

Table 3. Positive environmental conditions of habitats.

| Location | Mangrove | Forest | Sandy Beaches | Fresh Water | Presence of the Species | Protected Area |
|-----------------------|----------|--------|---------------|-------------|-------------------------|----------------|
| Neverí River | X | X | X | X | X | |
| Píritu Lagoon | X | X | X | X | X | |
| Uchire Lagoon | X | X | | X | | |
| Caño Sur | X | | X | X | X | |
| Caño Camaronera | X | | X | X | | |
| Unare River | X | | X | X | X | |
| Tacarigua Lagoon | X | X | X | X | X | X |
| Río Chico Channels | X | | | X | X | |
| Turiamo Bay | X | | X | X | X | |
| Yaracuy River | X | X | X | X | X | |
| Aroa River | X | X | X | X | X | |
| Paují Creek | X | X | X | X | X | |
| Las Pabas II Creek | X | X | X | X | X | |
| Morrocoy NP | X | | X | | X | X |
| Cuare WLR | X | X | X | X | X | X |
| Tacarigua Reservoir | | X | X | X | X | X |
| Játira Reservoir | | X | X | X | X | X |
| Tocuyo River | | X | X | X | X | |
| Tucurere River | X | X | X | X | X | |
| Hueque | | | | | | |
| Los Olivitos WLR | X | X | X | X | X | X |
| Burro Negro Reservoir | | X | X | X | X | X |
| Cumaripa Reservoir | | X | X | X | | X |

nesting, affluence or predominance of freshwater, protection by law of the areas. As negative factors, tourism and urbanism, together with fishery and other human activities were identified. Keeping as a goal the conservation and recovery of the wild populations of the species, it is strongly recommended the protection by law of the identified suitable habitats for releasing or re-introduction of ranched animals.

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Table 4. Negative environmental conditions of habitats.

| Location | Tourism | Housing | Agriculture | Industry | Navigation | Fishery | Roads |
|-----------------------|---------|---------|-------------|----------|------------|---------|-------|
| Neverí River | | X | X | X | X | | X |
| Píritu Lagoon | X | X | X | | | X | X |
| Uchire Lagoon | X | X | X | X | X | X | X |
| Caño Sur | | X | X | | X | X | X |
| Caño Camaronera | | X | X | X | X | X | |
| Unare River | | X | X | | X | X | X |
| Tacarigua Lagoon | X | | | | X | X | |
| Río Chico Channels | X | X | | X | X | X | X |
| Turiamo Bay | X | | | | | | |
| Yaracuy River | | X | X | X | X | X | |
| Aroa River | | X | X | | | X | X |
| Paují Creek | | X | X | | | X | X |
| Las Pabas II Creek | | X | X | | | X | X |
| Morrocoy NP | X | X | | X | X | X | X |
| Cuare WLR | X | X | | | X | X | |
| Tacarigua Reservoir | | | | | | | |
| Játira Reservoir | | | | | | | |
| Tocuyo River | | | | | | X | X |
| Tucurere River | | | | | | X | X |
| Hueque | | | | | | | X |
| Los Olivitos WLR | | | | | | X | X |
| Burro Negro Reservoir | | | | | | | |
| Cumaripa Reservoir | | | | | | | |

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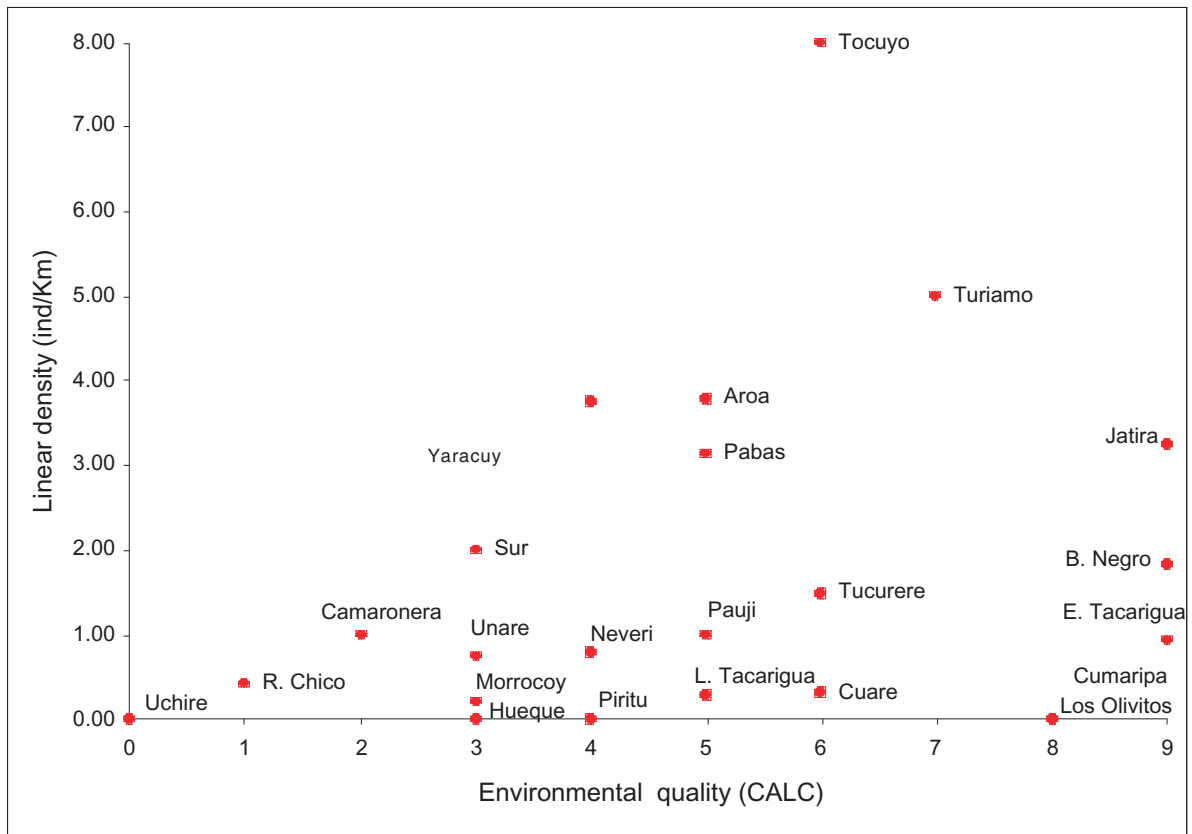


Figure 3. Graph for Olmstead-Tuckey test with density and environmental quality values for each habitat.

Analysis of the Program of Conservation and Use of the Spectacled Caiman (*Caiman yacare*) in Bolivia, and Recommendations to Improve It

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Abstract

The Program for Conservation and Use of Spectacled Caiman (*Caiman yacare*) in Bolivia began in 1995, with limited population surveys carried out in the lowland areas of the country. In 1997 a small-scale experimental harvest was carried out, and in the following years between 30,000 (1999) and 59,000 (2003) individuals were harvested. A first analysis of the program was carried out in 2002 in a workshop with the participation of national and international specialists. This workshop detected some problems in the development of the program, mainly related to control mechanisms. Despite subsequent recommendations, during 2003 serious flaws to the Program were detected, related to the weakness of control mechanisms exercised by Departmental Governments, unreliability in the monitoring and harvest components, unjust distribution of benefits, and violations to regulations. Here we detail some considerations that should be followed in order to improve the Program. These include: a) legal modifications to regulations to improve their applicability, b) capacity building for direct users of the Program (rural and indigenous communities, and cattlemen), c) improvement of the control systems and inspection mechanisms, d) design and implementation of a comprehensive and reliable monitoring program, and e) administration and management of spatially defined units, based on land tenure, and with greater participation of local actors to increase social control mechanisms.

Introduction

Although from the decade of the 70s we have information about the caiman of Bolivia (Donoso-Barros 1974; Lovisek 1977, 1980), the studies carried out in that time were very casual and with little transcendence for the conservation of the caiman in the country (Pacheco 1996). During the same decade, Medem carried out the first inventory at great scale whose results were published ten years later (Medem 1983), with information, for the first time, on the natural history of the caiman in Bolivia. The second great effort to gather information at a major scale about the populations of caiman was carried out in 1986, with six months of work was possible to obtain information comparable to the one gathered by Medem on the distribution of the species and the status of some populations (King and Videz-Roca 1989). Starting from that moment, several works that offer information on the population status of the spectacled caiman (*Caiman yacare*) were carried out in different areas of the country like Beni, Santa Cruz and Cochabamba (Ruiz 1988; Videz-Roca 1987, 1989; Ergueta and Pacheco 1990; Vaca 1992; Pacheco 1993; Rebolledo-Garin and Tapia-Arauz 1994; Llobet 1996; Llobet and Goitia 1997).

The studies made in 1986 showed that, although the species was practically exterminated in some areas of Beni, in other regions it was particularly abundant with densities up to 70 ind/km of shore. (King and Videz-Roca 1989). The same situation was observed in Santa Cruz, where very low densities were reported in some areas (King and Videz-Roca 1989; Ergueta and Pacheco 1990; Rebolledo-Garin and Tapia-Arauz 1994), meanwhile in other (as the area of San Matías), the observed aggregations (especially during the dry time) produced high densities, similar to those reported in the Venezuelan plains (Pacheco and King 1995). It is considered that at the moment the species is not endangered (Pacheco and Aparicio 1996), however it is necessary to remember that the *C. yacare* populations suffered in the past a strong hunting pressure, being depressed in most of their distribution area (Pacheco 1996). According to the recovery experienced by the spectacled caiman populations in the last years, a program of sustainable use of the species can be carried out, but it is necessary to respect the conditions and the harvest quotas settled down in the national rules (Godshalk 1994; Llobet and Aparicio 1999).

The use of crocodylians can be carried out in different ways: harvests of wild animals, ranching (crops of eggs and/or hatchlings for breeding in captivity) and breeding in complete captivity (farms) maintaining reproductive adults in captivity. Each system involves advantages or disadvantages in terms of the conservation value, regulation easiness and costs and economic return (David 1994); for this reason, the application of each one (or several) of these methods should be preceded of an analysis of the reality (considering biological aspects of the species, and socioeconomic characteristics of the region where it is sought to work).

The chosen model to develop a program of sustainable use of *C. yacare* in Bolivia was the harvesting of wild animals, based on the success demonstrated by the Venezuelan experience with *C. crocodilus* (Thorbjarnarson and Velasco 1998). This system requires the smaller economic investment, and the biggest beneficiaries are the owners of the lands (Velasco *et al.* 1995). The use is based on the sexual differences presented in the species to establish the limits of minimum size for the animals to be harvested; in such way that the harvest process is focused towards the animals bigger than 180 cm total length (TL), which are generally males, protecting this way the reproductive females. A situation that it is necessary to have in mind, is that the hunt in the nature is very difficult to regulate and it has a high risk of not being sustainable; so the crocodile populations can be diminished very easily by the removal of reproductive adults. If add to this that the great overexploitation of crocodile populations that took to many species at critical levels from the point of view of its conservation, was owed in great measure to the direct hunt (King 1989), it is easy to deduce that different control systems are needed to adjust and to correct the flaws of the program, in such a way that we can assure the implementation of the main objective: to achieve the effective conservation of the *C. yacare* in Bolivia.

It has been pointed out that the sustainable use can generate bigger interest in the conservation of the species to be used (Thorbjarnarson 1992; Jenkins 1993; Ross 1995); however, in Latin America the benefits of the use are not generally reinvested in programs of conservation of the same species (Hines and Abercrombie 1987; Magnusson 1995). The idea that the use can produce benefits to the conservation processes is interesting, and it arises on a base of investigation of many years that demonstrated the success of the sustainable use of crocodylians in countries like New Guinea, Venezuela, Zimbabwe, United States and Australia (Hutton and Child 1989; Joanen *et al.* 1990; Genolagani and Wilmot 1990; Webb *et al.* 1992; Velasco and De Sola 1997). In spite of these successes, the use programs can be affected or weakened if no benefit is dedicated to the conservation by the lack of an integrated plan.

It is necessary to consider like a reality the fact that the commercial use of the crocodylians is subjected to the fluctuations of the market, where many times the involved actors concentrate their efforts on the economic aspects, causing that the field of the sustainability of the resource is neglected (Magnusson 1995). The big fluctuations in the market of crocodylian products suggest that no conservation plane should be based exclusively on the success of the economic use. As any other international merchandise, the crocodylian products are object of the force of the market and the changes of prices that are beyond the control of the producers (Woodward *et al.* 1994). Such economic fluctuations represent a great danger for the programs of sustainable use, because they impel the economic balance toward the decrease of the production costs increasing the “temptation” to return to a non-sustainable exploitation of wild leathers (Ross 1995).

One of the problems of the projects of economic use is that they are seen as results in the economic plane, and don't as opportunity to generate information that improves the management or increase our scientific knowledge. That is to say, if we consider that the knowledge of the dynamics of the crocodile populations is still limited, it should be assumed that this type of information also has a limited utility in the development of management plans. If we assume that the task of the investigators and administrators of resources responsible for the management of crocodylians are to establish programs with high probabilities of sustainable use of the resource (Ross 1995), then the management plans should also be constituted as a source of information on the population dynamics, as feedback to correct the errors and to assure the execution of the outlined objectives. For this reason each management plan should be intimately linked to a monitoring program (McNab 1983; Walters and Holling 1990 in Magnusson 1995).

Finally, the capacity to apply the laws is a particularly complex topic in the Latin American countries, because many times this is related with the political will to develop processes. Generally the lack of institutionalism in the government agencies is a common factor that affects negatively every conservation effort in Bolivia. A way to attack this problem is looking for support on the different international agreements (like CITES) of which Bolivia is signatory.

