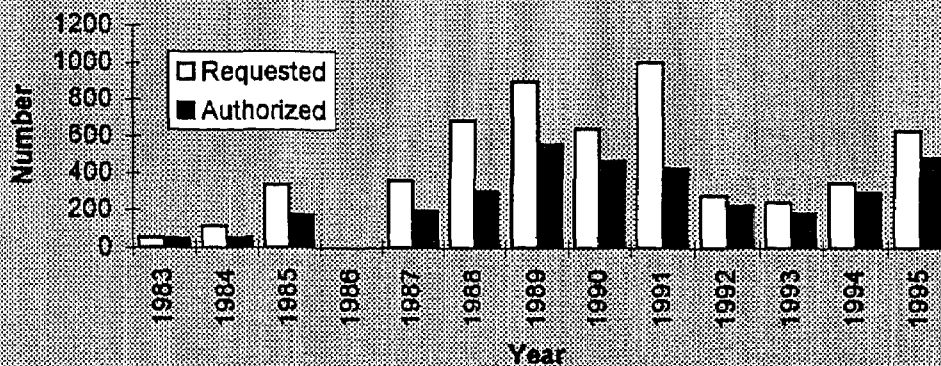


Figure 3. Percentage of permit requests that were approved by MARNR. This figure does not include the first year (1983) when 89% of the requests were granted.

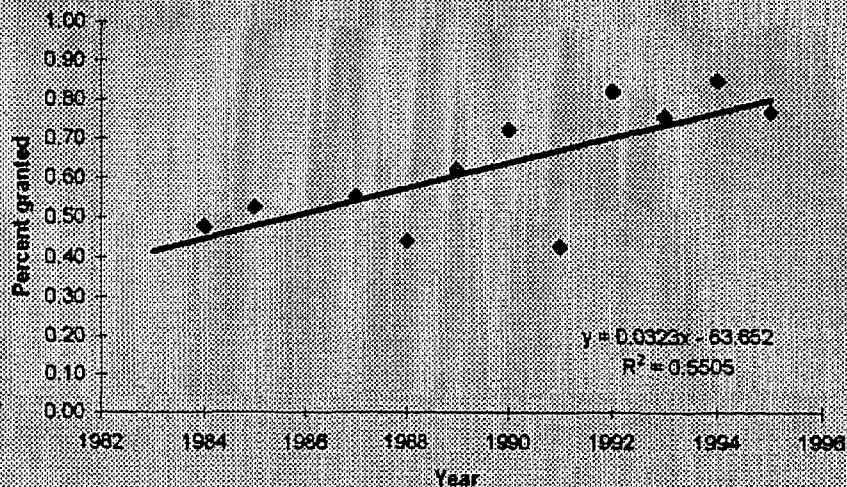


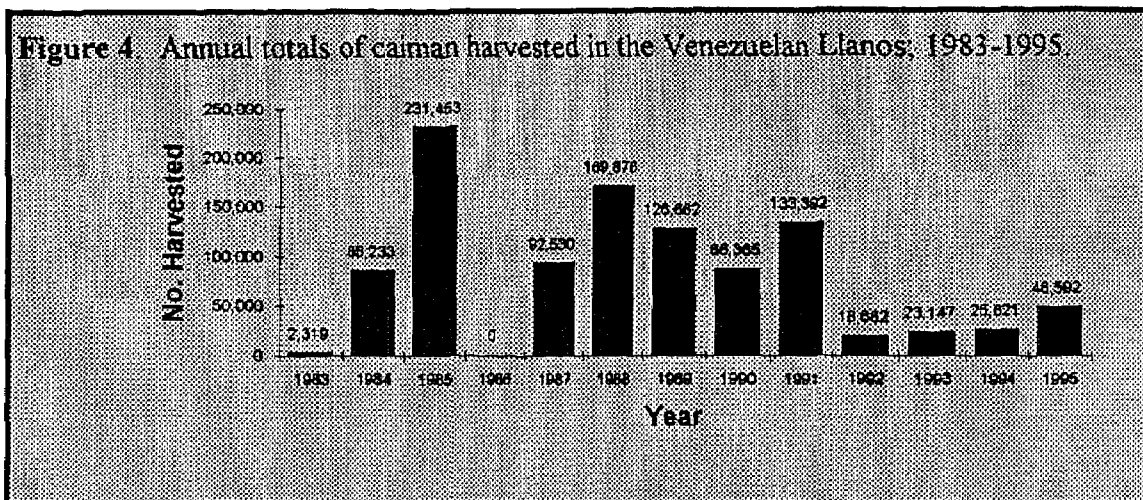
Table 6. Outcome of 1,051 requests made for caiman hunting permits in 1988. Data from Useche (1990).

	Number	Percent
Total requests	1,051	
Missing documentation	136	12.9%
Missing technical report	216	20.6%
Permit denied:		
Legal issues	59	5.6%
Technical issues	58	5.5%
Permits < 30 caiman	18	1.7%
Permits not picked up	7	0.7%
Permits issued	557	53.0%

Numbers of Caiman Harvested

The numbers of caiman harvested on an annual basis increased from a small initial harvest of 2,515 to a record take of 234,455 by 1985 (Fig. 4). Following a one year ban on hunting the program entered a period of moderately stable harvest totals (85,000-165,000) between 1987 and 1991. After a drop in skin prices the harvest was reduced greatly in 1992, but harvest size has subsequently slowly increased. Another ban on hunting was authorized in 1996 (see Population Censusing and Monitoring). The total number of caiman legally harvested from 1983-1995 is 1,043,874.

Figure 4. Annual totals of caiman harvested in the Venezuelan Llanos, 1983-1995.



Harvest quotas were established based on information concerning the status of the caiman population on each ranch seeking hunting permits. Larger ranches with more aquatic habitat tended to have larger caiman populations and receive larger harvest quotas. For example, in 1987, the authorized number of caiman to be hunted increased with the estimated population size of the ranch (Fig. 5). However, most ranches received (in 1987) relatively small quotas (Fig. 6). As the number of ranches requested permits has increased, and the size of the harvest quota has tended to decrease, the average number of caiman harvested per permit authorized has decreased (Fig. 7; excludes 1983 when a small number of caiman were authorized per license).

Figure 5. Estimated population size of caiman on ranches as a function of the size of the assigned harvest quota for the year 1987, Apure and Barinas states (MARNR 1987).

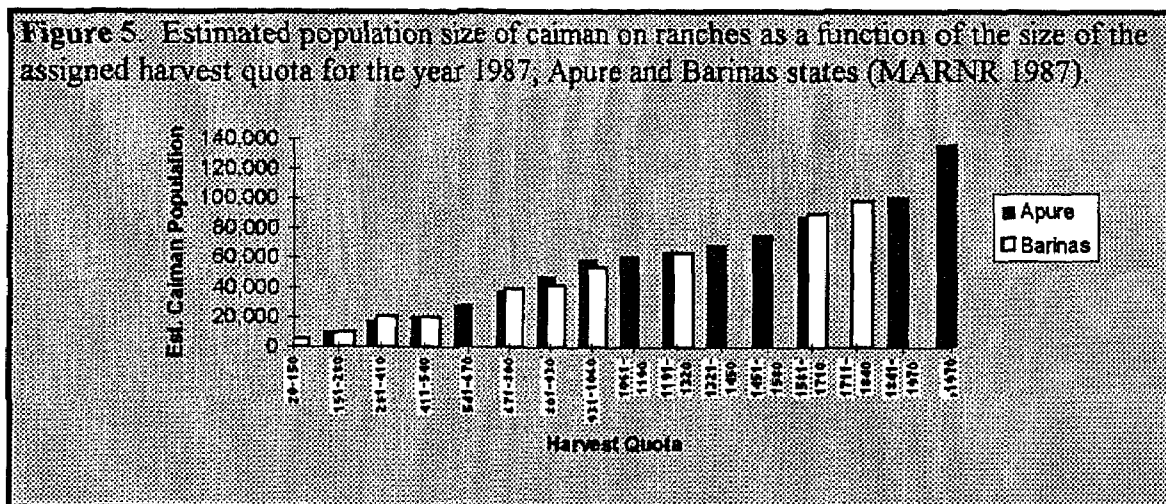


Figure 6. Number of ranches receiving quotas of caiman harvest by size of quota. Data for 1987 in Apure and Barinas states (MARNR 1987)

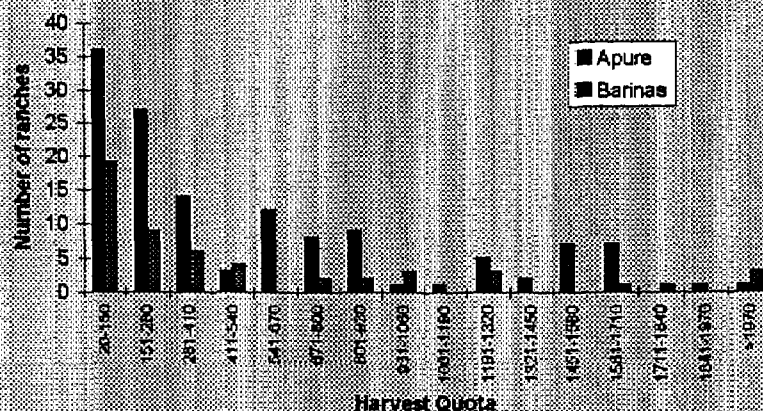
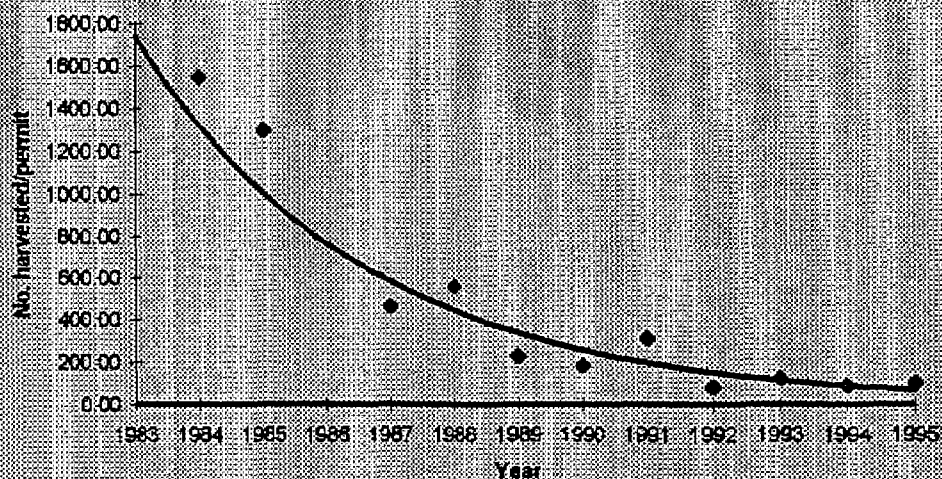


Figure 7. Mean number of caiman harvested per hunting permit. The data exclude the figure for 1983 when an average of 46.4 caiman were taken for each permit.



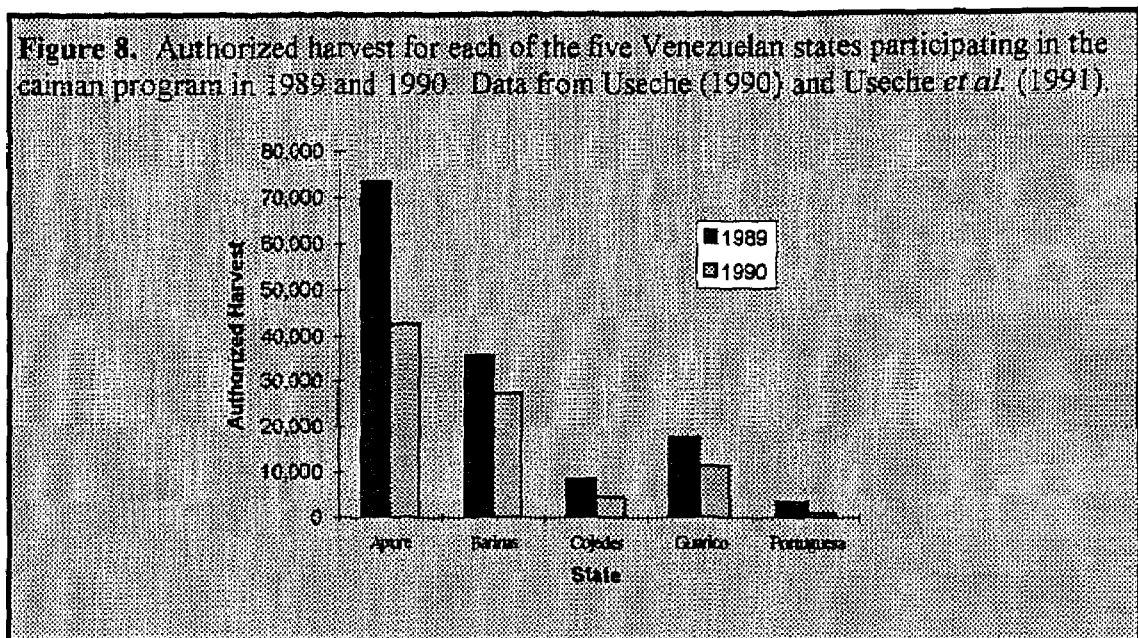
Bans on Harvesting.