Chronology of the Program of Conservation and Use of the Spectacled Caiman (*C. yacare*) in Bolivia

In Bolivia the development of a pilot program of sustainable use of the *Caiman yacare* arose in 1995 with the project

“A Programme for the Sustainable Utilization and Management of Caiman in Bolivia” (King 1995; Godshalk 1994), which gave basis to promulgate in 1997 the Regulation for the Conservation and Use of the Spectacled Caiman (*C. yacare*) for the Departments of Santa Cruz and Beni (Supreme Ordinance - S.O. 24774, of July 31st of 1997) (Fig. 1). At the same time, the National Direction for the Conservation of Biodiversity - NDCB (now General Direction of Biodiversity-GDB), elaborated the National Program of Conservation and Sustainable Use of the Caimans of Bolivia, in which the monitoring of spectacled caiman populations (and other crocodylian species) were considered (Llobet and Aparicio 1999). With this base, the use of *C. yacare* was authorized, under requirements and conditions of the Regulation, and an Experimental Plan of Use of the Spectacled Caiman was settled down in areas selected by the term of 2 years. At the same time, the burning of confiscated products was established as a mechanism directed to control the illegal hunting.



Figure 1. Map of Bolivia. The Departments where the Program of Conservation and Sustainable Use of the Spectacled Caiman was implemented are highlighted (dark grey).

In November of 1997, on this legal base and with financing of the Royal Embassy of Holland, a Management Plan was elaborated (Aparicio 1997) and the use of the Spectacled Caiman began, with reduced harvesting quotas and a hunting methodology only consented with harpoon. The results of the experimental harvest allowed to determine that the hunt with harpoon was very difficult to carry out in Bolivia, basically for the lack of experience of the local people in the use of this instrument. On the other hand, the harvest quota assigned for the different cattle ranches was insufficient at least to pay the expenses of transport and of the personnel dedicated to carry out this activities.

The same year, seizures made by the Authority of Beni Department, originated disagreements and confrontations by the instruction of burning 17,609 skins of Spectacled Caiman. That instruction based on the S.O. 24774, caused that several regional institutions of that Department, headed by the Civic Committee of Beni, carried out a series of protests, causing that in 1998 a Commission of Revision of the mentioned Supreme Ordinance was conformed (directed by the Presidency of the Republic) in order to giving solution to the problems generated by the S.O. 24774. Soon after the conformation of this Commission, an Administrative Resolution (01/98) is emitted. By means of this Resolution, the Prefecture of Beni (in coordination with the Civic Committee and the Technical University of the Beni) received authorization to commercialize the 17609 skins, besides the emission of the corresponding CITES certificates for the export of the same ones.

On July 21st of 1999, the S.O. 25458 was promulgated, which grants a new legal mark for the management of wildlife, allowing the rising of the prohibition for the susceptible species of sustainable use by means of a Ministerial

Resolution. On the other hand, on 22 October of 1999, the S.O. 25555 was promulgated, which authorizes to the Ministry of Sustainable Development, to emit the Ministerial Resolution that approved a Provisional Regulation (with exception character) that allowed the use of the *C. yacare* during the year 1999.

On 30 November of 1999, the Ministerial Resolution 307/99 was promulgated, that approves the Regulation (with exception character again) for the conservation and use of the Spectacled Caiman and norm the transition among the hunt carried out in the months of October to December of 1999, and the new process to be initiate in the year of 2000. On 17 December of the same year, the Ministerial Resolution 330/99 was promulgated, which authorized the harvest and the storing of *C. yacare* skins, and it established a quota correspondent to 60.8% of the recommendation of the group of experts of the IUCN of Bolivia (Pacheco *et al.* 1999), distributing a general quota of 36,500 skins into: 30,000 skins for the Department of Beni, 3500 for the Department of Santa Cruz and 3000 for the Department of La Paz. Although for the elaboration of the document, the specialists of the IUCN (now authors of this work) took as a supposition that the populations of *C. yacare* had been increased after the promulgation of the S.O. 22641 (that declared a General and Indefinite Prohibition of hunting), they established a series of conditions to assure that the populations of *Caiman yacare* were not affected by an excessive harvest (Pacheco *et al.* 1999):

- Not to harvest in forest areas.
- To distribute the harvest in an homogeneous way in the space (savanna areas).
- To look for a mechanism that impedes the legalization of skins totally above this figure.
- If it is not possible to avoid the realization of auctions that legalize illegal leathers above the established quota, a smaller quota (as the half of was proposed) should be given.
- Not to assign quotas for the harvest of the year 2000 without carrying out the population evaluations of *C. yacare* during the dry season of 1999.

Under this context, the use of the Spectacled Caiman began in the Department of Beni, benefiting indigenous people (Central de Pueblos Indígenas del Beni - CPIB) who made use of a harvest quota of 30,000 skins in that year. In parallel, although for Ministerial Resolution N° 330/99 a quota of 3500 skins had been granted for Santa Cruz and 3000 for La Paz, these Departments didn't make use of the same ones.

In the year 2000, the General Direction of Biodiversity, with the support of CESO/SACO - Canada (Canadian Executive Service Organization) and the adviser Dr. Douglas Ravenstein, defined Eco-regions for the Program of Use of the Spectacled Caiman, which were elaborated with base in information analyzed by a Geographical Information System (GIS), as a proposal to be adjusted in function of new information.

During the same year, authorizations of extraction of *C. yacare* skins were not emitted by absence of necessary technical information, but there were carried out population evaluations of the species by a consultant group (PIAS 2001a, PIAS 2001b). Four eco-regions were evaluated (3, 5, 9 and 10) of the 11 defined for the use of the Spectacled Caiman, recommending a harvesting quota of 43,683 individuals for the whole Department of the Beni. The study was approved by the Advisory Council of Wildlife, being authorized a quota of 40,000 individuals for the Department of Beni, 5000 for Santa Cruz and 1500 for Pando, totalizing a quota of 46,500 animals for the year 2001.

During the year 2002, was assumed that it was necessary to evaluate the development of the process and the operation of the use program to a national level. Between 2 April and 4 April of that year, in the city of Trinidad was organized a workshop with the participation of specialists, sectors and involved institutions; in this workshop some topics of interest related with the impacts of the previous crops, deficiencies and advantages of the administration, control and inspection, were discussed. In parallel, a new version of the Regulation for the Conservation and Sustainable Use of the Spectacled Caiman (*C. yacare*) was approved, through the Ministerial Resolution N° 147/02.

In August 2002, and based on the study presented by the Prefecture of the Beni and elaborated by the consultant company Amazonia Conserva SRL (2002) and with the guarantee of Wildlife Advisory Council (group of scientific and technical institutions whose paper is to advise to the National Authority), a Ministerial Resolution (R.M. 155) was emitted authorizing a harvest of 39,132 individuals of the species in Beni Department. In parallel, the R.M. N° 156 of the same year authorized a harvest of 5000 animals for the Department of Santa Cruz. However, for not having a study that justifies this quota in this Department, that number was approved "with exception character and only for one time", with the purpose of not stopping the process and to obtain funds to be able to carry out a study that determines the population status of the species in the region.

During the year 2003, in the Department of the Beni, there were a series of administrative irregularities with regard

to the bid process to select the company that could work in the population counts dedicated to define harvest quota. To this situation, we need to add the results of a study with doubtful levels of reliability (product of the methodology and the analysis), so the Vice-Ministry of Natural Resources and Environment took the decision of not recognizing the study presented by the Prefecture of the Beni, and by means of which a harvest quota of 66,858 animals was requested. In this sense, and with the purpose of not affecting the social and economic sustainability of the program, The Vice-ministry decided to use the information coming from the study of 2002, and apply the harvest indexes calculated for this year to the properties legally inscribed during the administration of 2003 (R.M. 182/03), approving a quota of 22282 animals in this Department. This situation produced a discontent in some local actors, those which made a movement of rejection to the number of animals proposed by the National Authority; as part of this dissatisfaction, some actors informed that a harvest had already been made (illegal by the way) on most of the animals that the rejected study already proposed. It is necessary to remember that in October of 2003, a serious social conflict took place in Bolivia which produced the exit of the President Gonzalo Sánchez de Lozada. The new government, knowing the precariousness of their situation (product of a social climate of deep dissatisfaction and a lack of support by political parties), started a policy destined to solve and/or to avoid conflicts. In this context, the Ministry of Sustainable Development, after a trip of the Minister to the Department of the Beni, emitted the Ministerial Resolution 244/03 of December of 2003, by means of which a harvest of 40,000 animals was approved in the mentioned Department.

Talking about the Department of Santa Cruz, during the year 2003 the entity that carried out the population study of the species in some ecorregiones of the area (by means of an agreement with the Prefecture of the Department of Santa Cruz), was the Museum of Natural History Noel Kempff Mercado (MHNNKM). This institution proposed a harvest quota of 19344 animals for two ecorregiones (22 and 15) of the Department, which was approved by the R.M. 181/03. This started from the post-harvesting study of the year 2002.

About the distribution of benefits, it is important to point out that, as the animals are in private properties or Indigenous Lands (TCO's), the Regulation for the Use of the *Caman yacare*, authorizes the proprietors to sell in direct form the leathers deposited in the storing centers. In this sense, with base in the use contracts subscribed by the Departmental Prefectures of the Beni, Santa Cruz and Pando (during the different years of the Program), we have evidence that the program has generated economic benefits to different indigenous towns, rural communities and cattlemen. Nevertheless, one also has evidence (product of carried out accusations) that in numerous situations a manipulation of the producers has taken place (mainly on the part of middlemen), what has taken to that a fair and equal distribution of the benefits of the Program is not obtained. Nevertheless, also some accusations have been received establishing that, in several situations, a manipulation of the producers has taken place (mainly from the part of middlemen); this affected negatively a fair and equal distribution of the benefits of the Program.

Errors and Lessons Learned

From their beginnings, the Program has experienced a series of problems, which should serve as an analysis base to avoid to make the same errors in a redesign of the process of use of *C. yacare* in Bolivia. We don't want to criticize the process developed up to now, but we want to use this experience like learned lessons in such a way we can think in a transparent and sustainable program from the biological, social, economic and political point of view.

The first consideration that is necessary to carry out, refers to the laws developed in Bolivia to use species. In this sense, it is necessary to point out that in all the versions of the approved rules, there were used some criteria (without not doubt very successful in other countries like Venezuela) but not compatible with the reality of Bolivia

In this sense, the errors go from the hunting technique proposed in the beginning (use of harpoon in areas where people doesn't get used to use this tool), until the portion of territorial space that should be surveyed to be able to establish the population status of the species (10% of each eco-region), which is totally impossible for the access conditions and hydrological aspects of the areas inhabited by the Spectacled Caiman in Bolivia. It should be pointed out that none of the carried out population evaluations done during these years, fulfilled the requirements defined in the mentioned regulation, which settles down that counts in at least the 10% of the extension of each identified ecological region should be carried out.

The second consideration, is about the lack of relationship between the population studies carried out and the authorized harvest. We will try to give some examples about occurred situations:

- From all the harvests authorized in Beni Department (30,000 in year 1999, 40,000 in year 2001, 39,132 in year

2002 and 40,000 in year 2003), only the years 2001 and 2002 had some relationship between the carried out studies and the approved harvests.

- The studies of the years 2001 and 2002 extrapolated results of four particular eco-regions to all the Department of Beni (that has 11 ecorregiones for the program), leaving without effect the eco-regional character of the program. In that way, the definition of eco-regions becomes useless from the point of view of minimizing the bias that can take place when we made the estimations of abundance and the population structure.
- The study carried out in Santa Cruz in 2001 (PIAS 2001b), reported a population structure of *C. yacare* with a proportion of Class IV individuals (>180 cm total length) corresponding to 1.72% of the total population (without considering Class I individuals from their first year, or less than 50 cm total length). The regulation establishes that is not possible to harvest populations where the Class IV is smaller to 15% of the population. Even though this situation, the Ministry authorized the harvest in Santa Cruz. We can discuss about if it is possible or not to harvest populations with major or minor proportion of Class VI individuals; but the important issue is that the National Authorities didn't obey the rule established by themselves.
- During the year 2002, according to the studies of Beni Department, a harvest of 13,054 individuals should be authorized. However, the Local Authorities authorized a harvest quota of 39,132 individuals (which was the potential of all the Department). In population terms, this means that instead of harvesting the 25% of Class IV individuals, a harvest of almost 75% of Class IV individuals occurred.
- The Ministerial Resolution N° 156, of the year 2002, granted to the Department of Santa Cruz a harvest of 5000 individuals, but in that year no monitoring process had been carried out in this Department.
- The year 2003, a harvest of 40,000 animals was authorized in the Department of the Beni without some study or technical instrument that it justifies the sustainability of this quota.

The third consideration that is necessary to carry out, also with relationship to the studies executed by the hired consultant companies, it is referred to the system of bid of the Bolivian State to hire goods and services. In this sense, according to the Bolivian norms, in a public bid preference is given to a consultant company (with ends of lucre) over on an academic or scientific entity or NGO (without ends of lucre). This situation originated that the processes of evaluation of *C. yacare* populations were awarded to consultant companies that, in most of the cases, had scarce or any experience in the study of animal populations. The obtained product was a series of studies developed with not very reliable methodologies, with different approaches and with personal with scarce or null experience in the evaluation of caiman populations. In this way, an important quantity of information was produced, but paradoxically it can not be used to analyze the population tendencies of the species, neither to evaluate the impact of the harvest on the populations of *C. yacare*, because (according to that settled down by the same consultant companies), each work was carried out in different areas and with different methodologies, so it is no possible to compare the information from one year to another.

This group of situations, was increased by the operative weakness of the Scientific CITES Authority, which lacks economic support on the part of the State or of the same Program, preventing them to carry out an appropriate tracking down of the development of the same Program, and in turn disabling the emission of a no detrimental extraction opinion.

The fourth consideration that is necessary to carry out is with respect to the poor application of control systems. This poor application of control systems, produced a lack of reliability of harvests. In this sense, examples have already been mentioned in which the recommended quantity of caimans to harvest was not respected, neither the places authorized to carry out the harvests. Additionally, as a result of a workshop carried out in the city of Trinidad in April of 2002, and according to the report elaborated by Larriera (2002) an aspect that should worry, is that all the skins of legal size are not tagged in origin, allowing the buyers to select those of more size (still inside the legal measure), and only sealing these. This means an unnecessary over capture of animals that, although in the future it could diminish for the natural laws of market, it would be preferable and simple to avoid today, assuring the commercialization of all the skins of legal size. This would simply be achieved, sealing all the leathers in origin, before commercialization.