Since the inception of the program, the annual harvest of caiman has been banned twice, first in 1986 and again in 1996. The first ban was as a result of criticism of the government's handling of the program in the wake of what was widely seen as an excessive harvest in 1985. The most recent ban was declared due to an overstock of skins in Venezuela and the desire to census populations without interference from hunting activities (Quero de Peña and Velasco 1995). During both bans the Venezuelan government undertook surveys to evaluate the status of the caiman population (Population Censusing and Monitoring).

Harvest by state

Although the harvest has involved five states in the central Venezuelan Llanos, the majority of caiman authorized for hunting were in the state of Apure (Fig. 8). Apure, although not the largest state in the Llanos participating in the caiman program, is considered to have the most low-lying seasonally inundated habitat preferred by caimans (Velasco and Ayarzagüena 1995). Bolivar state was included in the first resolution but was removed in 1984 and harvesting never took place there. Based on surveys indicating marginal habitat and overexploited populations, hunting in Guárico state was prohibited in 1991.

Figure 8. Authorized harvest for each of the five Venezuelan states participating in the caiman program in 1989 and 1990. Data from Useche (1990) and Useche *et al.* (1991).



Population Censuses and Monitoring

In the Venezuelan program, population censuses fulfill two functions, 1) to establish hunting quotas for landowners, and 2) to monitor the status of wild populations. It should be pointed out that all census figures mentioned in this report refer to the non-hatchling population of caiman (that segment of the population greater than one year old). The exclusion of hatchlings from analysis of crocodilian populations is not uncommon due to the high rates of mortality, and hence transitory nature of the hatchling population. However, it is atypical for hatchlings simply not to be counted, as was the case for the early years of the Venezuelan program. Hatchlings represent a good measure of reproductive output for the previous year and should be included in all population counts.

Establishing the Harvest Quota

The techniques used to estimate population size and determine hunting quotas on private lands have changed more than any other aspect of the program. The basis for the program was the study conducted by Seijas (1984) estimating caiman population density and population size-class structure on 16 ranches in the Llanos region. Counts were done both during the day and at night, and estimated that 3.29 as many animals were visible at night as during the day, but the relationship was highly variable.

During the early years of the harvest (prior to 1987), harvest quotas were estimated from sampled population counts made by MARNR staff. At this time no attempt was made to estimate the size-class structure of the population, and counts were done principally during the day, when a low, and extremely variable percentage of the population is visible (Seijas 1984; Velasco *et al.* 1993). Because diurnal counts only reveal a small percentage of the total population (Seijas 1984), these counts were multiplied by a correction factor (which itself varied from 3.17 to 3.70 between years) to estimate the total number of caiman. In 1984-5, counts were made in sample areas of 0.25 ha of each water body and calculated densities were extrapolated to the entire ranch (MARNR 1986). Bodies of water on each ranch were selected for sampling to determine mean density values for the entire property. However, due to the shortage of personnel, not all ranches could be censused and in some cases caiman populations were estimated based on the size of the property and a mean density figure of 0.241 caiman/ha (MARNR 1986). As can be seen from later surveys, this was a high figure for mean density of caiman in many areas.

Census techniques were altered slightly in 1985. Prior to initiating census work, MARNR personnel were trained in field counting techniques for sampling 0.25 ha areas in each body of water. After repeated counts a mean value was used. However, counts were still done during the day and a different correction figure of 3.29 was used (MARNR 1986).

Following the one year ban in 1986, censusing resumed in 1987, again based on diurnal counts of sample areas with another correction factor (3.17), following recommendations made by Rivero-Blanco (1985). Harvest quotas were based on a formula which included mean density values, the surface area of available aquatic habitat, and a correction factor.

In 1987-8, for the first time the size-class structure of the population was taken into consideration by estimating the length of caiman and placing them into one of four size-classes (Table 7).

Table 7. Size-class categories of caiman used during censusing.

Size-class	Caiman snout-vent length (cm)
I	>40
II	40-59.9
III	60-89.9
IV	≥90

Technical Reports. In 1988, as a direct result of recommendations made in a workshop evaluating the caiman program (FUNDIFAUNA 1989), MARNR required landowners requesting permits to submit an annual technical report describing the status of the caiman population on their property, and develop a 5 year management plan for caiman on their land. The requirements for the technical report were first established in Resolution 60 of 1988 and included the number and size-class structure of caiman in each of the property's water bodies, a physical characterization of each water body and the date of census.

As a result of the changes in the program timetable, census data from 1988 were used to establish harvest quotas for the 1990 hunting season. This schedule (using the previous year's census data to establish harvest quotas) has continued through the present.

Finally, in 1993, information from technical reports was corrected using the results of a regional survey of caiman undertaken by PROFAUNA, which classified caiman populations within seven ecological zones in the Llanos (Velasco and Ayarzagüena 1995). The technical reports of each ranch were analyzed and compared to the mean values for the corresponding ecological region. Caiman density figures and the percentage of adult males for each ranch were adjusted to not exceed the mean values for each ecological region. In 1995 the requirement of a technical report was completely eliminated and harvest quotas were determined based entirely on the results of regional surveys conducted by MARNR (as described in Setting of harvest quotas).

Caiman Status and Population monitoring.

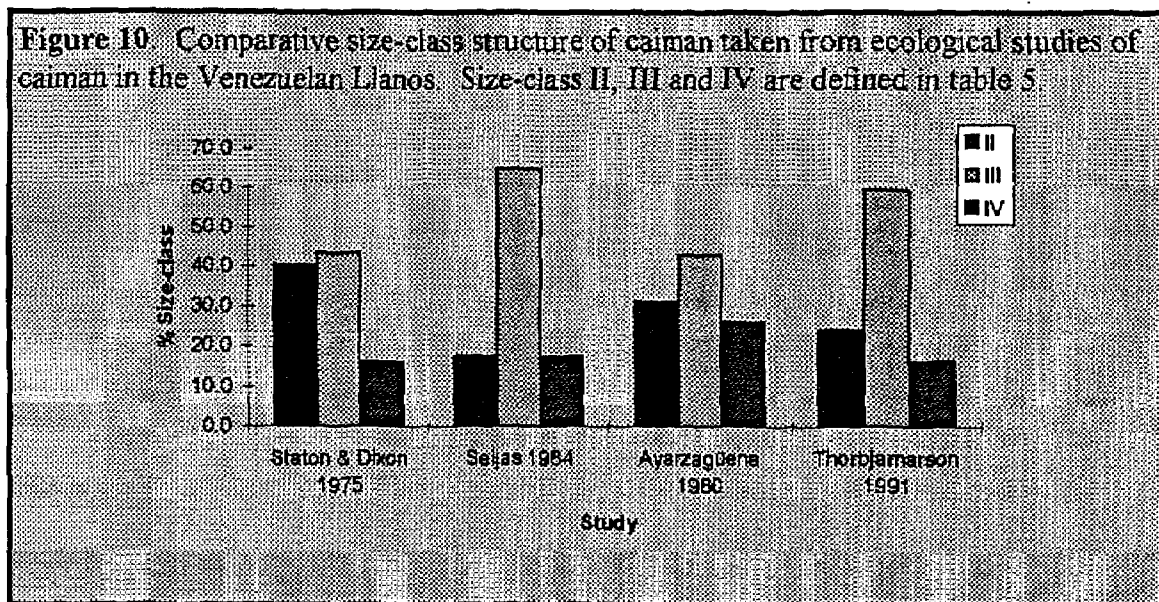
The monitoring of caiman populations has been carried out sporadically and has suffered from a lack of clearly defined objectives and standardization. MARNR conducted broad surveys of the caiman population in the Llanos in 1982 (Seijas 1984), 1986-7 (MARNR 1987), 1991 (Velasco and Ayarzagüena 1995), and again in 1996. However, the first three censuses were of variable quality, using different techniques, and making comparisons impossible. The information from the technical reports was also of such variable quality as to be useless for establishing population trends. Prior to the 1996 surveys little attention had been given to standardizing census procedures to evaluate caiman populations in the Venezuelan Llanos through time.

Part of the problem has been the reluctance of the Venezuelan management authority to invest adequate amounts of money in a monitoring or research program, as has been recommended by the SSC Crocodile Specialist Group (CSG 1986) and by the Venezuelan Presidential Commission. In a recent positive move, funds to support monitoring activities have come from fees charged to landowners based on the size of their properties (Velasco *et al.* 1995). The most recent surveys (1991-2 and 1995-6) were carried out under an agreement with the Universidad Central de Venezuela-Instituto de Zoología Tropical (UCV-IZT).

Surveys prior to the harvest. In the mid-to late 1970's studies of caiman populations on two ranches; Hato Masaguaral and Hato El Frio provided some of the first biological on the spectacled caiman in the Venezuelan Llanos. Censuses were conducted principally during the annual dry season and densities of caiman expressed in numbers of animals per hectare of dry-season lagoons. Studies on the Masaguaral ranch by Staton and Dixon (1975) and Marcellini (1979) reported densities of 63.5-130 caiman/ha in dry-season water bodies. Working on the 78,000 El Frio ranch, Ayarzagüena (1983) found a similar range of 80-150 caiman/ha in bodies of water, with an overall density value (including terrestrial habitats) of 0.212 caiman/ha. The study of Ayarzagüena (1983) was also the first to propose the four size-class categories that are now widely used to characterize the population structure. These studies confirmed that in parts of the Venezuelan Llanos dense populations of caiman were found in dry season water bodies, and provided the initial impetus for MARNR to propose a commercial harvest.

Prior to the initiation of the harvest program, the population of caiman in Venezuela was estimated to be 5,080,000 by Mendez-Arocha and Medina (1982), although no supporting data were presented. At the 1984 meeting of the Crocodile Specialist Group in Caracas, MARNR modified their population estimate to 3 million. However, this estimate was questioned by Gorzula (CSG 1986) who used mean density figures of 0.18-0.24/ha to calculate a total of 2.18 million adult and subadult caiman over an area of 108,900 km² of suitable habitat.

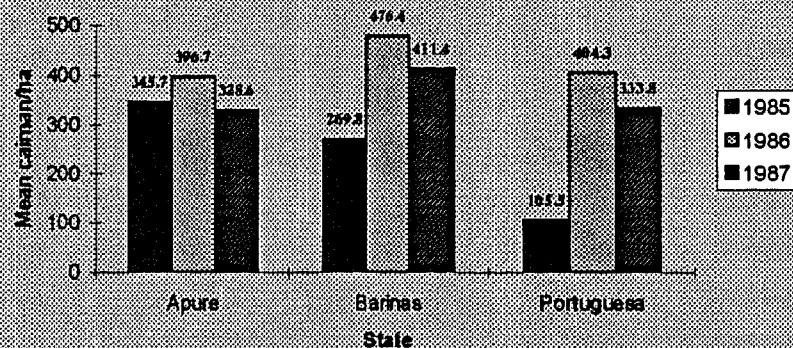
MARNR 1982 study. This study, conducted by Seijas (1984) was the first to evaluate caiman populations over a broad area in the Llanos. The surveys were based on a mixture of diurnal and nocturnal counts. Diurnal counts were used to count caiman and estimate the population size-class structure. The study was also the first to compare the number of caiman seen at day and at night and to calculate a conversion factor. Seijas surveyed a total of 16 ranches in Apure, Barinas and Portuguesa states that totaled 233,769 ha. Minimum population size was estimated at 55,072 (non-hatchlings) for an overall minimum density of 0.236 caiman/ha. Using just the areas covered by lagoons and other caiman habitat the mean density was 225 caiman/ha. Like Staton and Dixon (1975), Seijas (1984) also reported a population structure dominated by size-class III animals (60-89.9 cm SVL; Fig. 10).



MARNR 1986-7 Survey. Under Resolution 61 of 1985, MARNR was directed to evaluate the effects of the caiman harvest on wild populations of caiman. A survey was carried out during 1986-7, the results of which were summarized in MARNR (1987). The program was completed in 3 stages: 1) April-May 1986 census of 83 ranches in Apure, Barinas, Cojedes and Portuguesa states, 2) December 1986 census of 65 ranches, and 3) January-February 1987 census of 108 ranches. Censuses appear to have been mostly diurnal, using a correction factor of 3.17. The report used mean density values in each of three states over a three year period (1985-1987) to evaluate the effects of the harvest on wild populations. However, only mean values for each state for each year were presented (Fig. 11). Although in most cases density values were comparable, the lack of information

on count variability and the effect of environmental variation make analysis of the information impossible. Also, the provenance of the 1985 data was not explained. While the report refers the 1985 data to Rivero-Blanco (1985) the values cited are not those in the report. Furthermore, there were large discrepancies in the mean density values for states among figures within the MARNR 1987 report. Although population size-class structure was estimated, these data were not presented in the report. In summary, while much information on caiman densities was produced from the 1986-7 survey, very little was made public, inconsistencies in the data are prominent, and the analysis provided no insight on the effects of the harvest on caiman populations. Nevertheless, the 1986-7 surveys were used to estimate a total population of caiman in the Llanos study region as 6,974,785.8 (MARNR 1987).

Figure 11. Mean caiman density values (per hectare of water body) for each of three states over a 3 year period. Data from MARNR 1987.



PROFAUNA 1991-1992 Surveys. Another effort to evaluate the status of wild caiman populations was conducted in 1991-92, the results of which are summarized in MARNR (1992) and Velasco and Ayarzagüena (1995). With financial support from the European Community and the Japanese government, coordinated through the CITES Secretariat, survey work was initially planned to be completed during the dry season of 1991. However, because censuses did not start until very late in the dry season (April-June), only a part of the surveys could be completed and the rest were conducted during the following dry season (January-May 1992).

Surveys were conducted by three field teams over a total area of 922,581 ha, which represented approximately 10% of the area in the caiman harvest program. Censuses were conducted at night, although in some cases population size-class structure was determined during the day. Aside from the number of caiman counted (observed population), and estimated number of caiman was recorded for areas where: 1) bodies of water were inaccessible (usually due to dense vegetation), bodies of water were partially or totally covered with aquatic vegetation, or it was thought that some caiman were hiding in the surrounding forest (Velasco and Ayarzagüena 1995).

Departing from reporting procedure of previous surveys which broke down the data by state, the 1991-2 survey classified the region into six ecological regions (Table 8).

One of the six regions (Apure Meridional) was later divided into two (Aguas Claras and Cajón de Arauca).

Population figures were presented as the number of caiman observed and estimated population. Overall population densities were 0.155 observed caiman per hectare and 0.196 caiman per hectare estimated population. These figures are slightly below reported densities for previous surveys, and over the entire area of flooded Llanos habitat (9,010,365 ha) would indicate a population of 1.4-1.8 million non-hatchling caiman. Size class structures of censused populations are presented in figures 12-13.

The results of the survey were used to support the closing of Guárico state to hunting, as well as eliminating small ranches from the Llanos Boscosos region due to indications of over-exploitation (low density, small percentage of SC IV).

Table 8. Ecological regions, areas surveyed, numbers and densities of caiman. Data from MARNR 1992 and Velasco and Ayarzagüena (1995). Minor errors in calculated densities in the original documents, expressed as number of non-hatchling caiman per hectare, have been corrected.

Ecological Region:	Bajo Apure	Alto Apure	Aguas Claras	Cajón de Arauca	Guárico	Hoyo de Arismendi	Llanos Boscosos
Total Area (ha)	571,389	2,662,296	1,009,890	252,189	784,875	615,342	3,114,384
Area Censused (ha)	78,174	244,175	172,180	61,945	69,296	95,154	193,874
% Area Censused	13.9	9.2	17.1	24.6	8.8	15.5	6.2
Observed Population	22,952	41,878	12,495	9,227	5,122	28,124	23,575
Estimated Population	30,672	52,498	15,528	11,772	8,792	32,856	28,886
Observed Density (ha ⁻¹)	0.294	0.171	0.073	0.149	0.074	0.296	0.122
Estimated Density (ha ⁻¹)	0.392	0.215	0.090	0.190	0.127	0.345	0.149

Figure 12. Overall size-class distribution of non-hatchling caiman during the 1991-2 surveys conducted by MARNR. Size classes as defined in table 5.

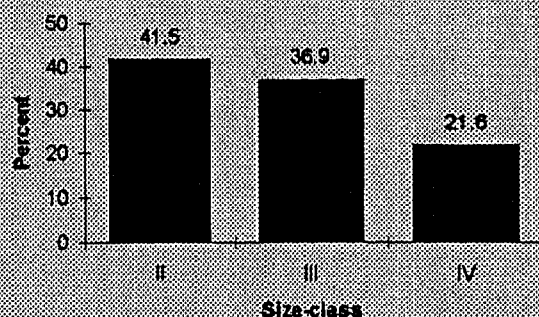
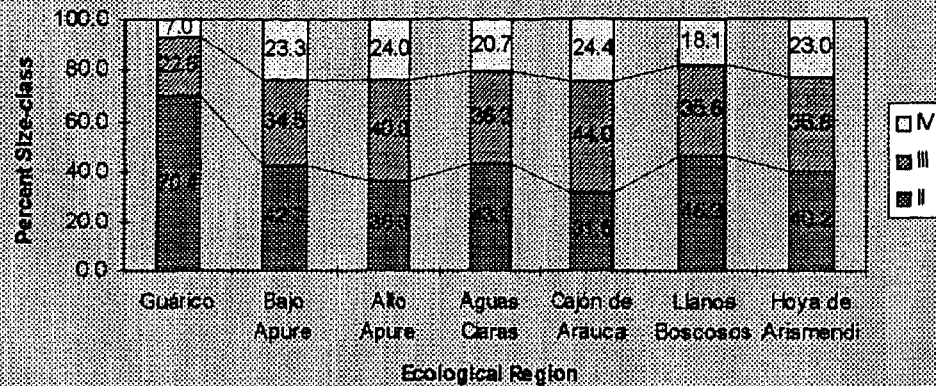


Figure 13. Size-class breakdown (size-classes II, III, and IV) for non-hatchling caiman for each of the 7 ecological regions defined in MARNR 1992 and Velasco and Ayarzagüena (1995) and modified by Velasco (pers. comm.) as in Table 6.

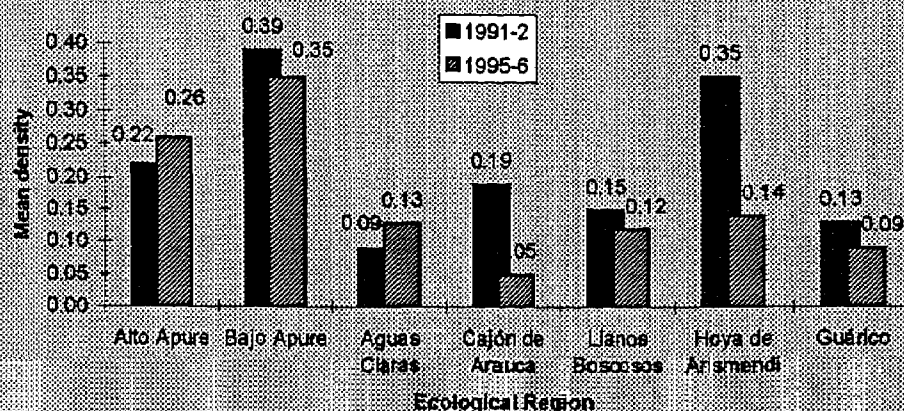


PROFAUNA 1995-96 Surveys. With funding from fees charged to landowners participating in the caiman harvest program, PROFAUNA undertook a survey of caiman populations in 1995 (Guárico state), and 1996 (balance of areas). As in the 1991-92 surveys the work was done by PROFAUNA in conjunction with the Instituto de Zoología Tropical at the Universidad Central de Venezuela. Censuses were carried out by 6 teams using nocturnal counts and covered an area of 802,716 ha. Some diurnal counts were used to estimate size-class structure.

Overall mean density values were similar to those in 1991-92 (Fig. 14), with a few notable exceptions. However, due to the lack of quantitative information on count variability no statistical comparisons can be made, and no population trends can be discerned. Abrupt declines in mean density values for a few regions (Cajón de Arauca and Hoya de Arismendi) were attributed to having sampled a smaller area and reduced water availability in 1996 (which leads to caiman burying themselves in the mud and not being seen during counts).

In three of the seven regions (Alto Apure, Bajo Apure, Aguas Claras) the size-class structure was similar in the two surveys (1991-92 and 1995-96; Fig. 15). In two regions (Llanos Boscosos and Guárico) there was an apparent increase in the proportion of SC IV caiman. However, as with the data for population density, no statistical comparisons can be made on the population size-class data, and it cannot be determined if any of these changes are significant or simply represent sampling variation.

Figure 14. Comparative mean density values for non-hatchling caiman in each of the seven ecological regions, 1991-92 vs 1995-96 surveys. Density is caiman/hectare. From Velasco (1997).



Taken together, the surveys of 1991-92 and 1995-96 indicate that caiman populations in the Venezuelan Llanos continue to be healthy, but are not adequate to determine population trends or the effects of harvesting on local populations.

Measurements of harvested skins.

Censuses of wild populations are the most appropriate method for monitoring wild populations of caiman. However, another valuable monitoring tool that targets the harvested population is the measurement of skin sizes. As the value of a skin is directly related to its size, hunters preferentially target large caiman. A decline in mean size of skins may indicate that large caiman are becoming scarce. Measuring a sample of skins on an annual basis is a fast, cost-effective monitoring tool. While MARNR initiated a skin size monitoring program in 1989, only recently have these data been made public (Velasco et al. 1997a).

Espinoza (1994) analyzed the sizes of skins produced from four ranches over a four year period. Results varied, but a general trend of decreasing numbers of large (super and first) skins was evident as hunting continued.

PROFAUNA summaries of size-classes of skins sold reveals a fairly stable pattern (Fig. 16). The largest skins (super) consistently represent a small fraction of the total. The sixth class (smallest skins, <90 cm) also include damaged skins and in some cases skins of unknown size and large variations (in 1992 and 1995) are hard to interpret. Most skins traded are first or second class (120-140 cm long), with variable composition of smaller skin classes. Between 1988 and 1991, there was been a trend for fewer first class skins, and after from 1992-1994 for more second class skins to be traded (Fig. 17). These may reflect changes in the size-class composition of the wild population (fewer large animals).

Figure 15. Comparative size-class structures of caiman populations in each of seven ecological regions. Data from 1991-92 survey and 1995-96 survey (Velasco 1997).

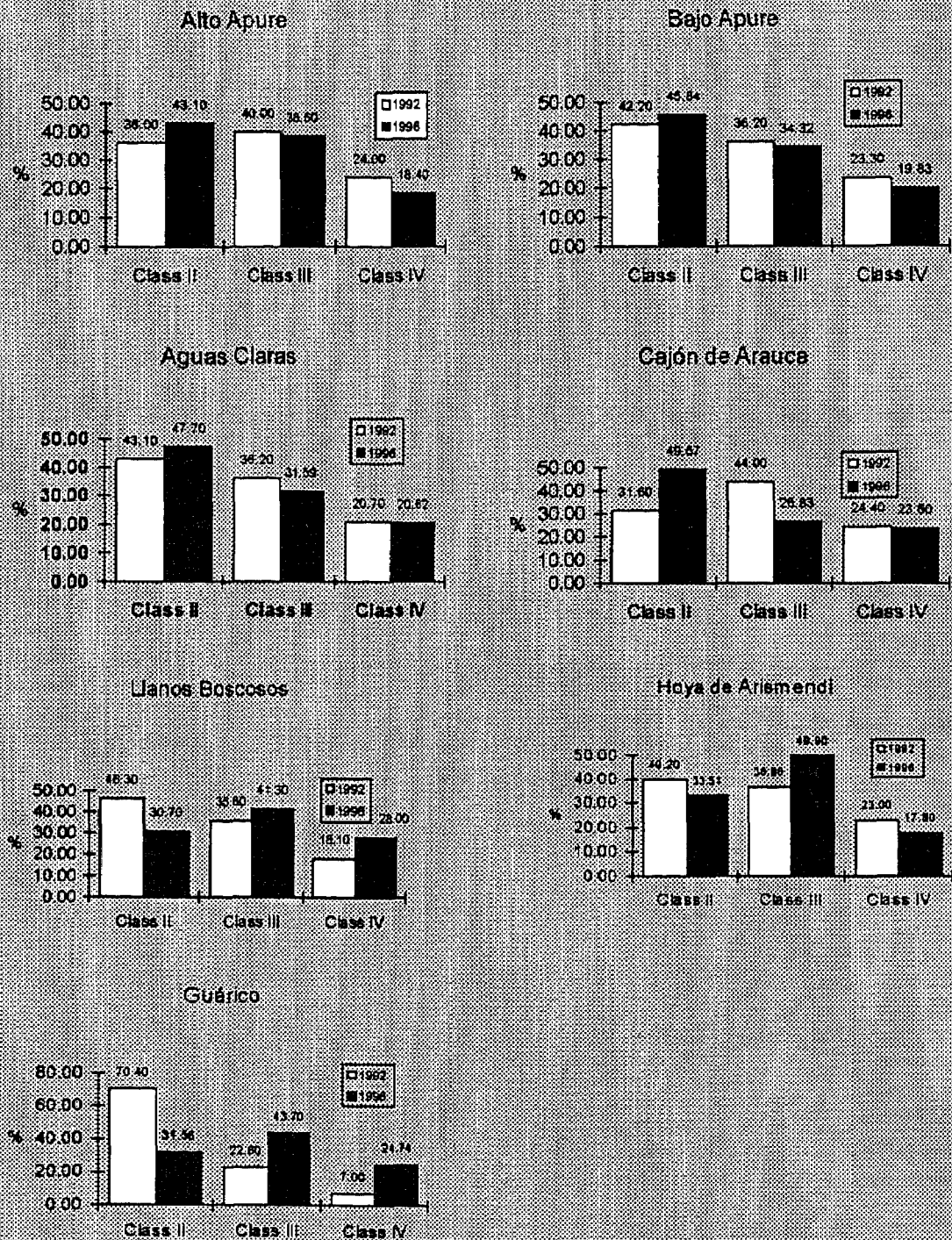


Figure 16 Summary of size-class distribution of skins of harvested caiman. Data from Velasco et al. 1997. The size categories are: super (≥ 140 cm), first ($140 >$ and ≤ 130 cm), second ($130 >$ and ≤ 120 cm), third ($120 >$ and ≤ 110 cm), fourth ($110 >$ and ≤ 100 cm) and fifth (< 100 cm).