Finally, another problem refers to the lack of communication among the different involved sectors, and the disinformation of the users with concerning not alone to the spirit, but also to the changing practical aspects of the program. This situation should be recognized as a very serious problem, because the users of the Program (in many cases) don't have a correct information about its rights and responsibilities regarding the sustainable use of the *Caiman yacare* in Bolivia. This scenario produced cases were owners of properties ignored completely the fact that they were inscribed in the program and that they had been carried out (theoretically) several crops in its property, although in the practice what happened was that some people took advantage with fraudulent licenses to harvest animals whose origin is not known.

Conclusions and Recommendations

It is clear that most of the inconveniences detected in the march of the program, are referred to: 1) the methodology of the “monitoring program” (that is not such) of the natural populations to determine the harvest at different levels (National, Departmental and for unit of production (indigenous lands, rural communities, and cattle ranches); 2) the internal distribution of the harvest quotas; and, 3) practical aspects of the inspection and the control. The solution of these problems will provide, on one hand a more just distribution of the benefits among the users, and on the other hand clearly will improve the standards of the harvest, avoiding over captures and the illegal transport of skins from one region to another (that today still takes place). The incorporation to the program of an instance of measure of skins in tanneries, will allow to establish an additional parameter for the monitoring of the sustainability of the program. Additionally (according to Larriera 2002), the establishment of a channel of periodic communication with the Crocodile Specialist Group (CSG), will facilitate the agile correction of the inconveniences that could arise.

It is not necessary to deny the difficulty that represents the fact that an extractive use of wildlife fulfills requirements of sustainability. The advance in this sense depends in great measure of the political will, and on pilot projects that establish the bases for the execution of projects at major scale. In this way, the sustainable use could be the right way, even though is a long and hard way in developing countries (Ojasti 2000). One of the challenges in Bolivia, is to achieve the transition of a long tradition of illegal use of wildlife towards a regulated handling of the same one, with the purpose of assuring the biological sustainability of the programs.

The sustainable use of the crocodylians has proven, in many situations, to be a successful activity from the point of view of the conservation of some species and also for its hábitats. According to the situation of the populations of *Caiman yacare* in Bolivia, a program of use of the species can be carried out in a sustainable way, but only if it is developed inside the mark of the established norms, without forgetting that the main objective has to achieve the effective conservation of the species. For this it is necessary to establish certain considerations (some already established as recommendations of the workshop carried out in April of 2002 in Trinidad), to take into account for the redesign of the Program in Bolivia:

1. The process of use of the Spectacled Caiman is in a transition stage from an old illegal activity to a management program which has the objective to use the species in a sustainable way. This transition generates problems in the administration and control.
2. An institutional weakness of the state exists in its three levels (National, Departmental and local) to administer the program, especially in the control aspects. To improve this situation the roles of different actors should be defined, and it is necessary to reinforce the technical instances of control. Particularly, all actors should know very clearly which institution establishes the harvest quotas and rules the program at a national level.
3. The problems and experiences experimented by the Prefectures demonstrate that a different approaches exist in the administrative and operative topics, and also technicians. In this sense, it is necessary to define clear and uniform approaches which could facilitate the administration of the resource, guaranteeing the continuity of the same one. At the moment in Bolivia it is being developed an analysis (with the participation of authorities, academic and scientific institutions, specialists and social actors) directed to define these approaches that guide in a clear way the form in that the species should be used according to the Bolivian reality.
4. A solid integration should be generated between the technical base and the administrative aspects of control. In this sense, the base of the program regarding harvest quotas should be eminently technical. If the technical aspects are not taken into account, they should be suppressed explicitly of the program, so that the responsibility of the conservation of the resource will fall on their administrators. Obviously, this is to fall in the same situation that put in risk the crocodile populations at world level.
5. The program has achieved important advances in the legal aspects, and also about social participation; but the technical aspects, of inspection and control, and the training and diffusion based on an integral program should be improved. A permanent program of diffusions an education should be developed. This should reach to all the actors of the program. The message should clarify the rights and the responsibilities of the different actors for using the species in a sustainable way.
6. The rule for the use of the *C. yacare* suffers uncertainties and contradictions that affects the efficient administration of the resource. A new proposal will be elaborated, and this should be discussed with the social actors. The

detailed analysis of all these uncertainties and contradictions would make necessary an article dedicated exclusively to this topic.

7. It is possible to create an advice and inspection instance at Departmental level with the participation of indigenous, cattlemen, tanners, academic and investigation Institutions, and Prefectures, with the purpose to inform, concert and investigate the administrative and technical determinations of the program. A kind of Committee Inter-institutional for the Advising of the Yacare Program. This would avoid the rejection from certain sectors to some norms and would give solidity to the decisions adopted by the national authority, because they would be already have concerted. Although it is certain that at the moment there is a Departmental Committee of the Program (at least in the Department of the Beni), the same one is not constituted equally, because some few tanners have bigger representativeness that the total of the land owners.
8. A true monitoring program should be designed that accompanies the whole process. The program should have the main objective of detecting the tendencies of the populations under use and to have a control (witness) in not harvested of populations. At the same time, the population estimates result of this program would be those that should be used to determine harvest quotas (refer to points 4 and 11 of these conclusions).
9. A process of accreditation of the institutions could be generated (non people), to have some legally authorized entities to advise in management programs of Spectacled Caiman in Bolivia. This accreditation should have a national component (the authority in wild life) and could have one international (the Crocodile Specialist Group). At the same time, it is necessary to eliminate the advantages that have the consultant companies over associations without ends of lucre. It is possible to substitute the system of bids for one of agreements among scientific-academic institutions and the Departmental Prefectures. The institutions that take charge of carrying out the population evaluations, should not only be hired for a one year period, but for several (at least 5 years), so that could be minimized the variability due to observer and different methodologies.
10. The management of any species is an opportunity to study its numeric and functional answers to an interference. Bolivia has lost valuable years because didn't take this program as an opportunity to obtain information about the ecology of *Caiman yacare*, which could be used to improve its current management, to propose alternative models of management and simply to increase our knowledge about crocodilians. The redraw of the Program should contemplate enough elasticity to include experiments at great scale that they could fulfill this scientific "obligation". A way to do it is to give responsibility of the technical management (but not on the benefits, that should be in any event for the local producers) to the accredited institutions (see point 9) on certain areas that could be specifically subject to management plans designed to be executed there. The execution of management plans under different models and monitoring will give us great in the knowledge of the scientific management of *C. yacare*. Of course, the rector at national level should be the Monitoring Program designed by the National Authority.
11. The monitoring program at national level should be designed to be statistically able to detect the changes that it considers biologically important (Gibbs *et al.* 1998), and also to avoid the waste of efforts (Stirrat *et al.* 2001). For this purpose, the new rules should contemplate a fee which could assure the technical sustainability of the Program.

Finally, the economic incentives that the users of the program of use of the Spectacled caiman receive, particularly the owners of lands, can not only be reflected in the conservation of the species, but also in the conservation of the hábitats inhabited by *C. yacare*. A key aspect to accomplish this, is the political will that should exist at level of the National Government and Local Governments, with the purpose of achieving a transparent and sustainable Program, not only in the biological aspect, but also from the social and economic point of view.

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Comparative Analysis of Habitats Occupied by *Caiman crocodilus* in Floodable Plains of Venezuela

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Abstract

Primary and secondary habitats occupied by *Caiman crocodilus* are described in 514,096 ha of Venezuelan flooding llanos, divided in 6 ecological regions. Night-light counts were done and the surface of waterbodies was estimated. Primary habitats were classified into channels, rivers and lagoons; secondary habitats in ponds and dykes, describing its dominant terrestrial vegetation and aquatic vegetation covering. Data were processed with ANOVA, with abundance of caimans as numerical variable and ecological regions, type of habitat, terrestrial vegetation and aquatic vegetation covering as classification variables. A total amount of 93,944 caimans were counted with a terrestrial density of 0.18 ind/ha. The aquatic surface was 2688.85 ha reached only 0.52% total terrestrial surface. The abundance showed significant differences between the 6 ecological regions, with maximum in primary habitats. Among secondary habitats, dykes showed the highest abundance values. Most abundant populations were founded in primary habitats with forests and small amounts of aquatic vegetation. Special measures of protection of such habitats are strongly recommended for this species, currently under management by Venezuelan Government.

Resumen

Se describen habitats primarios y secundarios ocupados por *Caiman crocodilus* (baba) en 514,096 hectáreas de llanos inundables venezolanos subdivididas en 6 regiones ecológicas. Se efectuaron censos nocturnos y se estimó la superficie de los cuerpos de agua. Los habitats primarios se clasificaron en caños, ríos y lagunas; los secundarios en préstamos (excavaciones) y módulos (diques), describiendo su formación vegetal y cobertura de vegetación acuática. Se practicó ANOVA a los datos, con el censo como variable numérica y como variables clasificadoras la región ecológica, tipo de cuerpo de agua, formación vegetal y cobertura de vegetación acuática. Se censaron 93,944 babas con una densidad de 0.18 ind/ha de terreno. La superficie acuática (2688.85 ha) alcanzó 0.52% de la superficie total. La abundancia poblacional mostró diferencias significativas entre las 6 regiones ecológicas. La máxima abundancia se observó en los ríos, mientras que lagunas y caños mostraron valores similares. Los préstamos mostraron valor mínimo y los módulos presentaron elevadas abundancias, siendo los ambientes secundarios más favorables. Las poblaciones más abundantes se encontraron asociadas a habitats primarios con vegetación marginal boscosa y vegetación acuática presente. Se debe promover su protección para favorecer a esta especie, actualmente sometida a manejo bajo control del Estado.

Introduction

The Baba (*Caiman crocodilus*) it is the most abundant crocodile in Venezuela, since the reduction of large caiman's populations American crocodile (*Crocodylus acutus*) and Orinoco crocodile (*Crocodylus intermedius*), caused by the indiscriminate hunt. Once initiated the industrial use of Baba skins, their commercial hunt began. In 1983 the Venezuelan Government implemented the Program of Commercial Use under control of the Ministry of the Environment and Natural Resources (MARN). In 1991-92 a first evaluation of the population status was made, in terms of abundance and size class structure, after 9 continuous years of controlled crops (Velasco and Ayarzagüena 1995).

One of the most important results of that work was the description of 7 ecological regions in the area used for hunting in the Venezuelan southwestern Llanos: Alto Apure, Bajo Apure, Aguas Claras, Cajón de Arauca, Llanos Boscosos, Hoya de Arismendi and Guárico (Fig. 1).

Subsequently, during 1996 a detailed study was carried out under the Agreement between Universidad Central of Venezuela and MARN, during the Ecological Pause of the Program of Commercial Use (Quero and Velasco 1995),



Figure 1. Ecological regions in Venezuelan Llanos.

covering 6 of the 7 ecological regions with the exception of the Guárico region. In each region, the population abundance and the primary and secondary habitats were characterized, in order to establish the most favorable habitats and to propose strategies for its preservation.

Methods

1. Fieldwork

The fieldwork was carried out during the dry season (February-April) of 1996, when the animals are concentrated in the habitats that keep water during the whole year and are easy to count. The fieldwork was made by six teams of technical personnel belonging to MARN and UCV. Observations were plotted in charts 1:25,000.

Night light censuses were performed (Chabreck 1966; Woodward and Marion 1977) in order to determine the population abundance. The aquatic habitats were classified accordingly to their type in primary habitats, integrated by “caños” (intermittent natural drainages of the flooded areas), lagoons, rivers and “esteros” (savanna depressions temporary flooded). As secondary or artificial habitats, “prestamos” (excavations for the construction of embankments), and “modulos” (cellular dykes to retain water on the savanna) were identified (Colomine 1993). The predominant plant formation was evaluated in the surroundings (forest, bushes and grasslands or their combinations), as well as the covering of aquatic vegetation. All the accessible water bodies in the selected farms were monitored, using vehicles, boats, horses or on foot. Where it was possible, the water body was completely observed; when it was impossible to get a full observation of the waterbodies, no extrapolations of the number of individuals was made. An estimation of each observed aquatic surface was accomplished.

2. Data Analysis

An Excel database was built to practice analysis of variance (anova) using Statgraphics, with total amount of individuals counted by water body as numerical variable, verifying its adjustment to normal distribution ($P < 0.05$).

As classification factors, the following categories were used:

- Ecological Regions: Alto Apure, Bajo Apure, Aguas Claras, Cajón de Arauca, Llanos Boscosos, Hoya de Arismendi.
- Covering of Aquatic Vegetation: completely absent, present (less than 30%), abundant (30-60%), very abundant (more than 60%) and total covering (100%).
- Associated Vegetation: forest, bushes, grasslands and its combinations.
- Type of Water Body: rivers, “caños”, lagoons, “esteros”, “prestamos” and dykes.

The ANOVA provides the arithmetic average of individuals present in each classificatory category, as well as the significance level of its differences confirmed with *a posteriori* Duncan test ($P < 0.05$). Variation coefficients were also calculated. Gross densities (individuals per hectare of land belonging to each property) and ecological or aquatic densities (individuals per hectare of observed water body) were estimated.

Results

1. Total Densities and Size Classes

The total number of water bodies surveyed was 693 (Table 1), with the lowest observations in “Hoya de Arismendi” (74) and “Cajón de Arauca” (28), due to difficulties to reach the waterbodies. The average number of individuals per water body for each region showed significant differences among the ecological regions, confirming the validity of the spatial subdivision of the whole study area proposed by Velasco and Ayarzagüena (1995). The levels of significance involved in the analysis, demonstrate variations in the spatial biotics and abiotic characteristics that could affect the quality of the habitats and its load capacities for the species.

Table 1. ANOVA results of the average number of individuals for in each region (ns = not significant, $P < 0.05$).

| Region | Cases | Mean | STD | Diff. |
|----------------------|-------|--------|-------|-------|
| Alto Apure | 140 | 199.3 | 33.97 | ** |
| Hoya de Arismendi | 74 | 187.4 | 26.94 | *** |
| Bajo Apure | 163 | 147.1 | 31.58 | *** |
| Aguas Claras | 115 | 10.6.1 | 13.65 | *** |
| Llanos Boscosos | 173 | 86.5 | 24.68 | ** |
| Cajón de Arauca (ns) | 28 | 37.0 | 14.75 | * |

The “Alto Apure” region reached the maximum average of individuals per water body. The intermediate values of “Aguas Claras”, “Bajo Apure” and “Hoya de Arismendi” did not show significant differences. Llanos Boscosos showed a significantly low average, with the largest number of observed water bodies. The value registered for “Cajón de Arauca”, with very low amount of individuals and observations, was not significant.

For the goals of the present study, the global analysis of the results in the 6 regions under study is comparable with the work made among 1991-1992 (Velasco and Ayarzagüena 1995) using the gross density (individuals per hectare of surveyed properties).

In total, 93,944 individuals were counted in 514,096 ha surveyed, with a terrestrial gross density of 0.18 ind/ha (Table 2). If the terrestrial or gross densities are compared between the ecological regions instead the average of individuals in waterbodies, a different result is obtained. In this case, “Alto Apure” and “Bajo Apure” presented the maximum densities and individuals counted. “Hoya de Arismendi”, “Aguas Claras” and “Llanos Boscosos” showed very similar intermediate values, and “Cajón de Arauca” reached the lowest density and counts.

The total aquatic surface was estimated in 2688.85 ha, which represents only 0.52% of the terrestrial surface, because the censuses were made during the period of extreme drought. The aquatic density was 34.94 ind/ha, which reflects a high concentration of animals in the water bodies that remains flooded.

Table 2. Comparison of number of individuals, surface surveyed and gross density (ind/ha) in 1992 and 1996, for 6 ecological regions.

| Region | No. of Ind. | Surface (ha) | Density '96 | Density '92 |
|----------------------|-------------|--------------|-------------|-------------|
| Alto Apure | 27,903 | 109,127 | 0.26 | 0.22 |
| Hoya de Arismendi | 13,442 | 97,320 | 0.14 | 0.35 |
| Bajo Apure | 23,977 | 68,198 | 0.35 | 0.39 |
| Aguas Claras | 12,615 | 91,545 | 0.14 | 0.10 |
| Llanos Boscosos | 14,970 | 125,515 | 0.12 | 0.15 |
| Cajón de Arauca (ns) | 1037 | 22,391 | 0.05 | 0.19 |
| Total | 93.944 | 514,096 | 0.18 | - |

2. Habitat Characteristics

Aquatic vegetation

The observed covering of aquatic vegetation in water bodies was classified in 5 categories: absent, present, abundant, very abundant and totally covered. The total amount of individuals associated to water bodies completely free of aquatic vegetation was 53,009 individuals (56.5%), compared with 40,837 individuals (43.51%) in areas with presence of aquatic vegetation. Globally, there were significant differences between the categories of aquatic vegetation covering in regard to the observed average of individuals (Table 3).

Table 3. Average of individuals for each aquatic vegetation covering category (ns= not significant, P<0.05).

| Aquatic Vegetation Cover | Cases | Mean | STD | Sig. |
|----------------------------|-------|-------|------|------|
| Absent | 353 | 150.5 | 18.5 | ** |
| Present (0-25%) | 132 | 179.9 | 39.5 | *** |
| Abundant (30-60%) | 84 | 102.6 | 14.8 | ** |
| Very Abundant (60-90%) | 80 | 52.2 | 8.7 | * |
| Total Covering (100%) (ns) | 37 | 32.1 | 9.9 | - |

The maximum average of animals was registered in water bodies with aquatic vegetation present. This fact indicates the preference of the species toward habitats with certain covering of aquatic vegetation, taking into account that the efficiency of night light count method is maximum in waterbodies without aquatic vegetation. So, in spite of the underestimation (not quantified) caused by this method's limitation, the amount of individuals was highest in habitats with floating plants. If the aquatic vegetation increases, the amount of surveyed crocs diminishes until a minimum in waterbodies totally covered, where the data obtained with the night light count is not reliable.

When crossing the aquatic vegetation with the surrounding vegetation, it is remarkable that the highest average of individuals (427.1) was found in waterbodies with forests and aquatic vegetation present, while without floating plants the average was 184.8 with significant difference. These results coincide with previous reports (Colomine, 1993). The waterbodies in savannas do not present significant difference in the average number of individuals regarding plant covering.

The comparison of average number of individuals against the aquatic vegetation covering in each ecological region offered significant differences. At "Alto Apure", "Bajo Apure", "Aguas Claras" and "Hoya de Arismendi", the largest amounts were registered in habitats with aquatic vegetation present, while in "Llanos Boscosos" and "Cajón de Arauca" more crocodiles were observed in habitats without aquatic vegetation.

Associated Vegetation

The following categories of surrounding vegetation were settled down: forests, bushes, grasslands and their

combinations. More frequently, the waterbodies were associated to open grassland savannas (56.81%), while the forest habitat were less observed (17.25%). There was not significant difference in the average of animals censused with regard to the plant formation (Table 4).

Table 4. Average number of individuals in each plant formation type (P<0.05).

| Vegetation | Cases | Mean | STD |
|------------------|-------|-------|------|
| Grassland | 392 | 128.5 | 16.4 |
| Bushes | 39 | 81.5 | 22.3 |
| Forest | 119 | 185.6 | 42.8 |
| Forest-Bush (ns) | 2 | 23.0 | 4.0 |
| Grassland-Bush | 89 | 121.6 | 19.3 |
| Grassland-Forest | 23 | 117.3 | 55.5 |
| All types (ns) | 26 | 155.8 | 59.3 |

The water bodies associated with forests presented the highest average of sighted individuals, in spite of the difficulties of access to carry out the survey. In second place, the habitats with the three types of vegetation combined followed, but this numeric result is not reliable as the association forest-bush, due to low amount of surveyed locations.

This analysis of crocs abundance in relation to the plant formation associated to the water body was practiced for each ecological regions, repeating the situation evidenced in the global analysis: no significant differences between the different vegetation types was observed, with the maximum averages in forest habitats.

Type of Water Body

The considered water body types were primary habitats (rivers, “caños”, lagoons, wetlands) and secondary ones (modular dykes and “préstamos”). Significant differences of the average number of individuals appeared between them. The most frequent waterbodies were lagoons, “caños” and “préstamos”. The lagoons and “caños” showed highest averages of 133.6 and 197.6 individuals respectively, without significant difference among these primary habitats. On the other hand, the “préstamos” hardly reached average of 37.3 individuals, reflecting their condition of low-capacity habitats. The surveyed dykes (33 in total) contributed with a high average number of individuals (181.8), being the most favorable secondary habitats for the species. The largest average croc amount was observed in the 7 surveyed rivers, which indicates that these primary habitats tend to be occupied by numerous populations (Table 5). At wetlands, temporary flooded areas, the lowest amount of individuals was observed, also not significant.

Table 5. Average number of individuals for water body type (ns= not significant, P<0.05).

| Type | Cases | Mean | STD | Sig. |
|---------------|-------|-------|-------|------|
| Rivers (ns) | 7 | 228.4 | 148.5 | - |
| “Caños” | 224 | 197.6 | 30.0 | *** |
| Dykes | 33 | 181.8 | 52.7 | *** |
| Lagoons | 273 | 133.6 | 17.6 | ** |
| “Préstamos” | 148 | 37.3 | 6.6 | * |
| Wetlands (ns) | 8 | 13.5 | 4.1 | - |

The high crocs average presented in the rivers is the result of very few observations and is not significant (Table 6), and this can be related with the fact that it is completely forbidden the hunt in these habitats.

The “caños” are the habitats where more crocs were found, with significant results regarding the other water body types. The “caños” constitutes very frequent natural drainages of variable depth in all the southwestern “Llanos” with alluvial soils, with the exception of “Aguas Claras” region, where sandy dunes prevail on the soil. In the “caños” high concentrations of animals were observed, reaching an average of 303.3 individuals in the Alto Apure (Table 7), remarking that the courses of water surrounded by grasslands reached 197.5 individuals on average, while

Table 6. Average of individuals in rivers for ecological regions (non-significant differences, $P < 0.05$).

| Region | Cases | Mean | STD |
|-------------------|-------|-------|-------|
| Alto Apure | 2 | 47.0 | 10.0 |
| Bajo Apure | - | - | - |
| Cajón de Arauca | - | - | - |
| Hoya de Arismendi | - | - | - |
| Llanos Boscosos | 3 | 23.0 | 9.0 |
| Aguas Claras | 2 | 718.0 | 356.0 |

Table 7. Comparison of average individuals in “caños” for each ecological region (non-significant differences, $P < 0.05$).

| Caños | Cases | Mean | STD |
|-------------------|-------|-------|------|
| Alto Apure | 54 | 303.3 | 78.4 |
| Bajo Apure | 50 | 242.3 | 93.4 |
| Cajón de Arauca | 14 | 50.1 | 29.2 |
| Hoya de Arismendi | 46 | 203.2 | 31.9 |
| Llanos Boscosos | 58 | 89.6 | 24.0 |
| Aguas Claras | 2 | 262.0 | - |

the forest surrounded “caños” showed a higher value (250.4 individuals). In general, one “caño” can cross forest, bush and grassland formations along its itinerary that can be very long. The water in many “caños” are segmented during the dry season, forming small lagoons in their channel full of fishes that serves as food for the crocodilians.

The natural lagoons are shallow water bodies that keep water during all the year, very frequent in all these regions. It can present circular form occupying depressions on the savanna, or horseshoe form when they are derived from bends of rivers and “caños”. It reach their maximum frequency in “Aguas Claras”, region with a landscape characterized by the presence of dunes. The lagoons can be surrounded by grasslands, bushes or forests in their margins. In these primary habitats, large concentrations of crocs were recorded with significant difference between the ecological regions, with similar values to those of the “caños” although slightly inferior. The maximum was observed on the average in the “Llanos Boscosos” (Table 8).

Table 8. Average of individuals in lagoons on each ecological region ($P < 0.05$).

| Lagoons | Cases | Mean | STD |
|-------------------|-------|-------|-------|
| Alto Apure | 31 | 214.7 | 41.4 |
| Bajo Apure | 50 | 242.3 | 93.4 |
| Cajón de Arauca | 13 | 25.6 | 5.4 |
| Hoya de Arismendi | 10 | 191.0 | 48.3 |
| Llanos Boscosos | 26 | 265.6 | 151.6 |
| Aguas Claras | 109 | 93.6 | 10.2 |

The “préstamos” are artificial excavations of small extension and depth, from which the land material is extracted for the construction of roads and dams. These secondary habitats presented very inferior values of average individuals in comparison with the primary habitats. This habitat type is very frequent at “Alto Apure”, “Bajo Apure” and “Llanos Boscosos” (Table 9).

The best secondary habitats for the species resulted the modular dikes (“módulos”). These dams built directly on the savanna cover large extents (3000 to 10,000 ha) contained inside cellular dike-embankments, retaining water during the whole year. In these large dimensions, “caños”, lagoons, “préstamos” can be embraced. Occasionally also

forest areas are contained, transforming it into favorable habitats for the maintenance of numerous and stable populations. The regions of “Aguas Claras” and “Cajón de Arauca” does not has this type of dikes (Table 10).

Table 9. Average of individuals in “préstamos” in each ecological regions (not significant, $P < 0.05$).

| Regions | Cases | Mean | STD |
|-------------------|-------|------|------|
| Alto Apure | 44 | 53.6 | 18.7 |
| Bajo Apure | 24 | 32.3 | 6.2 |
| Cajón de Arauca | 1 | 3.0 | - |
| Hoya de Arismendi | 5 | 66.4 | 28.3 |
| Llanos Boscosos | 72 | 27.9 | 6.7 |
| Aguas Claras | 2 | 18.0 | 7.0 |

Table 10. Average of individuals in dikes in each ecological region (not significant, $P < 0.05$).

| Regions | Cases | Mean | STD |
|-------------------|-------|-------|-------|
| Alto Apure | 8 | 298.5 | 127.1 |
| Bajo Apure | 5 | 125.6 | 104.4 |
| Cajón de Arauca | - | - | - |
| Hoya de Arismendi | 13 | 175.5 | 98.2 |
| Llanos Boscosos | 7 | 100.1 | 57.2 |
| Aguas Claras | - | - | - |

Finally, the “esteros”, wetlands located on depressions of open savanna, were relatively scarce in all the regions, due to the advanced dry season when the sampling was carried out. Only 8 cases were observed in “Alto Apure” with, with an average of 13.5 individuals.

Discussion

The method used for obtaining the field information is advantageous to evaluate the population status of this species, in connection with the habitats occupied. The effort applied in the surveys is acceptable for the magnitude of the obtained data and its reliability. The observers need to be trained to develop capacity to carry out the censuses and environmental evaluations in very wide territorial spaces.

The most important physical obstacle for the application of this method at this great scale is the accessibility to the water bodies. The source of more frequent error is the underestimation of abundance, caused by the presence of floating plants and the difficulty to observe the whole water body. However, the obtained volume of data allows the application of parametrical statistical methods of like the analysis of variance, with enough grades of freedom to validate the significance of the opposing differences. Even so, it is important to point out that this is only a punctual observation in time, and the obtained results are limited to the habitats condition for the moment of sampling.

In general, this species tend to occupy habitats with calm, shallow waterbodies, surrounded waters by forest, and physical-chemical relatively stable characteristics (Ayarzagüena 1983; Gorzula *et al.* 1988; Colomine 1993; Colomine *et al.* 1994). This preference is more conspicuous in the Venezuelan “Llanos”, where the Babas has a behavior closely linked to the annual hydrological cycle (Muñoz 1988), being dispersed during the rainy season with the maximum flood, and concentrated during drought on the habitats that remain with water, reaching large population densities in limited aquatic surfaces (Ojasti 1989).

The reproductive stages are linked to the habitat cycling condition: mating and nesting during the rainy season, and hachtlings appearance at the beginning of the dry season. Migrations can be produced governed by the habitat selection, in search of more favorable conditions for the reproductive phases (Muñoz 1988; Oubuter and Nanhoe 1988).