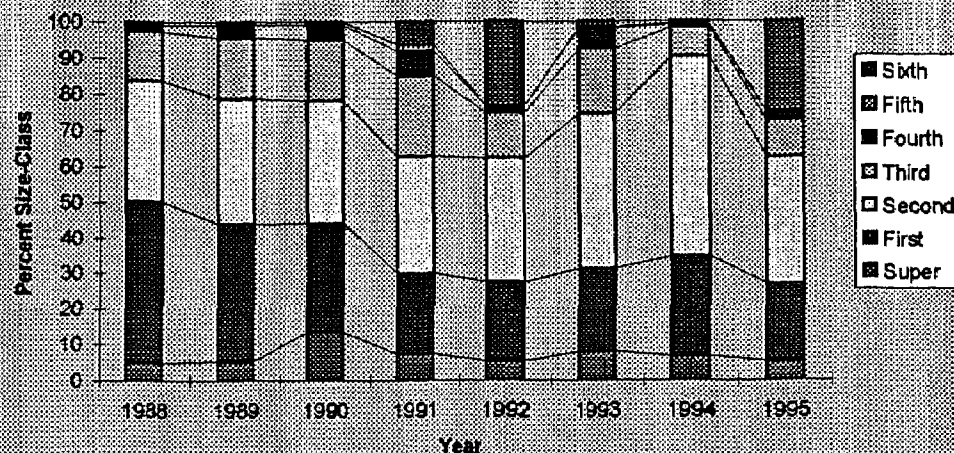
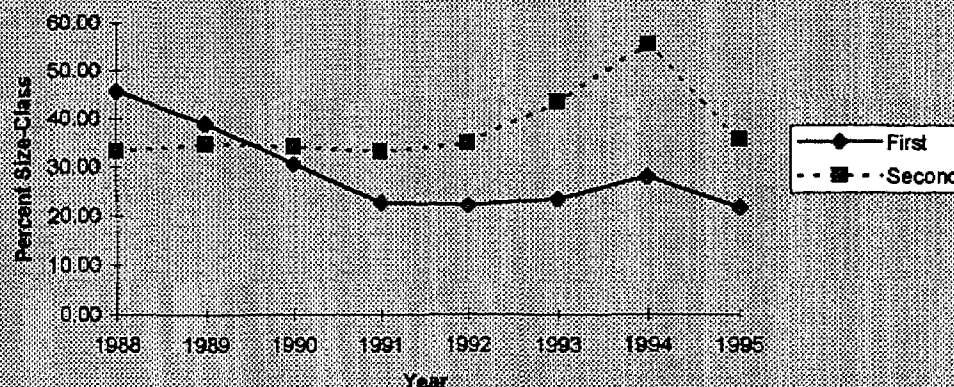


Figure 17. Percent of first and second class skins in the harvest, 1988-1995.



Sustainability of the Harvest

Given the available information on caiman populations it is not possible to fully evaluate the effect of past harvests on the wild caiman population in the Venezuelan Llanos. Variability in censusing techniques throughout the life of the program, and a failure to evaluate and take into account sampling variation and environmental variability factors makes analysis of population trends impossible.

Another approach to evaluating the effects of the harvest is to examine the number of animals harvested with respect to the estimated population of caiman. The Venezuelan program estimates a 5% population growth and recruitment rate of caiman, and this figure has been used as a basis for determining a suitable harvest rate (Velasco and Ayarzagüena 1995). The total population of caiman in the area included in the harvested population can be estimated using figures for mean density from several studies. The total area of Llanos

habitat suitable for inclusion in the harvest program is 9,010,365 hectares (MARNR 1992; Velasco and Ayarzagüena 1995). Using the average density values from the 1991-2 PROFAUNA study as the most reliable, the total non-hatchling caiman population size in the area managed by the harvest program is 1.4-1.7 million. A five percent harvest rate is equivalent to 70,000-85,000 caiman per year. However, under PROFAUNA guidelines, harvests are restricted to 20% of the size-class IV caiman population (A. Velasco, pers. comm). Using the same figures, and based on an average value of 21.6% SC IV individuals, the total number of harvestable caiman is estimated to be approximately 300,000-380,000. At a harvest rate of 20% of the size-class IV caiman, these figures would limit the overall harvest rate to 60,000-76,000 per year. These figures are somewhat larger than the suggested harvest limits cited in MARNR (1992) and Velasco and Ayarzagüena (1995) of 50,000-70,000 per year.

Using the two extreme figures of 85,000 and 60,000 as estimates of the sustainable harvest level, we can evaluate past harvests in terms of their sustainability (Figure 18). This analysis assumes that the population of caiman has remained relatively stable over the life of the caiman program, and that the 1991-2 MARNR survey presents an accurate assessment of caiman populations. In some years (1985, 1988, 1989, and 1991) harvests were greatly in excess of the 85,000 figure. However, annual numbers of caiman hunted varied and in many years the harvest was below 60,000. Examining the cumulative sum of harvests (the sum of all values in figure 18 since 1983) is another way of measuring the potential impact of the harvest on wild populations (Fig. 19), and indicates that the period 1988-1992 represented the period when over-harvesting should have been most apparent. The height of this period was in 1991-2, coinciding with the population survey done by MARNR. This suggests that the caiman density values calculated based on the 1991-2 caiman surveys may have reflected an over-harvested population. It will be interesting to compare the results of the 1996 survey with the data collected in 1991-2.

Again using the 1991-2 survey data for the six ecological regions, approximate values of appropriate harvests can be estimated. Using the data for mean population density, population size-class structure and area in each of the six ecological regions, values for total harvest are calculated based on a figure of 5% of the total non-hatchling populations size, and based on a 20% harvest of the size-class IV caiman population (Table 9).

Figure 18. Annual variation in the sustainability of the caiman harvest. Assuming a value of 85,000 (left) and 60,000 (right) as a sustainable level of harvesting, values represent the annual number of caiman skins sold minus 85,000 or 60,000. Area above the zero line represent years of excessive harvesting.

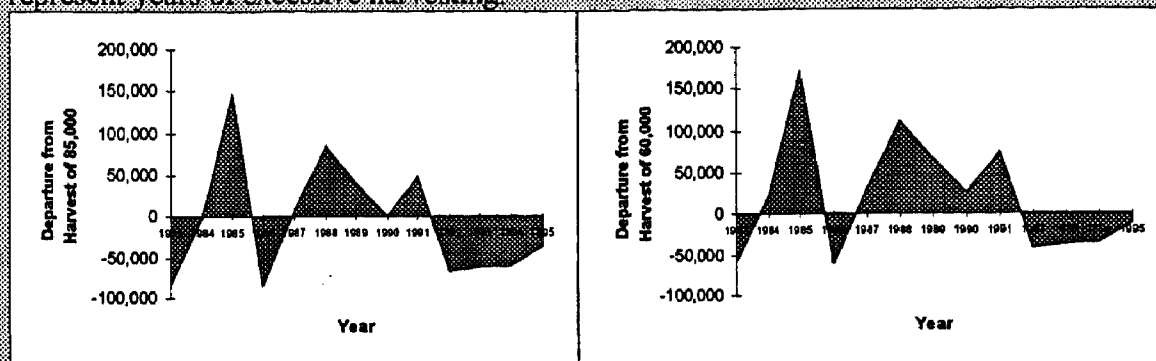


Figure 19. Cumulative sum of harvest totals deviation from an annual off-take of 85,000 (left) and 60,000 (right). Area above the zero ordinate value represent periods when the total harvest, since the beginning of the program, exceeded a cumulative annual figure of 85,000 or 60,000.

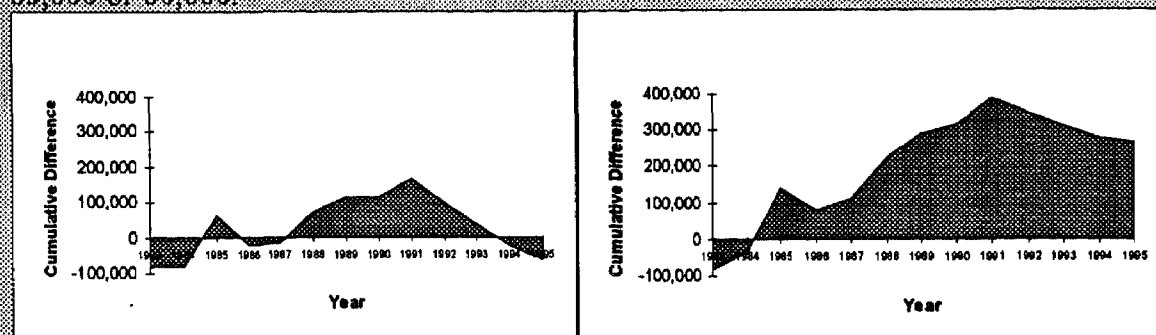


Table 9. Calculations of estimated values of sustainable harvest size, and legally permissible harvest size for each of the six ecological regions defined by MARNR.

Ecological Region	Surface area (ha)	Estimated Caiman/ha	Total n-h Population	SC IV	# SC IV Caiman	5% n-h Population	20% SC IV
Alto Apure	2,662,296	0.215	572,394	0.240	137,374	28,620	27,475
Bajo Apure	571,389	0.392	223,984	0.233	52,188	11,199	12,160
Aguas Claras	1,009,690	0.090	90,890	0.207	18,814	4,545	3,763
Cajón de Arauca	252,189	0.190	47,916	0.244	11,691	2,396	2,338
Guárico	784,875	0.127	99,679	0.070	6,978	4,984	1,396
Hoya Arismendi	615,342	0.345	212,293	0.230	48,827	10,615	9,765
Llanos Boscosos	3,114,384	0.149	464,043	0.181	83,992	23,202	16,798
Total Harvest						85,814	71,973

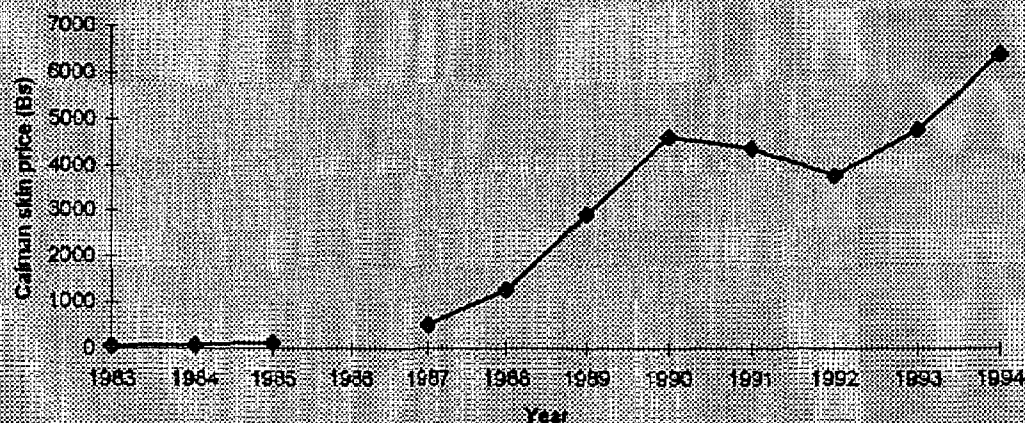
These values represent overall levels of harvest from the entire region open to caiman harvest (10,846,290 ha in 1997). However, in any given year, the harvests were legally only limited to the areas that received hunting permits. Data on the total area under hunting permit is only available for 1997, and shows that permits were given to a total of 640 ranches with an area of 5,005,187 ha (Table 4), or 46% of the total area. While it is not clear if the overall levels of harvest have been sustainable (Fig. 18,19), it is apparent that local harvest rates have exceeded the target values established by Profauna (5% total population, 20% SC IV). Assuming 1997 was a typical year, the global sustainable harvest quotas should have only been 46% of the values used in figures 18 and 19, or 33,000-46,750 caiman per year. As described in the section on how harvest quotas are established, the use of higher harvest rates on medium- and small ranches inflates overall harvest levels. Determining the impact of this locally higher levels of harvest should be one of the goals of the monitoring program.