These reproductive demands explain the fact that the most abundant populations are associated to the primary,

isolated and forested habitats with floating vegetation present that can offer refuge, availability of food for all the size classes and nesting possibilities. Nevertheless, the secondary habitats also can advantageously be occupied by the species to support extreme drought conditions (Ayarzagüena 1983). The large extents of the modular dikes built on the plains to enhance cattle raise, include natural areas (flooded grasslands, “caños” and lagoons) that allow the presence of abundant populations (Colomine 1993). Other populations have also been reported for reservoirs and in other places of the country (Arteaga 1989).

Significant differences in abundance were found, and the regions with more abundance and density were “Alto Apure” and “Bajo Apure”. This is valuable information for the management plan for this species, which take into account the remarkable characteristics of the waterbodies in these regions. Equally, the relatively smaller levels observed in “Cajón de Arauca”, “Aguas Claras” and “Llanos Boscosos”, demands the application of controls for the use of the species.

Conclusions

The subdivision in ecological regions of the area for managing the commercial hunting program of the species on the basis of environmental and population differences, was supported by the results from the present work.

The most abundant populations were associated to primary habitats (rivers, “caños” and lagoons) surrounded by forests and with presence of aquatic vegetation. Among the secondary habitats, the “préstamos” serve as refuge during the dry season, but the modular dikes are favorable for the species, due to their great extension that generally embraces forest areas and primary habitats.

The presence of abundant and permanent populations of *C. crocodilus* can be considered as indicator of high-quality habitats for associated terrestrial and aquatic wild fauna. This fact facilitates the adoption of management plans directed to achieve an effective protection of such habitats.

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Conservation of the Philippine Crocodile *Crocodylus mindorensis* in NE Luzon, the Philippines. An Update

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Abstract

Since the discovery of several remnant, fragmented populations of the Critically Endangered Philippine crocodile in Northeast Luzon in 1999, a conservation program has been implemented in the area using a community-based approach. The approach seems successful but several issues remain that threaten the crocodiles on the short and long term. An initial increase in the crocodile population following successful breeding in three distinct localities spurred hope for a recovery of the extremely small sub-populations. However, no breeding was observed during the last two years. A strong typhoon, which raged over the area in 2003, caused flashfloods in the deforested watersheds of the area and has taken its toll on the crocodiles as well. Awareness raising campaigns have increased local knowledge about crocodiles and most local inhabitants now support crocodile conservation. The direct killing of crocodiles has stopped, but accidental catches still occur. Law enforcement in general is weak in the area and the implementation of local crocodile conservation laws depends very much on the voluntarily willingness of local people to respect rules and regulations. Indirect threats such as the use of destructive fishery methods, agricultural encroachment and habitat conversion continue to threaten crocodiles and wetlands in general. A more comprehensive and creative Philippine crocodile conservation program in Luzon is needed to expand the first *in situ* conservation effort for this species.

Introduction

The Philippine crocodile *Crocodylus mindorensis* is considered to be the most severely threatened crocodile species in the world and is listed as critically endangered by the IUCN. Previously widely distributed throughout the Philippine archipelago, *C. mindorensis* is now thought to be restricted to Mindanao, Negros and Luzon. A widely-used population estimate of 100 non-hatchling individuals (Ross 1998) underlines the critical status of the species, although both distribution and population size estimations are rather speculative. A previously unknown population was discovered in the foothills of the Northern Sierra Madre Mountains on Luzon in 1999, sparking hope that *C. mindorensis* might occur in other, similarly unsurveyed localities (van Weerd 2002). However, in most newly surveyed localities since 2002, crocodiles have become extinct during the last 30 years (see also Tarun *et al.* these proceedings). Killing of crocodiles seems to be the major cause for the decline. In Northeast Luzon, a community-based conservation approach was adopted with the aim of reaching sustainable co-habitation of crocodiles and local people. This is currently the only *in situ* conservation project for the species and was reported to the CSG during the 16th working meeting in Gainesville in 2002 (Van Weerd 2002). Here we present an update of the conservation activities since that report.

Threats

The main threats to the survival of *C. mindorensis* have been listed as habitat loss, pollution of rivers mainly due to mining, and the killing of crocodiles for skins, meat, amulets and out of fear or ignorance (Banks 2000a). Most Filipino's are indifferent about crocodiles or regard them as vermin. The public image of crocodiles in the Philippines is very negative. The Filipino word for crocodile *buwaya* is commonly used to refer to corrupt politicians and to greedy people in general (Banks 2000a).

Philippine crocodile conservation

Following the report of C.A. Ross in 1982, which presented alarming results on distribution and population size of *C. mindorensis* (Ross 1982), the Crocodile Farming Institute was created on the Island of Palawan in 1987 with financial and technical assistance from the Japanese Government. The objectives were to conserve the two species of crocodiles in the Philippines and to promote the socio-economic development of local communities through the introduction of crocodile farming (Ortega 1998). In all, 235 *C. mindorensis* were acquired to establish a breeder stock. Eleven of these were directly taken from the wild; all others came from private collections (Ortega 1998). These private collections

were of wild origin. Collecting specimens from the wild, thereby decreasing wild populations, was thought defensible since wild populations were increasingly threatened and no crocodile protection and conservation measures were in place anywhere in the country (Messel *et al.* 1992; Ortega 1998). Captive breeding of *C. mindorensis* at the CFI has been very successful: 1276 Philippine crocodiles were alive at the farm in 2002 of which 87% was captive bred (Rebong and Sumiller 2003). However, no crocodiles have been re-introduced into the wild.

In situ conservation of the Philippine crocodile has not been pursued very actively. The Philippine Crocodile Recovery Team (PCRT) was created in 2000 to address the continuing decline of *C. mindorensis* in the wild and to strengthen international co-operation and partnerships in Philippine crocodile conservation (Banks 2000b). The PCRT developed a national recovery plan for the Philippine crocodile that was published in 2000 (Banks 2000a). The primary objective is to re-establish viable wild populations of *C. mindorensis*. The second National Biodiversity Strategy and Action Plan (Ong *et al.* 2002) identifies 34 priority inland water areas for conservation and research. Three sites with possible historic and/or present *C. mindorensis* populations are protected areas: (1) Naujan Lake on Mindoro, (2) Liguasan Marsh, and (3) Agusan Marsh on Mindanao. However, *C. mindorensis* has not been observed in any of these sites recently and no effective habitat management has been implemented in these areas (Banks 2000a).

Philippine Crocodile Conservation in the Northern Sierra Madre

Currently (May 2004), a minimum population of 27 non-hatchling crocodiles is known from Northeast Luzon of which 23 are found in the municipality of San Mariano and four in wetlands along the Pacific coast, on the eastern side of the Sierra Madre Mountains. In San Mariano, three breeding sites have been identified with permanent crocodile sub-populations: a) Dunoy Lake, b) Disulap River and c) Dinang Creek. See Tarun *et al.* (these proceedings) for more detailed information about the status of the Philippine crocodile in Northeast Luzon.

In 1999, a Philippine crocodile conservation program was set up in the municipality of San Mariano by the Northern Sierra Madre Natural Park-Conservation Project in collaboration with the Local Government Unit (LGU). This project phased out in 2002 and crocodile conservation activities have been taken over by the Crocodile Rehabilitation, Observance and Conservation (CROC) Project which since 2003 is being implemented by a newly established NGO named the Mabuwaya Foundation. Mabuwaya is a contraction of the Pilipino words Mabuhay (Long live!) and Buwaya (Crocodile). The activities of this project in Northeast Luzon have been legitimized through a Memorandum of Agreement with the Department of Environment and Natural Resources (DENR). The project has a strong partnership with the LGU of San Mariano which has been formalized through a municipal resolution accrediting the Mabuwaya Foundation as partner in crocodile conservation.

Philippine crocodile conservation workshop

A 5-day stakeholder workshop was held in May 2002 in Isabela province to obtain inputs for a long-term conservation program for *C. mindorensis* in Northern Luzon. During the workshop, four major issues were identified that underlie threats to the Philippine crocodile in the area (NSMNP-CP, 2002). First, rural poverty is leading to unsustainable land use, fisheries and wildlife utilization, which are threatening crocodiles and their habitat. Unsustainable land use and use of natural resources is further driven by continued population growth (both natural and through immigration) and the lack of tenure security for local farmers. Second, the lack of awareness and information regarding crocodiles is a major obstacle for crocodile conservation. Third, the lack of law enforcement is frustrating conservation efforts. Fourth, the lack of a strong and fully capacitated organization is hindering effective coordination of the multi-stakeholder effort to conserve the Philippine crocodile in Northeast Luzon. Such an organization should make sure that all stakeholders co-operate, share information and resources and ascertain a link between conservation and development activities in the area.

Rural poverty, unsustainable natural resource utilization and crocodile conservation

In collaboration with the local government of San Mariano, an integrated conservation and development approach is used to tackle this issue. See Miranda *et al.* (these proceedings) for a more elaborate overview of the activities in San Mariano and the important role the LGU plays herein. The conservation efforts have concentrated on the establishment of community-based crocodile sanctuaries. Following community meetings, the LGU of San Mariano proclaimed the Disulap River Philippine crocodile municipal sanctuary in September 2001. The local community manages the sanctuary, which has been demarcated with informative billboards in local languages. Sustainable fishing activities are allowed in the sanctuary, except in the breeding area of *C. mindorensis*, which is totally protected.

Currently the process to declare Dinang Creek as a crocodile sanctuary is ongoing. An environmental impact assessment was conducted and the impact of sanctuary establishment on local livelihoods was assessed. Community consultations have been conducted and an agreement has been reached between the community and the LGU of San Mariano on assistance to basic community needs and the establishment of the sanctuary. The main condition put forward by local farmers was assistance in the acquisition of land titles. This process is underway, facilitated and funded by the LGU and the Mabuwaya Foundation.

Awareness raising

The negative public image or at best the indifference of Philippine society towards crocodiles and crocodile conservation is the single largest underlying threat to the species' survival. Massive awareness raising and information campaigns are needed to create public support for crocodile conservation. The Mabuwaya Foundation is using a variety of instruments to achieve this in Northeast Luzon.

Information materials have been created and disseminated: two different posters (1000 copies and 4000 copies respectively) were distributed to all public places and households in target communities. These posters explain, in local languages, that the Philippine crocodile is threatened and endemic. They both carry the message that the Philippine crocodile is something "to be proud of", the motto of the awareness campaigns. Another poster (1000 copies) was made by students of the local Isabela State University. This poster calls for an end to crocodile killing. Flyers (1000 copies) were distributed to all target households. Large billboards were placed along access ways and in villages near Philippine crocodile habitats, with information about Philippine crocodile conservation in San Mariano. The Mabuwaya Foundation distributes a quarterly newsletter among its local stakeholders. One hundred and twenty schools have been visited to receive a presentation on the Philippine crocodile. School children can ask questions during these visits and posters are distributed. More than 150 High school and University students have been taken on trips to an observation tower that has been constructed in Dunoy Lake. Crocodiles can easily be observed from the tower and during the two-day adventure trip students receive much information about the crocodiles and the importance of crocodile conservation. Trips are also organized to the municipal crocodile rescue centre in San Mariano where two crocodiles are being kept that have been retrieved from fishermen.

Nine community consultations were organized in communities near critical crocodile habitats. During these consultations an introduction was given to the Philippine crocodile and the conservation project. A discussion was organized with community members to find solutions to issues pertaining to crocodile survival, freshwater habitat conservation and sustainable land use around crocodile localities. The community's input and the results of the discussions were used to write a site-specific conservation action plan. Perhaps even more important were informal meetings with community members near crocodile habitats; all households in these communities were regularly visited by fieldworkers, staying with these families and sharing food and stories with them. Some community members, especially those that hunted crocodiles before, were hired as guides during field surveys. As a result of the awareness raising campaigns, the killing of crocodiles has largely stopped in San Mariano (Fig. 1).

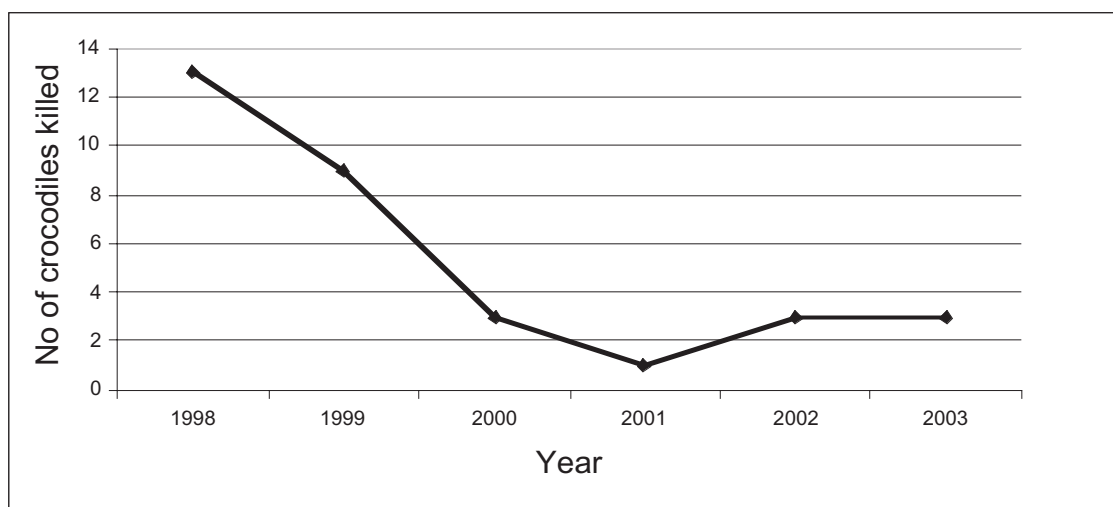


Figure 1. Reported crocodile killings in the municipality of San Mariano.

A transformation in public attitudes towards the species has taken place. A study by Tarun (2004) among 50 respondents in two local communities (Minanga and San Jose) in San Mariano shows that most people now know the Philippine crocodile (94%) and are aware of its endemic status (82%). Only 44% of all respondents know that the Philippine crocodile is threatened but in San Jose alone this is 68%. San Jose is located near the municipal Disulap River crocodile sanctuary and has received more direct information compared to Minanga which is located ca. 15 km away. Similarly, overall 46% of respondents are aware that the Philippine crocodile is a protected species, again for San Jose alone this is much higher (64%). Only 14% of respondents see the Philippine crocodile as a pest, 92% are proud to have the Philippine crocodile in the area and 100% think the species has a right to live (Table 1). Local Philippine crocodile knowledge, awareness and support for crocodile conservation have very strongly increased since 1999 when hardly anybody in San Mariano was aware that the species is endemic and threatened. Most people then saw all crocodiles as dangerous pests, best eradicated to protect people and livestock.