Economic value of the harvest

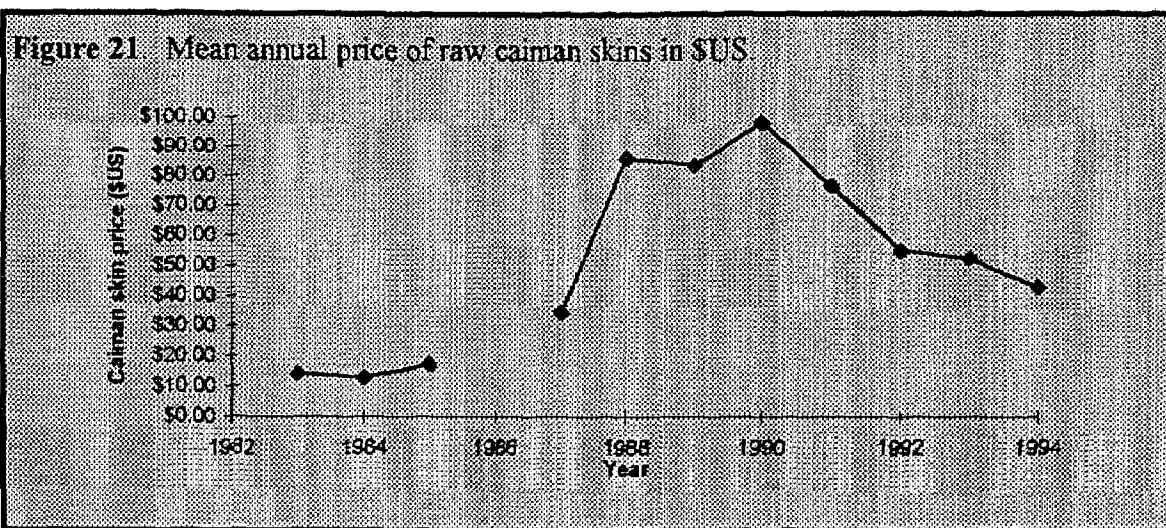
Prices paid for skins

Raw skins. Prices paid to producers (landowners) increased steadily throughout the period of the program, with the exception of a brief period during the early 1990's (Fig. 20,21; see next section). The large increases in prices in 1989 was a result of a major new tanner/buyer entering the Venezuelan market (Espinoza 1994), sharply increasing competition in a market that had been relatively stable. In fact, in one newspaper editorial a charge of price fixing among the pre-1989 tanners was made (Anonymous 1990). A decrease in prices paid for raw skins in 1991-92 reflected a decreased international market (see next section). During this period Gorzula (1991) reported that many ranchers were holding back from selling skins due to the low prices being offered. Overall, the average annual increase in raw caiman skin prices since the beginning of the program is 62%.

Figure 20. Mean prices paid to producers for raw caiman skins. Values in Bolivars for entire, salted chalecos



Although prices for raw skins increased substantially throughout the period, Venezuela had a highly inflationary economy. Espinoza (1994) modeled the net gains of landowners in the caiman program over a 5 year period (1989-1993) and assumed an average 35% rate of inflation. At the same time (1988-1993) the Venezuela Bolivar was being devalued at an average annual rate of 33%. Using the 1987 Bolivar as a base for comparison, the real value of net returns for landowners declined between 1989 and 1993. However, caiman harvesting remained a very profitable venture for landowners with a benefit/cost ratio in excess of 2.5 (Espinoza 1994).



Tanned skins. Prices paid for tanned caiman skins are measured per square foot of skin. When the Venezuelan caiman program began in the early 1980's, worldwide skin prices for crocodilians were relatively low. Over the next decade prices increased at an annual rate of 24% (1983-1990) before falling sharply in the early 1990's (Fig. 21, 22). The drop in skin prices in 1991-92 was a worldwide event for all crocodilians traded commercially, and has been attributed to a number of factors including low demand for products in Japan, a poor world economy, consumer resistance to wildlife products, a paucity of manufacturing facilities worldwide, an imbalance of production and consumption in the USA, a ban on wildlife trade with Italy, and oversupply of skins worldwide (Woodward, *et al.* 1993, Van Jaarsveldt (1992). The result was a significant reduction in purchases of crocodilian skins, with major repercussions for crocodilian management programs based on commercial use, including Venezuela (Quero de Peña 1994). In Venezuela, from 1990 to 1992 prices of crust hides fell almost 40% (Fig. 23), and the number of permit requests dropped from a high of 1,006 in 1991 to 279 in 1992. In 1991 it was reported that only 3 of 6 tanners were purchasing skins (Gorzula 1991). During this period of low skin prices many ranches withdrew from the harvest program and at least one Venezuelan tanner went bankrupt in 1993.

Figure 22. Mean prices paid for crust-tanned caiman skins exported from Venezuela. Values are U.S. dollars per square foot of skin. Area graph represents the difference between caiman hunted and skins exported for each year; positive values indicate years when more caiman were hunted than exported.

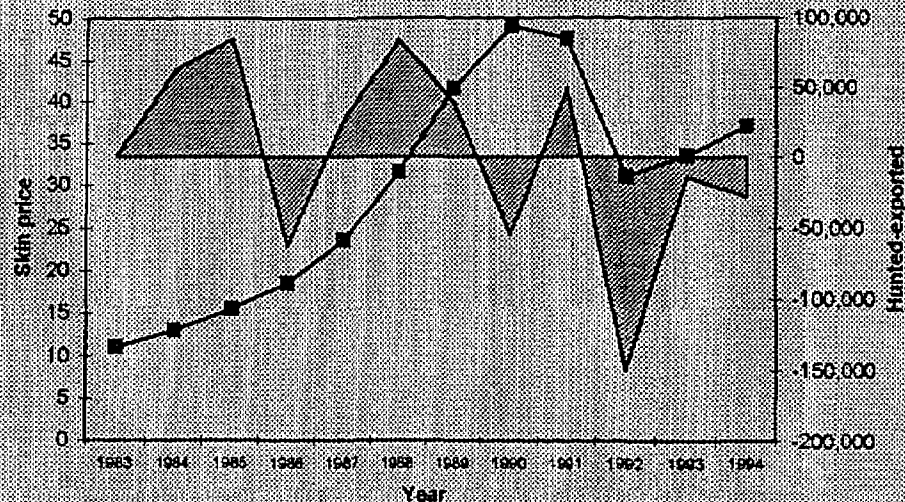
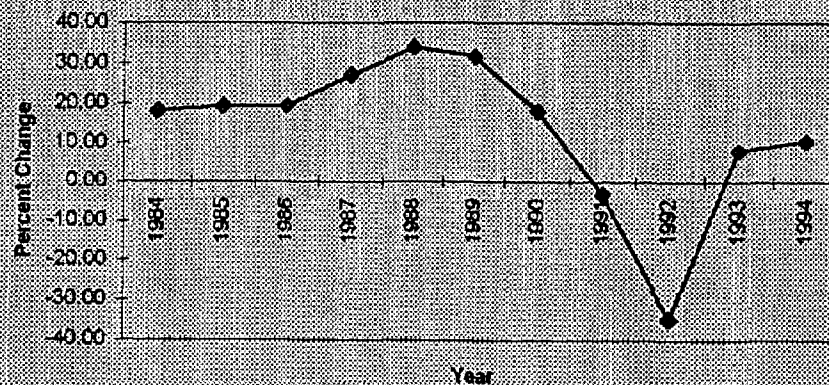


Figure 23. Annual percent change in the price of crust tanned caiman skins from Venezuela.



Estimated Earnings of the Harvest

Estimates of the value of tanned skin prices vary depending on the source of the information and have made economic calculation difficult. The data in figures 20 and 22 come from MARNR Quero de Peña *et al.* 1996, and were used with the annual export figures (Fig. 24) to estimate the total export value of crust tanned skins (Fig. 25). In 1985, the estimated foreign exchange earning of exported caiman skins was \$8.5 million. Due to the increased price of the skins, the export value increased dramatically by 1990 when the corresponding foreign earnings was \$26 million.

The estimated total export value of caiman skins since the beginning of the program (1983-1994) is \$US 115,980,966.

Figure 24. Total number of tanned caiman skins exported from Venezuela per year, 1984-1994. Data from Quero de Peña et al. 1996.

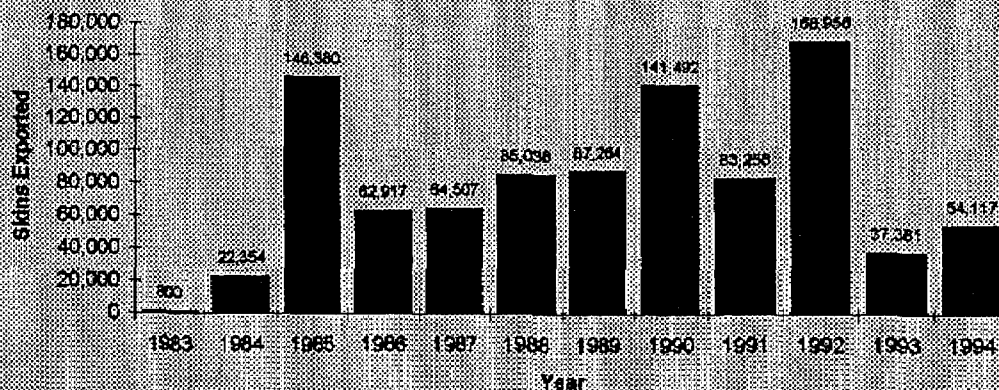
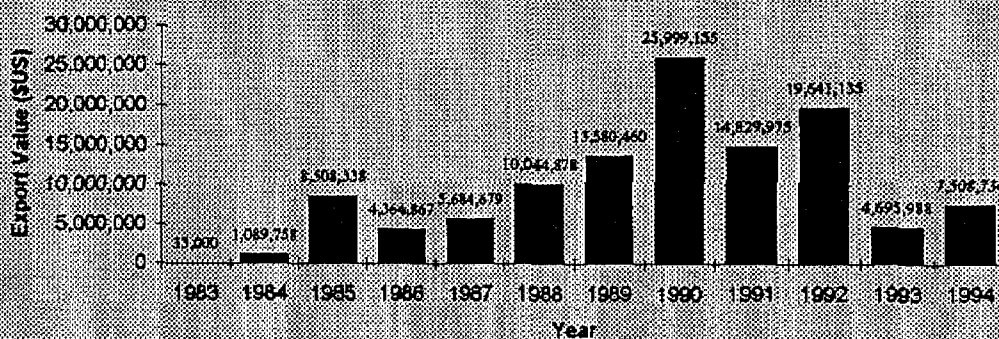


Figure 25. Estimated total value of exported skins by year, 1983-1994. Value based on the number of skins exported and values of skins reported by MARNR. Assumes a mean skin size of 3.75 ft².



Private Sector Earnings

Several analyses have examined the value of the harvest program to the various participating groups. At the level of raw, untanned skins (prior to sale to tanners), Espinoza (1994) found that landowners reaped the largest benefits with 73% of the proceeds. However, significant earnings accrued to the hunters (16%), PROFAUNA (6%), and biologists or technicians hired to census the caiman population (4%). By quantifying the present worth of the incremental benefits and costs of caiman hunting for ranchers, Espinoza (1994) was able to assess the economic value of caiman hunting for landowners. For a sample of 10 ranches between 1988 and 1993, caiman ranching was clearly a lucrative business with a the mean benefit/cost ranging from a low of 3.24 to a high of 5.49. Although the overall earnings of caiman harvesting were small when compared to that of cattle ranching, the high benefit/cost ratio makes it a very lucrative way for owners to cover many basic costs of their cattle ranching activities.

Hoogesteijn and Chapman (1997) compared the economic returns of caiman harvesting to earnings from cattle ranches. Based on mean values of density (0.241 caiman/ha), a harvest of 7%, and a mean price of \$US 53 per caiman, they estimated the annual value of the caiman harvest was equivalent to \$US 0.89/ha (calculated from Hoogesteijn and Chapman 1997). Comparative values for cattle ranching varied depending on the type of cattle management used, but were 7.9-26.4 times greater (Hoogesteijn and Chapman 1997).