Table 1. Philippine crocodile knowledge and awareness of local people in San Mariano (n= 50).

| Question | % of Respondents answering "Yes" |
|--|----------------------------------|
| Do you know the Philippine crocodile? | 94% yes |
| Is the Philippine crocodile endemic? | 82% yes |
| Is the Philippine crocodile threatened | 44% yes (68% San Jose) |
| Is the Philippine crocodile protected? (municipal ordinances) | 46% yes (64% San Jose) |
| Is the Philippine crocodile a pest? | 14% yes |
| Are you proud to have the Philippine crocodile in your region? | 92% yes |
| Has the Philippine crocodile the right to live? | 100% yes |

The third main issue defined during the workshop is the lack of law enforcement that frustrates conservation efforts. The Department of Environment and Natural Resources (DENR) is responsible to implement and enforce national environmental laws. Although the Philippine crocodile itself is not clearly officially protected as long as the Wildlife Act of 2001 is not being implemented there are a variety of other laws that protect watersheds, wetlands, and endangered species within wetlands. See Miranda *et al.* (these proceedings) for an overview of national legislation that offers a framework for crocodile conservation. Law enforcement, or the lack thereof, by the DENR in Northeast Luzon is a controversial issue mainly because illegal logging is rampant in the area. The excuse brought forward by the DENR is the lack of operational budget, which is a serious problem, but there are many voices who speak of corruption and bribery. Hardwood logging, mainly to provide the furniture industry with raw materials, is big business in which much money is going around. This is not so much an issue whereas crocodile protection is concerned. There is simply a lack of knowledge, legislative confusion and the lack of directions from higher up, which hamper the implementation of crocodile protection measures by the DENR. A study by Guingab (2004) among 20 DENR officials to determine knowledge and awareness levels regarding the Philippine crocodile shows that although most respondents are aware of the existence of the Philippine crocodile, only 55% think it is important to conserve it and only 45% believe it is the role of the DENR to do so (Table 2). Moreover, 25% of respondents indicated they will not enforce any environmental laws because they are afraid of possible political connections of offenders which could cost them their job.

Table 2. Philippine crocodile knowledge and awareness of DENR personnel (n= 20).

| Question | % of Respondents answering "Yes" |
|---|----------------------------------|
| Do you know the Philippine crocodile? | 95% yes |
| Is it important to conserve crocodiles? | 55% yes |
| Is DENR responsible for crocodile conservation? | 45% yes |

A possible solution for this issue is the formation of community protection groups. With the minimal personnel and financial resources available to the DENR, well functioning systems of tribal self-enforcement and local guards are essential (NORDECO & DENR 1997). Training and establishment of these community protection groups and local guards is one the main goals for the coming year.

The Mabuwaya Foundation

The Mabuwaya Foundation was set up in 2003 to heed the call from the May 2002 workshop to establish a local organization that would co-ordinate the Philippine crocodile research and conservation activities in Luzon. The official status of this entity also creates more possibilities for fundraising and enables it to enter into agreements with other stakeholders. The activities of the Mabuwaya Foundation are currently implemented by four paid research and conservation officers who all have their roots in Northeast Luzon and two researchers from Leiden University, the Netherlands. Many Pilipino and Dutch students contribute to research activities. The Foundation is hosted by the Cagayan Valley Programme on Environment and Development (CVPED), which is a joint research program of Isabela State University and Leiden University. Funding is limited but is currently sufficient to continue basic operations until the end of 2005. The main budget stems from the BP Conservation award received in 2003. Additional funding has been received from the Chicago Zoological Society and the Critical Ecosystem Partnership Fund (CEPF). Proposals have been submitted to the Haribon Foundation, a Philippine NGO that among others supports research activities on endangered species, and to the Small Wetlands Funding Programme of the Netherlands Committee for IUCN. A partnership agreement has been reached with WWF Philippines for crocodile research and conservation activities along the coast of the Northern Sierra Madre Natural Park where WWF is implementing a biodiversity conservation project. For any new program activities, additional funding has to be sourced. The Foundation has to be capacitated and strengthened further to play the role it is intended for.

The future

The direct threats to the Philippine crocodile in San Mariano, killing and destruction of crocodile habitat, have greatly been reduced but there are many issues that remain to be solved before a safe future glares for the species. Unsustainable fishing, agricultural encroachment, deforestation and pollution are indirect threats that have to be tackled. The conservation program has until now rather narrowly focused on the species, we want to expand the activities towards wise wetland management in general with the Philippine crocodile as flagship species. Eradicating destructive fishery methods in the municipality: dynamite fishing, electro-fishing and the use of poisonous chemicals, is a first priority. These widely used methods deplete fish stocks, food for the crocs but also very important protein additions to the diet of local people. The use of chemicals for fishing poisons rivers and creates dangerous health situations for crocodiles and people. A recovery of fish populations will benefit local people in a very visible way; many people perceive the decreased fish availability as an issue. Protection of riverbanks and finding solutions for pollution of freshwater bodies with farming chemicals is also in the interest of local people and crocodiles.

Discussion

Although captive breeding has been successful in re-establishing, and releasing hunting pressure on, wild populations of several crocodylian species in other parts of the world, in the Philippines the captive breeding program for *C. mindorensis* has so far not led to effective conservation actions in the wild. It must be feared that the Philippine crocodile is extinct in most of its former range but the lack of survey data makes assessments highly speculative. The discovery of remnant populations in Northeast Luzon since 1999 raises hope that the species might still be surviving in other remote parts of the country. More extensive Philippine crocodile surveys are urgently needed to clarify its present status in the wild.

The Philippine crocodile survives in the foothills of the Northern Sierra Madre. A small and fragmented population of only 27 non-hatchling crocodiles, 23 of them in the municipality of San Mariano, now represents the best documented group of individuals of this species in the wild. Breeding has been confirmed in three key sites and conservation activities focus on these sites. A community-based conservation approach has been chosen to fit best the local context. A strong partnership with a local government has led to the first real steps towards conservation of this species in the wild. Local expertise has been developed and a local foundation established to implement the research and conservation work. Funding has been secured for the coming years. The causes for the decline of the Philippine crocodile in Northeast Luzon have been identified and, together with local communities, solutions have been defined to address the threats. There is a need to widen the program towards wise wetland management in general; this would solve several issues identified during the problem assessment of May 2002.

It is too early to tell whether the Philippine crocodile, which still stands on the brink of extinction, will survive in the wild in the Northern Sierra Madre. But, in San Mariano the tide is slowly turning from indifference, continued killing of crocodiles and destruction of habitat, towards a committed local government, concerned communities and highly motivated local conservationists which are jointly protecting one of the rarest species in the world.

This is not only good news for the few surviving crocodiles in Northeast Luzon but could also be a starting point for renewed efforts to re-introduce the species in other parts of the country from the captive-bred stocks in Palawan. The San Mariano experience shows that it is possible in the Philippines to work with local communities and governments in crocodile conservation and that public opinion can be turned positive towards this goal. Lessons learned in Luzon could well be adapted for use in other parts of the archipelago. There is, however, no silver bullet strategy that will guarantee success. We'd rather suggest a shot of hail in the form of lobbying, encouragement, funding and technical support, and that should be directed at the Philippine islands.

Acknowledgements

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False Gharials (*Tomistoma schlegelii*) in Tanjung Puting National Park, Kalimantan, Indonesia

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Abstract

An opportunist survey undertaken in Tanjung Puting National Park, Kalimantan in 2002, revealed that false gharials (*Tomistoma schlegelii*) are readily seen in the rivers around the Camp Leakey Orangutan Research Centre. Four false gharials were seen from a tourist boat during the day, and all were unusually tolerant of boat traffic. A spotlight survey revealed 18 false gharials in 32 km of rivers, with the majority being found within Tanjung Puting National Park; 11 false gharials were seen in 7.6 km, resulting in a density of 1.4 crocodiles/km, one of the highest densities ever recorded for the species. Crocodiles ranged in size from 2-3' to 6-7' indicating that breeding has been occurring in the area over the last few years. Other surveys conducted in the area in 1990 revealed a similar density and population structure, suggesting that the population has been stable and reproductive for over 12 years.

This globally significant population is well protected within this well managed National Park that provides excellent peat swamp forest habitat. Further in-depth studies are required for these false gharials however, as other populations of the species continue to decline elsewhere.

Introduction

The false gharial (*Tomistoma schlegelii*) is one the most striking of the 23 species of crocodylians. The vivid markings and colouration over the snout and body, even in adults, make this slender-snouted species easily recognisable. It is now restricted to the island of Borneo, Sumatra and Peninsular Malaysia, although historically it was also found in southern Thailand, where it is now thought to be extinct (Ross 1998).

Until recently, this large freshwater species was listed as "Data Deficient" by the International Union for Conservation of Nature (IUCN 1996) and was one of the world's least known crocodylians. Recent studies over the last 10 years however (Ramono 1994; Bezuijen *et al.* 1995, 1997; Ross *et al.* 1998; Simpson *et al.* 1998; Bezuijen *et al.* 2002), have shed some light on the distribution, ecology and status of this species. It is now classified as Endangered (Ross 1998) but in-depth studies are still required.

Tanjung Puting National Park

Tanjung Puting National Park is situated in Central Kalimantan District (Kalimantan Tengah), in the South of Kalimantan, Indonesia. It covers some 3000 square kilometres of lowland coastal forest and is covered by a complex of Nipah palms, mangrove swamps, peat swamps and tropical heath forests. Situated on a peninsula, the northern boundary is formed by part of the Sekonyer River, while the western and southern boundaries front the Java Sea (Fig. 1). It is one of the largest protected areas of tropical heath forest and peat swamp forest in Southeast Asia (Birute and Shapiro 1994).

Tanjung Puting National Park hosts a wide range of flora, with over 600 species of trees and more than 200 species of orchid known. Over 220 species of birds are found here, of which 5 are endemic to Borneo. The Park however, is best known for its populations of orangutans, which are the largest of the 9 primate species in the Park. Two species of crocodile can also be found here, the saltwater crocodile (*Crocodylus porosus*) and the false gharial (*Tomistoma schlegelii*) (Birute and Shapiro 1994).

The Camp Leakey research station lies within Tanjung Puting National Park and is situated 7.6 km upstream from its confluence with the Sekonger River (Fig. 1). It was first established in 1971 as a base for the study of wild orangutans and is now run by Orangutan Foundation International (OFI) in conjunction with the Indonesian Forest Protection and Nature Conservation Agency (PHPA). It aims to conserve orangutans and their rainforest habitat and is used by students, researchers and tourists as a base from which to conduct orangutan research and tourist activities.

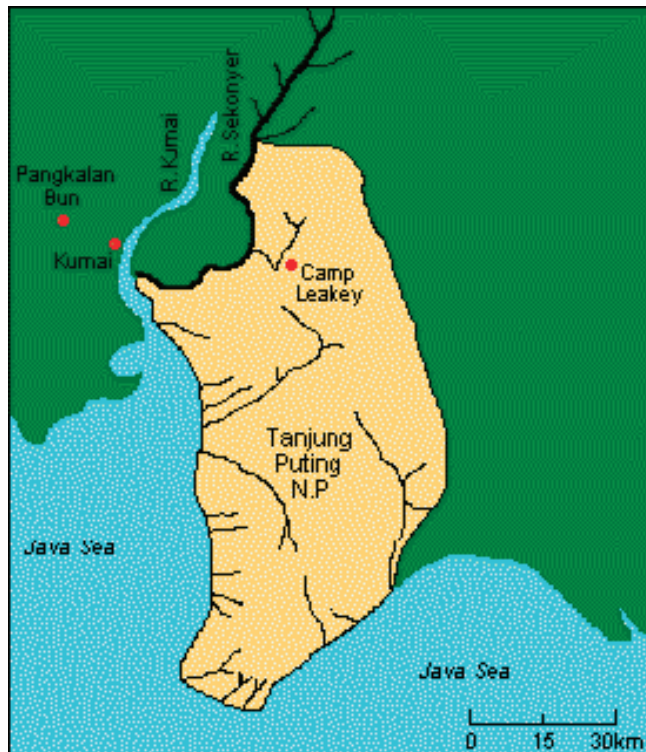


Figure 1. Map of Tanjung Puting National Park, Kalimantan.

Because of the influence and input from OFI to protect the orangutans and their habitat, this National Park is relatively well protected, although there has been some recent concern regarding illegal logging, mining and fishing activities (S. Brend, OFI, pers. comm.). The presence and protection afforded through OFI restricts these destructive activities, especially when compared to the wholesale forest clearing in other parts of the Kalimantan (and the country). This National Park therefore remains one of the best protected and managed National Parks in Indonesia

Methods

This study was carried out while visiting Tanjung Puting National Park as a tourist, and the observations were made from one of the many tourist boats that ply the rivers between Camp Leakey in Tanjung Puting National Park, and Kumai town. Observations were made on 27-30 August 2002, from the deck of the wooden tourist boat, both during the day and at night, as it moved along the rivers.

A spotlight survey was conducted on 30 August 2002 from the bow of the tourist boat as it made the 4 hour trip from the Camp Leakey Orangutan Centre back to Kumai town. The survey started at Camp Leakey and continued downstream on the Simpan Kanan creek for 7.6 km to the junction with the Sekonyer River (and police post). The boat then entered the Sekonyer River and continued downstream until its confluence with the Kumai River, a distance of approximately 25 km. The very wide and tidal mouth of the Kumai River was not surveyed as the boat made its way upstream to Kumai town.

A strong torch light was used to scan the shoreline of the river and the water surface, to detect the crocodile 'eyeshine.' Once a crocodile was found, an estimate of the total length was made, if possible. As the tourist boat moved along a set route, down the middle of the river, it was not always possible to get close enough to estimate the size of the crocodile. In this case, and in the case of the crocodile diving before an estimate could be made, an 'Eyes Only' classification was given. Although the survey vessel was not ideal for the purpose of crocodile surveys, it was adequate to provide meaningful results.

Results

Observing false gharials at the waters edge during the day was not possible in the 40-60 m wide Sekonyer River, as the distance from the boat to the littoral zone was too great. However, in the 10-15 m wide Simpan Kanan Creek, it was possible to see false gharials as they rested at the waters edge or basked on the bank or a fallen tree trunk.

Four false gharials were observed during the day as the boat made the 7.6 km trip up Simpan Kanan Creek on the 28 August 2002. All were juveniles, one estimated at 3-4' long while 3 were 4-5' long. Two other individuals both 5-6' long, were also seen near the Police Post at the junction of Simpan Kanan creek and Sekonyer River, during the evening on 30 August, 2002 (these 2 animals were not seen in the subsequent night survey 2 hours later). All animals were very tolerant of boat traffic and would often stay at the surface and bob in the wake as the boat passed. As the river was narrow, boats would often pass within 5m of these false gharials.

A night survey over 33km of the Simpan Kanan creek and Sekonyer River revealed 18 false gharials ranging in size from 2-3' long to 6-7' long. All eyeshines (EO) were assumed to be from false gharials, although saltwater crocodiles (*Crocodylus porosus*) are known to inhabit the area on occasions.

Within Simpan Kanan creek itself, eleven (11) false gharials were seen in the 7.6 km, from Camp Leakey to the confluence with the Sekonyer River, resulting in a density of 1.45 crocodiles/km (Table 1). There were no crocodiles seen in the first kilometre or so downstream of Camp Leakey, and so all observations were made within a 5 km section of Simpan Kanan Creek.

Table 1. False gharial (*Tomistoma schlegelii*) survey data for Tanjung Puting National Park, Kalimantan on 30 August 2002. EO= Eyes Only. * completely within Tanjung Puting National Park.

| | km | Crocodiles observed (in one foot size classes) | | | | | | EO | Total | Density (crocs/km) |
|----------------------|------|--|-----|-----|-----|-----|-----|----|-------|--------------------|
| | | 1-2 | 2-3 | 3-4 | 4-5 | 5-6 | 6-7 | | | |
| Simpan Kanan Creek * | 7.6 | - | 2 | 3 | 3 | - | - | 3 | 11 | 1.45 |
| Sekonyer River | 25 | - | - | 2 | - | - | 2 | 3 | 7 | 0.28 |
| Total | 32.6 | - | 2 | 5 | 3 | - | 2 | 6 | 18 | 0.55 |

Seven (7) false gharials were seen in the Sekonyer River, from the junction with Simpan Kanan Creek, downstream for 25 km. All of these sightings were within approximately 8 km of Simpan Kanan Creek, in the upstream portion of the Sekonyer River unit, near Simpan Kanan Creek.

Although 18 false gharials were seen during the whole survey, which covered 33 km, all observations were actually made within a section of approximately 13 km, that is, in 5 km of Simpan Kanan Creek and the first 8 km section of the Sekonyer River.

It should also be noted that a large bright red eyeshine was seen in the tidal waters 2 km from the mouth of the Sekonyer River the night before the survey (29 August 2002), and this was assumed to be that of a large saltwater crocodile (*Crocodylus porosus*). Saltwater crocodiles are sometimes seen in the Sekonyer River (S. Brend, pers. comm.).

Discussion

The false gharials of Tanjung Puting National Park represent a significant global population. The 18 false gharials seen during this spotlight survey compare very favorably with the results of a similar survey in 1990 (Frazier and Maturbongs 1990). Although the 1990 survey was slightly shorter (22.5 km) and covered a slightly different route, the results were very similar with a total of 16 false gharials being seen (Fig. 2). Twelve (12) of these 16 were seen within Simpan Kanan Creek, which is also similar to the results obtained during this survey, when 11 false gharials were seen.

This population has not only been stable for the past 12 years but the numbers and density found here are higher than for any other false gharial population. A density of 1.45 crocs/km was obtained for the 7.6 km stretch of Simpan Kanan Creek, from Camp Leakey to the Sekonyer River. This is the second highest density for false gharials ever recorded, the highest being obtained by Frazier and Maturbongs (1990) 12 years earlier on the same stretch of river (1.58 crocs/km).

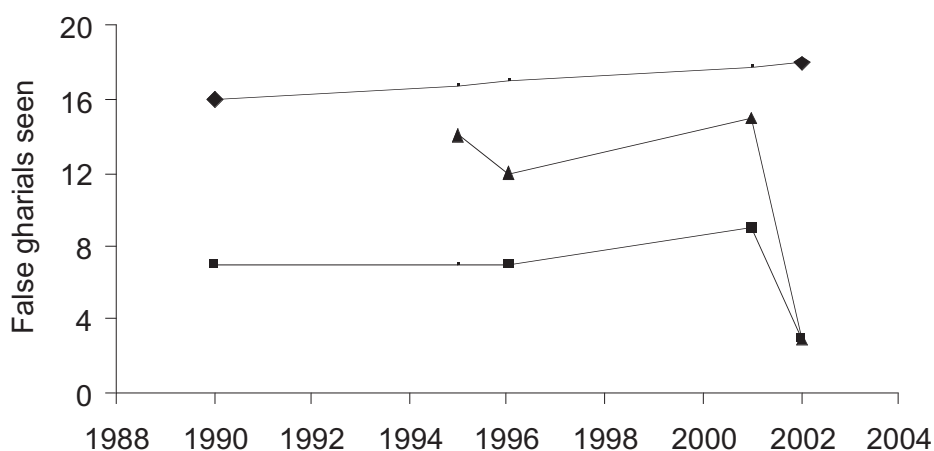


Figure 2. Summarised spotlight results for false gharial surveys in Indonesia. Diamond (top) = Tanjung Puting NP, Kalimantan, Triangle (middle) = Merang River, Sumatra, Square (bottom) = Berbak NP, Sumatra.

The survey results from 2002 (this report) and 1990 (Frazier and Maturbongs), both show various size classes of false gharials were seen, including very small individuals. This indicates that breeding has been occurring in the area for at least 12 years. Although nesting has been reported to occur upstream of Camp Leakey on the Simpan Kanan Creek (B. Galdikas, OFI, pers. comm.), neither survey explored this area.

Even though both surveys reported a high abundance and healthy population of false gharials in Tanjung Puting National Park, neither could be defined as comprehensive. Both surveys were carried out in sub-optimal conditions, and not all the navigatable waterways were surveyed. Both the 1990 (Frazier and Maturbongs) and 2002 (this report) surveys only traveled part of the suitable river system, and so the potential for further false gharials to be found in a more comprehensive survey exists. The Simpan Kanan creek for example, is navigable by boat for approximately 13 km upstream from its confluence with Sekonyer River. That is, boat travel is possible for a further 5 km upstream, beyond Camp Leakey (S. Brend, OFI, pers comm.). It is therefore reasonable to assume that this upstream section could hold a similar number of false gharials to the downstream section.

Further, more comprehensive surveys are needed for this National Park in order to fully understand the distribution and abundance of the false gharials here. The importance of this population becomes even more significant as other populations elsewhere continue to decline (see below). It is therefore essential that this entire population be surveyed thoroughly, so that an accurate assessment of the population and status can be achieved.

False Gharial Populations Elsewhere

The understanding of distribution, abundance and status of the false gharial is generally very poor, and there are very few sites where comprehensive surveys have been conducted. Tanjung Puting National Park is one of only 3 known Indonesian sites where surveys have been conducted on more than one occasion. These repeat surveys are extremely important and allow population trends to be followed while providing baseline data on threats and ecological parameters. Figure 2 represents data from these 3 areas in Indonesia where false gharial surveys have been conducted on more than one occasion. Two of the sites are in Sumatra, the Merang River and Berbak National Park, while the third is in Kalimantan, the Tanjung Puting site.

[The data points shown in Figure 2 were extracted from various reports and represent surveys undertaken over different river lengths, under varying conditions by different people. References for the data points are as follows: Tanjung Puting NP, **1990**= Frazier and Maturbongs 1990, **2002** = Simpson 2004 (this report); Berbak NP, **1990**= J. Cox unpubl. data, **1997**= Bezuijen *et al.* 1997, **2001**= Bezuijen *et al.* 2001, **2002**= Bezuijen *et al.* 2002 (note that the 2002 point was obtained by allocating EO data in the same proportion as the identified species); Merang River, **1995**= Bezuijen *et al.* 1995, **1996**= Bezuijen *et al.* 1997, **2001**= Bezuijen *et al.* 2001, **2002**= Bezuijen *et al.* 2002.]

An assessment of the Sumatran populations have been summarised below from Bezuijen *et al.* (2002). The Merang River population is located in South Sumatra province, Sumatra, and false gharials were all recorded from the river mouth to 67km upstream. This population has recently declined severely, from around 14 crocodiles in the 1995-

2001 period, to just 3 crocodiles in the 2002 survey. The cause of this drastic decline was attributed to a large influx of illegal loggers to the area in 2001. One large false gharial was killed in 2001, while a further 18 have been caught and are being held in villages and logging camps. The number of nests found in 2002 had also dropped to zero, no doubt due to the removal of most of the false gharial population, and the destruction of the peat swamp nesting areas. Extensive damage to the habitat has been, and continues to be, caused by these illegal, well organised, well-funded logging groups.

The Berbak National Park population of false gharials is located in Jambi province, Sumatra (Fig. 2) and represents the combined data from the Air Hitam Laut River and Melaka Creek (see Bezuijen *et al.* 2002). This population also shows a distinct decline after 2001. Bezuijen *et al.* (2002) states that there is no obvious reason for this decline, but it may be attributed to large-scale forest fires in 1997-98 that burnt large tracts of potential nesting habitat.

The monitoring of false gharial populations in Indonesia has shown that known populations in Sumatra have declined dramatically since 2001 (Fig. 2). These declines can be attributed to a number of factors, including large forest fires, extensive illegal logging, killing of crocodiles and the extensive capture of wild false gharials. Due to the extensive destruction of nesting areas, and the continued presence of illegal loggers, it is doubtful whether the Merang River population (Fig. 2) will ever recover. The Berbak National Park population may recover if the habitat regenerates and threatening processes are minimised, and has the potential to expand given suitable habitat is present. The Tanjung Puting population on the other hand, shows a significant population that has been stable for the last 12 years. This population is well protected in this National Park. It is therefore crucial that this population be fully assessed, and that habitat destruction and other threatening processes continue to be minimised.

While other populations of false gharials have declined, mainly through habitat destruction and the capture of animals, the Tanjung Puting population continues to remain stable and support significant numbers of the species. The well protected nature of Tanjung Puting National Park can be attributed to the presence and commitment of Orangutan Foundational International (OFI), in conjunction with the Indonesian Forestry Protection and Nature Conservation Agency (PHPA). The work of OFI to protect the orangutans and their habitat has also had great benefits for many other species including the false gharial. The continued presence of OFI in this National Park will continue to benefit the False Gharials of Tanjung Puting.

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A Pilot Project to Integrate Crocodile Conservation and Livelihoods in Cambodia

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Abstract

The 900 residents of O'Som Commune, Veal Veng District, share their land with at least 55 Siamese crocodiles (*Crocodylus siamensis*), which they have traditionally revered for generations. Since peace came to Southwest Cambodia in 1998 however, the commune's extreme poverty and starvation, coupled with increasing access to outsiders, exposed the crocodiles to new dangers from poaching and habitat loss. The Forestry Administration, Fauna and Flora International, CEDAC (local NGO) and O'Som Commune leaders formed this project in 2001 to solve underlying problems facing both people and wildlife. Building on careful research and consultations, our activities have included the participatory development of a commune land use and natural resource management plan, in which the villagers notably agreed to protect *all* crocodiles and other wildlife on their land, *and* allocated >200 ha of Veal Veng Marsh as a crocodile sanctuary. Food production has been significantly increased in the designated agricultural zones, and new income-generating schemes are showing promise. The link between this much-needed livelihoods support and the crocodiles is being constantly reinforced, and independent sources confirm that the villagers are reciprocating by actively defending them from crocodile farm collectors. Lessons learned here are now being applied to other communities in Southwest Cambodia.

Introduction

O'Som Commune

O'Som Commune is one of Cambodia's poorest and most remote communities, situated in Pursat Province at 12°5'N, 103°15'E, at nearly 600 metres above sea level in the Cardamom Mountains. The community contains nearly 1000 people in four villages: O'Som, Chai Louk, Kamlot and Kien Jong Roak. According to Veal Veng District Government records, the O'Som Commune land area covers 171,144 ha. Approximately one third is within the Phnom Samkos Wildlife Sanctuary, under the management of the Ministry of Environment. The remainder, including all four villages and Veal Veng Marsh, is in the Central Cardamoms Protection Forest, which is managed by the Forestry Administration. The third and smallest portion (12,194 ha) lies within a logging concession, currently held by Samling International.

People have lived in this area for over 1000 years, according to local folklore and the presence of an ancient shrine beside the marsh. Martine (1997) identified them as *Khmer Daeum* ('Original Khmer'). More specifically, 70% of the people are *Por*, an ancient Highland Khmer minority (Hammond and Hor 2002). This community used to be relatively prosperous, with its own pagodas, schools and 20 domestic elephants. When the Pol Pot Regime began in the mid-1970s, however, the villagers reportedly suffered from widespread persecution, malnutrition and slave labour. Veal Veng District remained in Khmer Rouge hands for the best part of 20 years, and it was not until the late 1990s that the final peace deals were signed and O'Som Commune rebuilt. Only about 863 people were registered by 1998, out of approximately 5000 who were present before the genocide (CARERE/UNDP/SEILA 1999; UNDP 1999).

In spite of a generation of war, many traditional customs have survived among the older villagers. Maxwell (2000) described their annual ancestor festival, when villagers tend the shrines of their ancestors and certain individuals communicate with the spirit world through trances. During the ceremony, 'the ancestors repeatedly extolled the virtues of protecting the forest, and reminded the villagers not to hunt the animals. One spirit even criticized the waste-management system of the nearby yellow-wood processing plant, and recommended that the factory owner dig a pit, far from the stream, for the disposal of his waste'.