Other economic analyses have been conducted based on the commercial value of exported, partially tanned skins. Thorbjarnarson (1991a) used data from Rivero Blanco (1985) to estimate the percent of the value of the export of caiman products that went to ranch employees and hunters (10.4%), land owners (45.3%), and the tannery employees (29.6%) and administration (14.8%). For the 1989 harvests CEC (1990) estimated that 0.5% of the programs proceeds went to professionals (biologists and trained technicians) who conducted the caiman population surveys on the ranches, 1.8% went to the hunters, 3.7% to MARNR, 24.5% to the landowners, and 69.5% to the tanners. This last figure may be an overestimate as a mean export value of \$65/ft² for crusted skins was used in the calculations. However, both studies agree that a major portion of the proceeds of the harvest went to tanners. This is, to a certain degree, a reflection of the high costs associated with tanning caiman skins.

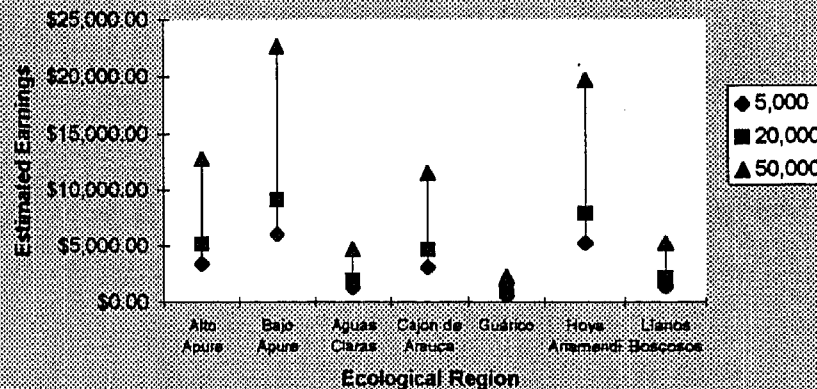
To estimate the value of caiman to landowners, we calculated the mean number of SC IV caiman that could be harvested per hectare of land for each of the seven ecological regions (Table 10). Using these values we estimated the economic production based on an average price of Bs 12,000 per skin (average 1995 price) and an exchange rate of Bs 485/\$US. It should be noted that these calculations are for skins only, and do not include the meat (which in most cases is much less than the value of the skins).

Based on these values we have calculated the expected income of hypothetical ranches of three sizes (5,000, 20,000 and 50,000 ha) in each of the seven ecological regions (Fig. 26). It is clear that the economic returns vary considerably by region. Economic incentives for participating in the caiman program are much lower in three areas (Llanos Boscosos, Aguas Claras and Guárico) than in other areas. However, for relatively small ranches (5,000 ha), the differences between ecological regions is comparatively small.

Table 10. Calculations of value of caiman harvest \$US/hectare for landowners in each of the seven ecological regions. Based on an average value of Bs. 12,000 per skin. Meat sales not included.

Ecological Region	Density (no/ha)	% SC IV	No. SC IV/ha	No. harvestable	Bs/animal	Bs/ha	\$US/ha
AltoApure	0.215	0.240	0.0516	0.0103	12,000	123.84	0.2553
Bajo Apure	0.392	0.233	0.0913	0.0183	12,000	219.21	0.4520
Aguas Claras	0.090	0.207	0.0186	0.0037	12,000	44.71	0.0922
Cajon de Arauca	0.190	0.244	0.0464	0.0093	12,000	111.26	0.2294
Guárico	0.127	0.070	0.0089	0.0018	12,000	21.34	0.0440
Hoya Ansmendi	0.345	0.230	0.0794	0.0159	12,000	190.44	0.3927
Llanos Boscosos	0.115	0.181	0.0208	0.0042	12,000	49.91	0.1029
Mean	0.211	0.201	0.0453	0.0091		108.67	0.2241

Figure 26 Estimated earnings of ranches of 5,000 ha, 20,000 ha, and 50,000 ha in each of the ecological regions based on information in table 10. *Note:* the value per hectare for the 5,000 ha ranch (a Fundo) is increased 2.65 times due to larger harvest quotas given to small ranches.



Venezuelan Government Earnings.

Aside from the landowners and tanners, the caiman program provided significant economic benefits to the Venezuelan wildlife management agency. Total earnings of PROFAUNA from the caiman harvest, derived from fees charged to program participants beginning in 1989, are substantial. Velasco *et al.* (1995) state that the participants in the program pay four types of fees: 1) a tax paid to the federal government, 2) fees paid to PROFAUNA by landowners, 3) fees paid to PROFAUNA by tanners and skin dealers, and 4) and finally a fee collected based on the size of the property harvesting caiman; this last fee is to cover PROFAUNA monitoring costs in the various ecological regions of the Llanos (see censusing). Initially, landowners were taxed based on the quota assigned; the funds going to the Venezuelan central treasury. Early in the program the taxes represented up to 20% of the costs of the landowner (Rivero-Blanco 1985), but by the early 1990's this was reduced to about 2% through inflation (Espinoza 1994). In 1989, the fee structure changed and in addition to the central government tax, a fee was charged directly by PROFAUNA. The actual amount charged landowners and tanners was set in the various governmental decrees. However each year these amounts are incremented according to the official level of inflation (M. Quero, A. Velasco, pers. com), with the adjustment made in June.

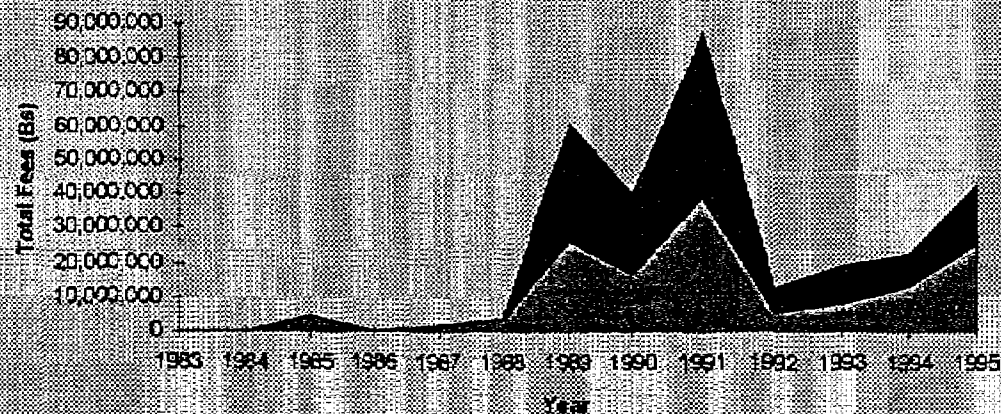
This change provided a more direct funding mechanism for PROFAUNA and its wildlife management activities using the proceeds from the caiman harvest. The income from the program to a large degree underwrote a major expansion of PROFAUNA in the late 1980's. In 1989, fees were Bs 170/caiman (\$4.7) for landowners and Bs 270/caiman (\$7.5) for tanners (table 9). As landowners were charged for the number of caiman they were authorized to hunt, and the tanners the number of skins tanned, the total revenue for 1989 is estimated to be Bs 60,391,380 (\$1.7 million), of which Bs. 57,634,260 (US\$ 1.6 million) would have gone to PROFAUNA. CEC (1990) cited a figure of Bs 40.8 million (US\$ 1.1 million) for PROFAUNA's income from the 1989 caiman harvest. The director of PROFAUNA (J.L. Mendez Arocha; cited in Colomine 1991) reported that in 1989 the

government received Bs 44 million (\$1.26 million). Earnings for other years, based on reported numbers of caiman authorized and hunted, are given in table 9. The totals of government taxes and fees for producers and tanners is represented graphically in figure 28. Over the life of the harvest, the fees paid by landowners (Bs. 119,818,592) and tanners (Bs. 132,089,697), have been almost equal.

Table 11. Federal tax and PROFAUNA fees charged to landowners (based on number of caiman authorized to hunt) and tanners (based on the number of skins purchased) from 1983-1995.

Year	Tax	Landowners/Tanners Fees		Government Proceeds		PROFAUNA Proceeds	
		Fees	Fees	Bs	US\$	Bs	US\$
1983	2			27,950	6,500	0	0
1984	2			170,884	27,254	0	
1985	20			4,712,980	628,397	0	
1986	20			0	0	0	
1987	20			2,000,000	137,531	0	
1988	20			3,460,640	238,665	0	
1989	20	170	270	60,391,380	1,741,389	57,624,260	1,661,888
1990	20	170	270	39,871,540	850,139	38,129,120	812,988
1991	20	255	360	86,910,520	1,529,576	84,082,200	1,479,799
1992	20	255	360	12,707,320	185,834	12,272,280	179,472
1993	20	332	465	19,186,424	211,262	18,714,144	206,035
1994	20	498	551	22,466,151	151,267	21,945,951	147,764
1995	20	498	852	66,661,690	376,960	65,686,350	371,445

Figure 27. Fees paid by producers (landowners-hatched) and tanners (black) to the government to obtain hunting permits (producers) and purchase skins (tanners).



Beginning in 1994, PROFAUNA began charging a fee to landowners to generate funds for caiman population monitoring efforts. A sliding fee schedule was developed with increasing fees for larger properties (Table 12).

Table 12. Sliding caiman monitoring fee schedule charged landowners.

Property size (ha)	Monitoring fee (Bs.)
<2,000	12,000
2,001-5,000	20,000
5,001-10,000	35,000
10,001-20,000	40,000
20,001-30,000	50,000
30,001-40,000	60,000
40,001-50,000	70,000
50,001-60,000	80,000
>60,000	120,000

Role of Private Organizations

In the late 1980s a group of five licensed tanners of caiman skins created an organization called AVECUR (Asociación Venezolano de Curtidores) which donated \$US 0.50 for every hide that was sold. The money was placed into a trust fund for wildlife conservation. Similarly, a group of landowners, who had formed a parallel organization ASOBABA (Asociación para la Cria y Conservación de la Baba) also paid a similar amount for every caiman harvested from member ranches. The money from these two organizations was used to create, in 1988, a third organization, FUNDIFAUNA (Fundación para la Investigación, Manejo y Aprovechamiento de la Fauna Silvestre).

The creation of FUNDIFAUNA was a direct result of the troubles experienced by the program in the late 1980's. At this time, the various program stakeholders, land owners, tanners, scientists and conservationists, all became well acquainted with the problems the program was experiencing, both technical problems and failures of implementation (FUNDIFAUNA 1990). Under these circumstances, it was notable that the two most important program stakeholders (the producers and the tanners) formed organizations, and in turn provided funds to establish FUNDIFAUNA, one of whose principal roles was to act as a medium for discussion of the caiman program's problems. As an independent organization, FUNDIFAUNA played an important role in organizing review of the caiman program, drawing together people from diverse backgrounds to participate in a process for reviewing the program, and creating a forum for discussion of its problems.

Programmatic Reviews

Periodic programmatic reviews have been carried out and have played an important role in correcting problems and establishing new harvest guidelines. These reviews have provided much of the information used in this analysis, providing a historical context in which the program can be viewed. Reviews have come from three sources: 1) PROFAUNA self-reviews, 2) workshops jointly held between PROFAUNA and a private organization (FUNDIFAUNA), and 3) a presidential commission (CONABABA) that was appointed in 1989.

PROFAUNA reviews have come largely through a series of published documents, many of which are cited in this report. Other reports were presented at meetings of the Crocodile Specialist Group. In 1995, PROFAUNA also held a workshop in Caracas to discuss the management program and seek ways to improve it. However, no results were ever published from this workshop.

FUNDAFAUNA collaborated with the government wildlife agency (PROFAUNA) to conduct a series of 3 workshops (in 1988, 1989, 1990) that reviewed the program and published summaries of these meetings.

In 1989, the presidential commission for the evaluations of the caiman management program (CONABABA) reviewed the program and issued a series of recommendations concerning the yearly calendar of activities, aspects of monitoring and control, training field personnel, the development of a research program, and public education and extension activities. The major recommendations of this review were:

1. Modify the hunting calendar to permit censuses conducted during one year serve for establishing harvest quotas for the following year (*was adopted by PROFAUNA*)
2. Reduce the harvest quota to 5% of the total population (*PROFAUNA regulations allow harvest of 20% of the SC IV which tend to be even more conservative than the suggested value*)
3. The separation of the CITES defined management and scientific authorities, both of which are assumed by PROFAUNA (*no action taken*)
4. Require that skin tags remain attached through the tanning process (*no action taken*)
5. Coordinate skin tagging operations between the Guardia Nacional and PROFAUNA (*coordination improved*)
6. Decentralize the administrative control of the program by establishing regional offices of PROFAUNA (*regional offices opened but have little authority in caiman program*)
7. Improve training of individuals who prepare technical reports by assigning training responsibility to a University or Universities with experience in wildlife biology. (*Technical report requirement has been eliminated by PROFAUNA*).
8. Establish a periodic re-certification system for individuals preparing technical reports. (*see # 7 above*)
9. Establish a computerized information system for the program and its annual results, and publish an annual report summarizing all pertinent information. (*no action taken*)
10. Design a program of research (including involvement of Universities) on caiman population dynamics and dedicate no less than 25% of the program's income to this program. (*no action taken*)
11. Establish an autonomous *ad hoc* committee to continue program reviews. (*no action taken*)

Discussion

The Venezuelan program has been widely cited as a model management effort for caiman. The program has benefited from a number of factors that predispose caiman as excellent candidates for SU management. Spectacled caiman have a valuable hide, are relatively small (for crocodilians) and due to the hyperseasonal nature of the llanos ecosystem, are easily censused and captured during the annual dry season. These same factors have lead to a number of ecological studies that have made caiman one of the best known species of wildlife in Venezuela.

Crocodylians in general are fecund animals, and because of their small size, caiman are relatively fast-maturing. Caiman are habitat generalists, and due to their size and adaptable nature can coexist well with humans. Because caiman are hunted directly from wild populations, there is no need for investment in costly infrastructure or to purchase large quantities of food as is required by programs based on captive rearing. Finally, caiman harvesting is complimentary with cattle ranching (Espinoza 1994), the dominant economic activity in most of the llanos region. Common habitat alterations that benefit cattle (e.g., creation of artificial bodies of water) also benefit caiman populations.

Since its inception, the program has gone through three major phases: 1) an initial period of rapid growth (1983-1985), 2) a period of program evaluation and relatively stable, high harvest levels (1987-1991), and 3) continued evaluation with a sharp reduction in harvest levels due to a drop international demand for skins (1991-1994). During boom years of late 1980's, the caiman program provided clear economic incentives for landowners to conserve wild caiman populations. The harvest generated significant revenues for the country (export value in excess of US\$ 115 million), particularly for skin buyers, tanners and landowners. Ranch employees also benefited, and the program provided seasonal employment opportunities for biologists and other individuals trained in caiman census techniques. Beginning in 1989, the caiman harvest also provided significant funding for PROFAUNA, which like many wildlife agencies had been a chronically underfunded. To a large degree, funds from the caiman program underwrote a major expansion of the wildlife management authority, which during this period underwent an unprecedented period of growth, hiring new personnel and opening regional offices in several parts of the country.

Nevertheless, the Venezuelan management program has had its share of difficulties. Some of these problems have been beyond the sphere of control of PROFAUNA, such as the inflationary economy in Venezuela and the fickle international demand for crocodilian skins and fluctuating skin prices, both of which tend to destabilize the program. However, many of the difficulties can be attributed to the administration of the program itself. As pointed out by Ojasti (1990), while the management plan has a firm technical foundation, failures of implementation of diverse origins have created numerous problems, and have been exacerbated by a lack of program of evaluation, follow-up and control which would allow PROFAUNA to detect program failures and correct them. While program evaluation has lead to a number of changes and improvement in the program, problems remain. Some of the major problems can be summarized as:

1. Lack of program transparency, particularly with respect to harvesting and censusing, the number of caiman authorized per ranch and sizes of ranches in the program.
2. Lack of understanding of the management/conservation objectives of the program by the general public, including landowners and ranch workers participating in the harvest.
3. Periodic bans on hunting that have contributed to a general lack of confidence in the stability of the program among landowners and tanners; reducing the incentive to invest in measures that will promote long-term sustainable management.

4. Lack of adequate control and enforcement capability (including penal sanctions) that led to:
 - Illegal hunting of caiman outside the established hunting season or on properties not issued permits
 - Transport and storing of skins without proper documents
 - Inadequate control at tanneries/customs
5. Inadequate training of personnel censusing caiman and preparing technical reports.
6. Insufficient checking of technical report results.
7. Poor design and implementation of a monitoring program.
8. Lack of an adequate research program.
9. Lack of a protocol for annual or biannual reviews of the program.

Harvest Quotas and Program Guidelines

The program initially aimed to keep the harvest under a certain fraction of the total population (7-12% originally, 5% later). This was later replaced by the harvest criterion of 20% of the size-class IV (large adult male) population. Based on the data from the regional surveys conducted in the early 1990s, we have tried to evaluate the harvest using the two criteria (5% total population, 20% SC IV). The survey data suggest that, using these criteria, target annual harvest levels for the region would be 60,000-85,000. Treating the region as a unit, harvesting over the life of the program has exceeded lower of these target values, but has been consistent with an annual offtake of 85,000.

However, these target values were estimated for the entire area of the caiman program. In any given year, only a certain percentage of that area is permitted for hunting. Data from 1997 suggests that this value is approximately 50%, and indicates that locally harvesting has exceeded the target harvest values. Harvest levels above those indicated by the surveys of Velasco and Ayarzagüena (1995) are a result of Profauna calculating harvest quotas for small and medium sized ranches using higher mean density values. Because a large fraction of the ranches participating in the program are medium sized, the overall harvest rate exceeds the target values based solely on the average density of caiman for each ecological region. The impacts of the higher harvest rates for the medium-small ranches should be an area of particular concern in future evaluations of the program.

Overall, the lack of evidence indicating unsustainably high levels of exploitation is in all likelihood due to a combination of factors, most importantly 1) the lack of a long-term monitoring program, and 2) the use of conservative target harvest quotas.

Illegal hunting and control issues

Within a worldwide context of crocodilian skin trade, illegal hunting and the trade of illegal skins has been a major impediment to the establishment of caiman SU programs in Latin America. The development of consumer confidence in the legality of the products made from caiman skins is essential for the long-term viability of the caiman skin industry. Illegal trade in caiman skins was widespread during the 1980's (refs), and as recently as the early 1990's it was estimated that of a worldwide trade of 1 million skins annually, only approximately 60% were from legal sources (IACTS 1996). Nevertheless, the trend

over the last 10 years has been increasing numbers of legal skins, and a decrease in the proportion of illegal skins. The recently accepted universal tagging resolution of CITES (Res. Conf. 9.22), which requires that all whole crocodilian skins be tagged in the country of origin, will make international monitoring of the skin trade much more effective and hopefully speed the decline of illegal trade in caiman skins.

In Venezuela, during the early years of the program, the size of the harvest grew at a rate much greater than did the capacity of MARNR to control it. Relatively lax controls and the high prices paid for caiman skins made illegal hunting a lucrative and widespread business. It is ironic that because some landowners felt that harvesting would reduce the number of caiman counted in subsequent censuses, and so reduce their future hunting quotas, they opted to purchase skins obtained illegally hunted from other areas. As in other cases (e.g. elephant ivory) the value of the commodity itself impeded efforts to develop a controlled SU program.

From a conservation viewpoint the most important question to be asked is what effect did illegal hunting have on caiman populations? Much of the illegal harvesting involved shifting a hunting permit from one area to another. Under this scenario the total number of caiman harvested may not have been increased, just the areas where they were hunted from were changed. Unfortunately, little information is available concerning the volume of illegally hunted in Venezuela. In a regional sense this illegal hunting may be viewed as being of little importance for the caiman population (Velasco and Ayarzagüena (1995), but has resulted in a patchy distribution of caiman, with some areas overexploited, while others retain large and healthy populations. However, the fact that widespread illegal hunting was taking place was symptomatic of a lack of adequate control, leaving open the possibility of over-harvesting.

It is quite possible that other types of illegal hunting have resulted in larger numbers of caiman being killed than legally allowed. In Venezuela, the price paid for skins is determined solely by size, with larger skins commanding higher prices. In order to fill hunting quotas as quickly as possible, hunters will take small animals (near the 1.8 m lower limit), but may throw these skins out if larger ones are available. During hunting, some animals escape and die without being skinned, and during the early years of the program, a significant proportion of skins were lost due to poor preservation and were replaced with other skins. Also, the lack of control in tanneries (by allowing the removal of skin tags) created a mechanism whereby smaller skins could be cut up and exported in pieces (which were not controlled) and replaced by larger, illegal skins. Although it is unclear how many skins were replaced in tanneries through this means, it potentially could have significantly increased the number of caiman harvested.

The combination of illegal hunting, skins losses, and the cutting up or discarding of small skins together resulted in many more caiman being killed than were permitted under PROFAUNA regulations, and are factors that argue for the use of conservative harvest quotas, especially for newly established programs.

Illegal hunting was facilitated by inadequate control by government authorities, and an emphasis on skins at the level of the producers (landowners). While adequate enforcement and monitoring of caiman hunting on ranches is certainly necessary, a much more cost-effective approach is to control the program at the level of the tanners. At the height of the program, some 600 ranches received hunting permits. At the same time, all

these skins had to pass through only six tanneries in Venezuela. By closely monitoring the skins that enter and exit tanneries, the Venezuelan wildlife authorities could more efficiently focus control efforts at one of the programs bottleneck points. However, because tanners are allowed to remove the skin tags it became impossible for the management authorities to follow skins through the tanning process. This has been the single greatest impediment to effective control of the national skin trade. Presently, tags on skins are removed and new tags applied prior to export to meet CITES requirements for international trade. One tagging system that serves both national control needs as well as the would be the most practical and cost-effective solution. The Venezuelan management authority has recognized the need for keeping skins and tags together (J.L. Mendez-Arocha, pers. comm.), but has awaited the design of tags acceptable to tanners. In other countries some tanners minimize tag loss by wrapping them with rubber bands to part of the skin. This reduces tag loss during tanning and could be complimented by a system where lost tags are replaced by the management authority after being matched to the skin from which they came (P. Ross, pers. comm.).

Although figures for the volume of illegal trade are not available, the decline of skin prices in the early 1990's most certainly played an important role in reducing economic incentives for illegal hunting in Venezuela, as they did in Brazilian Pantanal (Mourão *et al.* 1996). Prices are again rising and the question is will this lead to increased illegal hunting? Perhaps the best possibility for the long-term stability of the Venezuela harvest program will be the maintenance of stable, moderate prices of caiman skins. However, this is complicated by the economic situation in Venezuela where high rates of inflation could devalue skin prices to the point where it is no longer a lucrative business for landowners.

Role in Habitat Protection

Crocodilian harvest management programs are often claimed to benefit conservation by generating economic incentive to protect habitat. In the Venezuelan Llanos, there is no evidence of such a benefit. Cattle ranching is the most lucrative economic use of land throughout the area where caiman are harvested, and quite fortuitously for caiman, habitat improvements for cattle have also benefited caiman. The creation of stock ponds by damming streams, digging borrow-pits or the use of windmills has greatly increased the availability of savanna wetlands during the critical four month dry season. On some ranches caiman populations are now much higher than in the past (Thorbjarnarson 1991a), in some cases by an order of magnitude or more. To a certain extent caiman are symbiotes of cattle in the Llanos, and cattle ranching and caiman harvesting are very compatible activities.

Incentives for Landowners to Protect Caiman Populations

Initially, harvest quotas were based on direct counts on each ranch. As the program, and the number of applicants grew, so did the demands on PROFAUNA's ability to adequately census all the ranches involved. The move towards requiring technical reports from private individuals trained and certified by PROFAUNA to census caiman was the result of an censusing work load beyond the capacity of PROFAUNA personnel to manage. However, due to inadequate training and a variety of other factors, many of

the technical reports were of low quality and PROFAUNA was forced to reconsider. Subsequently, in an attempt to simplify and standardize the quota determining process, the number of caiman permitted is determined principally by the size of property and the mean regional values of caiman density and size-class structure. One consequence of these changes in the way quotas are assigned is that now the economic benefits derived from the harvest is less likely to reflect the density of caiman on a landowner's property. Although the present system greatly simplifies the procedure for assigning harvest quotas, the unit of management has been changed from the private ranch to the ecological region.

In a very real sense this change goes to the heart of the debate over sustainable use of wildlife. Among the strongest arguments for SU programs is that it creates a situation where it makes economic sense to protect wild populations and their habitat. Under the present system landowners can still benefit economically from harvesting caiman, but the economic incentives to protect caiman and their habitat have been diminished. For those landowners who may have taken steps to protect their caiman, and have density and population size-class above the regional mean, no extra economic benefits accrue. Why should a landowner take steps to encourage the growth of caiman populations on his/her property when in many cases his/her harvest quota is determined instead by the state of the caiman population in the surrounding region? Furthermore, as caiman densities vary considerably in different parts of the Llanos, the economic incentives for participating in the program depend on which ecological region the ranch is located (e.g., Fig. 26).

Nevertheless, as pointed out by Espinoza (1994), caiman harvesting has a very high benefit/cost ratio. So while the overall earnings are minor compared to cattle ranching, caiman harvesting is seen as a lucrative, short-term activity that can be used to cover some of the basic costs of cattle ranching. Also, when caiman hunting is combined with harvesting programs for other economically important species, and ecotourism, the economic benefits that accrue to landowners that protect natural llanos landscapes can be substantial. Hoogesteijn and Chapman (1997), show that combined harvesting schemes for caiman and capybara can be equivalent to 25-52% of the total ranch income. One of the ranches has a successful ecotourism business that earns approximately \$US 350,000 annually (Hoogesteijn and Chapman 1997). MARNR has demonstrated interest in developing managed harvest for other species of economically valuable llanos wildlife (tegu lizards- *Tupinambis teguixin*, anacondas-*Eunectes murinus*, both for their skins) which could increase the economic value of natural habitats to llanos landowners. Provided the programs are biologically and economically feasible, commercial management of a suit of species could provide significant incentives for landowners to protect habitat in the llanos.

Could the reduction of economic incentives lead to increased illegal hunting? This is one potential result as landowners may be less likely to take steps to prevent hunters from entering their land illegally. Also, as quotas are not as tightly tied to an actual census of the caiman population on individual properties, there may be more incentives for landowners to permit illegal hunting to sell the skins to others (the "pata quebrada" problem). Alternatively, one of the apparent reasons why there was so much trade of illegal skins was because landowners did not wish hunting to reduce the size of the caiman on their properties (as they believed that would diminish the size of future censuses and hence their harvest). The new system for assigning quotas (based on values for the

ecological region, and not the ranch) could reduce the incentives for landowners to purchase illegal skins.

Population monitoring-How much is needed?

How important is population monitoring, especially given the high time and cost investments are required? In the case of caiman, three strong cases can be made for the need for monitoring: 1) to establish biologically viable harvest quotas, 2) to evaluate the sustainability of the harvest, and 3) to increase consumer confidence in the legality, and conservation value of the managed harvest. Many harvest programs claim to be sustainable use initiatives. However, without a monitoring component, there is no way to verify if use is sustainable or not. Monitoring is essential to evaluate the effect of the harvest on the species in question, and in the case of Venezuelan caiman, should target two samples: the wild population, and the harvested population. The key lies in the design that will allow both to be done at relatively low cost, while producing information adequate to evaluate trends.

In Venezuela, a great deal of effort has been put into population counts to determine population quotas for landowners, and to monitor the effects of the harvest on caiman populations. Despite the large volume of information produced, two major problems have hindered analysis: a lack of census technique standardization, and a failure to evaluate factors which affect the proportion of the population visible (especially water level). The failure of the Venezuelan program to adequately monitor populations is due in large part to the large area to be covered, the lack of adequately trained staff, and an evolution in census techniques used to estimate caiman populations. The early census technique, based on diurnal counts, was a low-precision method of estimating population size (Velasco *et al.* 1993). Even today, estimates of population size-class structure are made based on a combination of diurnal and nocturnal observations, which leads to considerable error. Also, as the program grew it rapidly out-stripped the capacity of MARNR-PROFAUNA to adequately census all the properties requesting permits. The subsequent use of technical reports by accredited individuals was seen as a way to improve the quality of the census data while meeting the increasing demand of ranches requesting harvest permit. However, the lessons from the Venezuelan experience suggest that unless significant time and resources are devoted to training individuals, this approach will result in poor quality information which is useless for monitoring purposes.

It was due to the lack of credibility of the technical reports that PROFAUNA replaced the censusing program with a regional census carried out in conjunction with a major university (Instituto de Zoología Tropical- Universidad Central de Venezuela; IZT-UCV). Since 1991, increased attention has been paid to the need for a monitoring program. Initially funded by external funds in collaboration with CITES, now all censusing is financed by a fee charged directly to the ranchers, and surveys are carried out in conjunction with a major Venezuelan University. Nevertheless, the program has been limited in scope and current program, while adequate for producing information on the status of wild caiman populations, has not been designed for determining population trends or measuring the effects of hunting on wild populations.

Determining the effects of the harvest of caiman populations requires a monitoring program capable of determining population trends. The 1996 PROFAUNA-IZT-UCV

survey used the same censusing guidelines as in the 1991-92 surveys. This is a welcome first step towards standardizing survey protocol. Population counts, however thorough, only represent samples of the caiman population, and an understanding of the sampling errors involved is essential for interpreting the results. A number of environmental factors also influence the proportion of the population that is viewed, the most important being water level (Messel *et al.* 1981, Wood *et al.* 1985, Thorbjarnarson 1991b). Variation in water level, which exerts a profound effect on the number of caiman seen, has not been taken into consideration in the design of the Venezuelan population monitoring program. A strong recommendation is for PROFAUNA to undertake a multi-year study to quantify these variables. Similar studies have been done for other species of crocodilians (Woodward and Marion 1978, Wood *et al.* 1985, Bayliss 1987), where habitat factors make censusing more difficult than in the Venezuelan llanos. A clearer understanding of the effects of sampling errors in counts of caiman can lead to the design of a much more cost-effective, and statistically valid censusing protocol. Aside from the design of surveys, standardization of personnel that conduct censuses for technical reports should be carried out. Emphasis needs to be placed on the quality, rather than the quantity of data and censuses need to be performed by well-trained individuals.

The results of the research program could be used to design an efficient and statistically valid monitoring program. The current mechanism of collaborating with UCV-IZT to conduct surveys has great potential and should be continued and expanded. If each of participating ranches was surveyed periodically by PROFAUNA-IZT-UCV personnel it would provide: 1) quality data for a regional survey that evaluates population trends and the impact of the harvest on wild populations, 2) improved quality of technical reports, and 3) a mechanism to re-establish direct economic incentives for landowners to protect their caiman populations.

Since 1990, an average of 350 ranches have been issued hunting permits each year. If ranches were surveyed by MARNR every third year, this would require counts be made on approximately 117 ranches per year. This is not an unreasonable workload for survey personnel provided that: 1) adequate funding for monitoring is maintained through direct fees to the landowners (and tanners), and 2) appropriate sampling methodologies (based on the results of the research program) are employed.

Monitoring of the status of wild populations is one approach. Aside from measures of population density, the size-class structure of the harvested population is a powerful monitoring tool. Since 1988, PROFAUNA has measured skins at the Centro de Acopio to monitor the effects of harvesting. However, little of this information has not been made publicly available and cannot be used to evaluate the effect of hunting. It is vital that these data be analyzed and published.

Adequate reporting of the results of monitoring efforts is also vital. Analyses of the results of the 1991-2 surveys were published (in 1995), but contained only summaries of data by ecological region. While the stratification of the survey by ecological regions is a valid approach, there is considerable variability among ranches within each region. Summaries of population density and population size-class distribution, while presenting a good overview of the status of the populations, is inadequate for analyzing the effect of the harvest. Presenting information on the within-region variability would greatly assist the analysis and understanding of survey results. More detailed analyses of counts on a

ranch by ranch basis would also be very helpful for determining the effect of hunting on caiman populations.

Research: Lost Opportunities

The Venezuelan caiman management program is based on a relatively good understanding of the basic biology of the species. Nevertheless, very little is known about the effect of hunting on caiman populations. The harvest program creates excellent opportunities for basic and applied research on caiman, research which will benefit the program at several levels. With few exceptions, these research opportunities have not been taken and this has been one of the major shortcomings of the Venezuelan program.

Research efforts have been one of the hallmarks of many successful crocodilian management programs (e.g., Australia, Papua-New Guinea, Zimbabwe, and the United States). In Brazil, an experimental harvesting program is underway to determine the effects of hunting on populations of *Caiman yacare* (G. Mourão, pers. comm.). Yet despite biological conditions very favorable for research, no such program has been initiated in Venezuela. Not even to examine such things as diet and reproductive status, which could be done with very little effort. One of the principal recommendations of the CONABABA Presidential Review Commission was to devote a sizable fraction of the program proceeds ($\geq 20\%$) on research into the dynamics of exploited caiman populations.

Research will have important implications for the future of the program in at least three areas: 1) the design of an efficient censusing protocols, 2) understanding how the harvest is affecting wild population and 3) the setting of harvest quotas.

Lack of Program Transparency and Need for Regular Review

The history of the Venezuelan caiman harvest has pointed out the importance of periodic programmatic review. While the review process was sporadic, it has resulted in a number of changes that have improved the program. While internal, self-review is a valuable process, examination by independent groups in conjunction with PROFAUNA (e.g. FUNDAFAUNA) has produced the greatest benefits.

One of the greatest impediments to program review is the lack of readily available, reliable information on the program. Most of the information contained in this report has come from a variety of MARNR-PROFAUNA reports, the FUNDAFAUNA review documents, and a variety of published articles. However, annual summaries of the harvest are not published by PROFAUNA. Not only does the lack of readily available information on the program make scientific review difficult, it can lead to an atmosphere of mistrust among the program participants (landowners, skin buyers, tanners). Increasing the transparency of the caiman harvest operations can only benefit the program in the long term.

To address these problems, PROFAUNA should produce (in a timely fashion) an annual review of the caiman harvest that contains information on:

- Ranches requesting permits
- Ranches denied permits and the reasons why
- Ranches given permits, plus information on:
 - Size of land-holding
 - Number of caiman authorized

Number of caiman hunted

Size-class distribution of hunted caiman

- Summary information on the total number of caiman harvested and size-class structure (as monitoring efforts are now based on ecological regions, the total harvest and size-class structure of harvested caiman should also be broken down and summarized by ecological region)
- Information on the number of confiscated skins, and a list of ranches issues citations for program abuses
- Average prices paid for raw and tanned skins
- Number of and size-class structure of skins exported and countries of destination

Additionally, a new venue must be found for periodic program review.

FUNDAFAUNA no longer exists, but it played an extremely important role in sponsoring annual workshops evaluating the caiman program. The combination of presented papers followed by round-table discussions and recommendations worked very well and should be continued by either a conservation NGO or a University.

Recommendations

A summary of the recommendations discussed above follows:

Financing of program.

1. The program's activities (including control, monitoring, research) should be financed in its entirety though fees charged to program participants.
2. Within the activities of the management authority, first priority of the use of caiman program proceeds should be for the adequate funding of these activities.
3. The recent inclusion of a fee to fund monitoring activities is laudable, but should also be applied to tanners and not just landowners.

Research and Monitoring Program

1. Implement a cooperative research program on caiman population biology with one or more universities using funding from the program fees. Objectives should include:
 - develop standardized census procedures that take into account sampling and environmental variability
 - investigate the impact of harvesting on wild caiman populations.
2. Design a long-term population monitoring strategy and implement it on an annual basis-preferably in conjunction with an independent organization such as the present arrangement with the Universidad Central
3. Reports on the results of monitoring surveys should be produced on a timely basis. Analyses should not only summarize data by ecological region but should present and compare results from individual ranches in a more complete attempt to discern the effects of hunting on caiman populations.

Control

1. Skins on ranches should be provided with tags that comply with the CITES Universal Tagging Resolution, and these tags should not be removed prior to export.
2. Conduct periodic, unannounced visits to tanneries to inventory skins.

Harvest Quotas

1. Harvest quotas should be based on the more conservative figure of 20% of the size-class IV (adult male) population, rather than 5% of the total non-hatchling population.
2. Using either of these values, however, suggests that maximum annual harvests should not exceed 60,000-85,000 (if 100% of the available properties are included in the program). Quotas should be reduced according to the percentage of land that receives hunting permits.
3. Pending modifications in the censusing and monitoring program, return to the system of basing harvest quotas on census values for individual ranches.

Greater Program Transparency

1. On an annual basis MARNR should prepare a report which should include:
 - Names of ranches participating and a brief summary of the technical report results (name of individuals who prepared report, dates surveyed, size of ranch, caiman density and population structure)
 - Quotas assigned to each ranch
 - Number harvested by ranch and total harvest.
 - Measurements of a sample of skins from each ranch (as part of skin size monitoring program)
 - Average prices paid for crude and crust tanned skins.
 - Number of skins exported and major importing countries.

Program Review

1. Plan biennial workshops reviewing the program open to all interested parties.
2. Workshops should follow the blueprint of the FUNDAFAUNA sponsored meetings by combining formal presentations with roundtable discussions and the prompt publication of the proceedings.

General Recommendations for Developing Caiman Harvest Programs

The Venezuelan harvest program has been a learning process that has provided a number of lesson regarding the development of similar programs based on sustainable use.

- Programs should begin on a small, experimental basis
- Program growth should be in step with the management authority's administrative and technical ability to run the program
- Initial program planning should include an economic analysis to ensure the program is:
 1. autofinanced through taxes and fees assessed to program participants
 2. Adequate resources are devoted to control and monitoring activities

3. A simultaneous research program should be developed and financed through program proceeds
 - Control should be carried out at several levels, with particular emphasis on skin-trade bottlenecks (in the case of Venezuela, which exports semi-tanned skins, the bottleneck is the tanneries)
 - Monitoring should be designed to be as simple and efficient as possible while allowing enough power to measure the impact of harvesting on wild populations (e.g. through population trends or size-class composition)
 - Build-in design of annual review workshops, involving all levels of program participants to discuss how to improve program- fund through program proceeds.

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