Of special note is the *Por* community's taboo against harming certain 'sacred' animals, especially crocodiles and hares. There is no record of any villager having been attacked by a crocodile in O'Som, and some knowingly bathe or fish in pools containing large specimens. If a crocodile is hurt or killed, it is said that '*Ta Jiruk*', an ancestor who has become a forest spirit, will bring sickness or death on the person or family responsible. This taboo broadly applies to all commune members, but does not automatically extend to visitors who, it seems, may catch or kill crocodiles without fear of supernatural retribution.

Siamese crocodiles

Nao and Tana (1994) predicted that Siamese crocodiles might occur in the Cardamom Mountains, but it was not until 2000 that the crocodiles were confirmed here (Daltry and Chheang 2000). There are now known to be crocodiles in at least 16 sites in the mountain, from 10 to 600 m above sea level (Simpson and Sam, this volume). Two key sites are near O'Som Commune:

1. Veal Veng Marsh

Located near the centre of the Cardamom Mountains, Veal Veng ('Long Field') Marsh is a unique rain- and river-fed wetland at 560 m above sea level (Fig. 1). During the dry season, the crocodiles are confined to the wettest part of the marsh, within an area of less than 50 ha. During the rainy season, the crocodiles disperse across a flooded area of 500 ha. The water level can rise by one metre across the marsh in 24 hours of heavy rain, and takes up to 25 days to empty (Carvalho *et al.* 2002). The marsh contains the largest known colony of Siamese crocodiles in the wild in Cambodia, with an estimated 40 individuals (Daltry *et al.* 2003). Nesting was confirmed here as recently as May 2004 (Simpson and Sam, this volume).

2. Koi and Krau River System

The Krau River drains the marsh and forms a tributary of the Koi River. Four crocodiles have been documented



Figure 1. Map of Cambodia, showing the location of O'Som Commune.

in the Krau River during the dry season, and a further ten occupy 'Anlong L' Ang', a deepwater section of the Koi River that is also used by O'Som villagers for fishing (Daltry *et al.* 2003). All of the individuals seen and reported along these rivers to date are adults, and no nests or juveniles have been reported. These individuals may be able to interact with the colony in Veal Veng Marsh during the rainy season.

Problems Facing the O'Som Commune and Crocodiles

When the project team first encountered the villagers in 2000, a number of interrelated problems were identified, including:

- i) The villagers lacked sufficient food for up to seven months a year. Health care and schooling were almost non-existent, and life expectancy was low.
- ii) Farming and income generating opportunities were limited because of low fertility, lack of know-how and lack of materials, including seeds.
- iii) The villagers resorted to illegal and destructive strategies to obtain food and money, leading to ugly clashes with law enforcers.
- iv) A new road was constructed in 1999, linking O'Som Commune to two cities (Pursat and Koh Kong) and the Thai border. Wildlife traders visited the commune every month, offering money for rare animals.
- v) Migrant workers and entrepreneurs came to O'Som to take land, yellow vine, timber, cardamom, tree resins and other valuable resources. These outsiders did not share the commune's taboo against harming crocodiles.
- vi) The villagers lacked recognition of their rights to land or natural resources. There was nothing they could do to stop other people from taking land, wildlife or other resources.
- vii) The population of O'Som Commune was small, but increasing. There was no plan in place for coping with internal population growth or immigration.
- viii) Increased use of new nylon fishing nets and hooks in Veal Veng Marsh led to several young crocodiles being accidentally killed every year, as well as complaints of valuable fishing gear being broken by large crocodiles.
- ix) There was no co-ordination between conservation and humanitarian welfare and development organisations, leading to real problems for people and wildlife. Aid agencies were proposing to turn the whole of Veal Veng Marsh into rice fields, for example, which would have destroyed the core crocodile population and other wildlife.

Methods and Results

O'Som Community Conservation Project

The Forestry Administration (Royal Government of Cambodia) and Fauna and Flora International founded this project in 2000 as part of the broader Cambodian Crocodile Conservation Programme. Our mission is 'to conserve the population of Siamese crocodiles and improve the livelihoods of the people of O'Som Commune in ways that are sustainable, culturally appropriate, environmentally sound and compatible with biodiversity conservation.'

All phases of this project were developed in close partnership with the people of O'Som Commune and local authorities. The Centre d'Etude et de Developpement Agricole Cambodgien (CEDAC, a Cambodian NGO) joined the project in 2002 to provide specialist assistance to improve the community's food security (Phase 4). The project also benefit from the support and active involvement of Conservation International, Ministry of Environment, SEILA Development Program, and other key stakeholders.

Phase 1 - Gathering information and building relationships (2000-2002)

FFI and FA organised a series of participatory research activities and consultations to develop a better understanding of the area, the community, the crocodiles and other wildlife. The work involved specialists from FFI, FA officers and members of the local community, with additional contributions from Pursat provincial staff from the Departments of Environment, Agriculture, and Meteorology and Water Resources. The main foci of our ecological research programme included baseline studies of the status, distribution and ecology of the Siamese crocodiles (Daltry and Chheang 2000; Daltry and Tith 2002; Daltry *et al.* 2003) and inventories of mammals, birds, reptiles, amphibians and fish. The latter led to the identification of other endangered species and several species new to science (Long *et al.* 2002; Baird *et al.* 2002; Ohler *et al.* 2002). A hydrological survey of Veal Veng Marsh was also commissioned in 2002 (Carvalho *et al.* 2002).

We also engaged socio-economic specialists to examine the demographics, ethnicity, history, religion, education, health, economy, physical capital, agriculture and natural resource use of the O'Som Commune, and identified some of the main concerns and problems affecting their livelihoods (eg Maxwell 2000; Hammond and Hor 2002). The villagers were then taught basic mapping skills and assisted the project team to map their current and historical land use areas, including private fields. This led on to a more detailed Participatory Rural Appraisal and investigations into how to improve food production on existing farmland. Soil analyses were carried out, and confirmed the villagers' observations that most of their existing fields were severely depleted of nutrients (Ironsides *et al.* 2002).

FFI and FA also began an ongoing process of consultation with other stakeholders in and around Pursat province, including Cambodia Area Reconciliation and Rehabilitation (CARERE), United Nations Development Program (UNDP), Conservation International, Ministry of Environment, and the local government. It was during this stage that the team learned of plans by CARERE and UNDP to convert the whole of Veal Veng Marsh into rice paddy, and to settle landless internally displaced persons here (see Introduction). To their credit, UNDP retracted their support when they were informed of the global importance of the marsh for Siamese crocodiles, but not quickly enough to prevent CARERE from donating nearly 100 buffalo in 2000 and 2001 to plough the new fields.

The information gathered during Stage 1 contributed to much of the O'Som land being taken out of logging concession and incorporated into the new 420,000 ha Central Cardamoms Protected Forest in 2002 (see Phase 3).

Phase 2 - Raising awareness of the crocodiles and other conservation issues (2001-2002)

In 2001, we seconded Mr Aing Leang Heng from the provincial Department of Education to train O'Som's four teachers, several of whom were functionally illiterate. Over seven months, his objectives were to build better general teaching skills within the community, raise awareness of the natural environment and strengthen the relationship between the project and the commune. The environmental education sessions included raising awareness on wildlife and habitats (including the Siamese crocodiles and Veal Veng Marsh), water health, waste disposal, hygiene and tree planting. This led to a noticeable improvement in waste disposal around the villages, improved hygiene, tree planting and a decrease in the number of children observed hunting or trapping birds around the commune. Heng became accepted as part of the community and observed that "the community of O'Som demonstrated a willingness to work with outsiders on a project that did not offer huge financial rewards, but offered a long term community benefit" (Fox 2004).

Since 2001, the commune became even more aware and proud of their natural environment through the international attention that the crocodiles have received. Visits by National Geographic film crews, journalists, senior government officials, international tourists and conservation workers helped to boost community support for crocodile protection and environmental management generally. In 2002, FA and FFI invited the village leaders to design a t-shirt for their commune. They chose a picture of a crocodile with the words, in Khmer, '*O'Som Commune, Veal Veng District*' on the front and '*Together We Can Save Ta Jiruk's Crocodiles*' on the rear. Every adult in the commune received a t-shirt, and the leaders frequently wear theirs to important meetings.

Phase 3 - Community land use and natural resource management planning, including the creation of a crocodile sanctuary (2002-2003)

By 2002 (the third year of the project), it was still unclear what rights the people - or crocodiles - of O'Som had to land and natural resources around the commune. This area became part of the Central Cardamoms Protected Forest in July 2002, and rangers were stationed in O'Som to stop villagers from hunting or felling trees, but not from making new wet rice fields or fishing or burning in the marsh. Using the information and experiences from Phases 1 and 2, we realised that an urgent priority was to negotiate and collaboratively agree a community land-use and management plan, and present this to the government for endorsement. The plan had to clarify exactly where and how different areas may be used for community development and conservation, and be enforceable by the commune leaders and Central Cardamom Protected Forest rangers.

The O'Som Commune land use plan was developed slowly and organically using a slightly modified form of the national Participatory Land Use Planning method (Rock 2001). A series of workshops and meetings were held in 2002 and 2003, beginning from household and village level, through commune, district and provincial levels, to national level. Almost every villager contributed to the meetings. FFI and FA provided facilitators and some technical guidance. The resulting land use plan (Figs. 2 and 3) covers the entire commune territory and follows traditional management zones where possible. These include, for example, residential areas, spirit forests, rotational forest

gardens ('chamka') and wet rice fields. The draft plan also incorporates specific biodiversity needs: for example, a 239 ha crocodile sanctuary, fish sanctuaries and strict wildlife preserves. All of these were at the villagers' own suggestion.

Detailed regulations, or commune by-laws, were drawn up for each zone and major natural resource, largely following the peoples' practices before the war. The implication of this plan and regulations for crocodiles will be discussed in more detail under Phase 5 below. The plan and its accompanying regulations have already secured strong support



Figure 2. Project team examining a commune sketch-map of current land use. Clockwise from bottom-left: Chay Sem (Vice Chief, O'Som Commune); Hor Leng (Community Liaison Officer, FA); Sam Han (Crocodile Field Coordinator, FA); Lang Tunh (Head of Women's Affairs, O'Som Commune); Jeremy Ironside (Technical Adviser, FFI); a village elder; Y Naron (Agricultural Trainer, CEDAC).

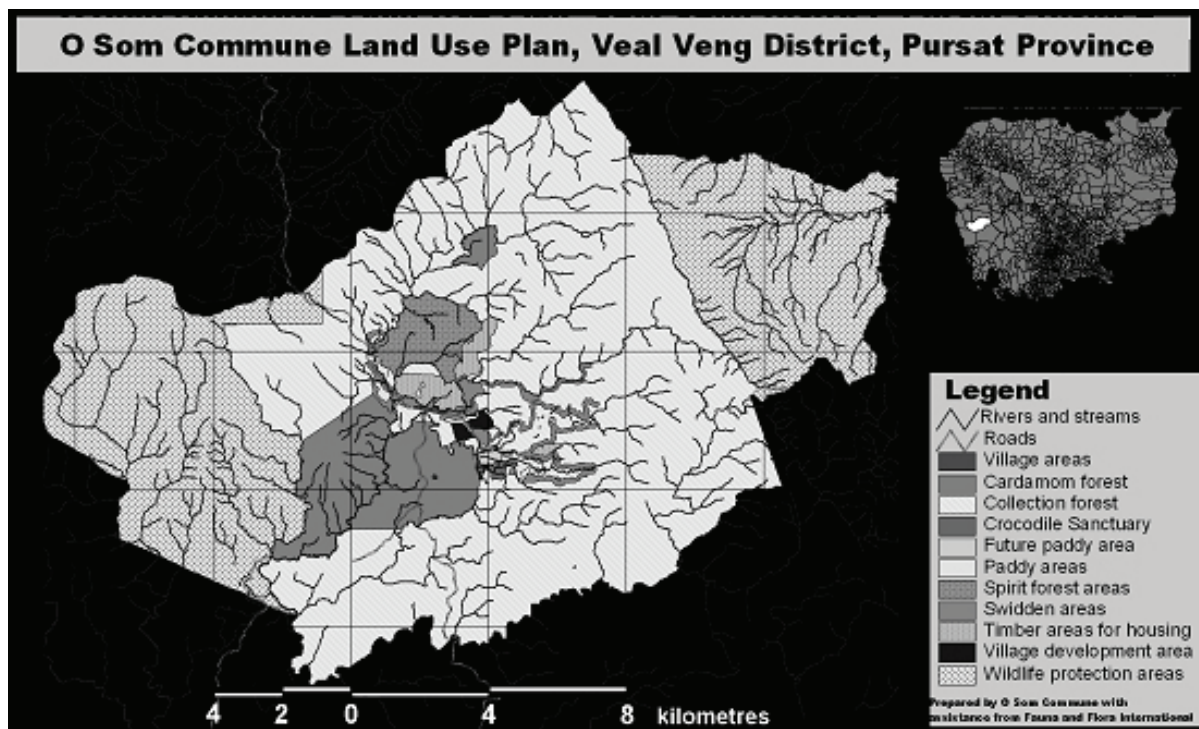


Figure 3. O'Som Commune Land Use Plan.

from the local government, and will be put before the national government for official approval before the end of 2004. The villagers have also considered establishing commune-level penalties for offences by commune members that are not already covered by national laws (eg for wilfully lighting fires near the crocodile sanctuary). These generally include fines to be paid to the commune fund and/or a period of community service, depending on the severity of the crime.

The draft plan and regulations set the framework for the next phase of the project, by identifying which areas and resources may be used for income or food production.

Phase 4 - Sustainably increasing food security and income in ways compatible with crocodile conservation (2003-2006)

During the earlier phases, FFI and FA provided emergency assistance to help the commune, including providing over a tonne of rice and hundreds of kilograms of seeds. This clearly was not a long term solution, however, so Centre d'Etude et de Developpement Agricole Cambodgien (CEDAC) were invited to join the project to assist the farmers to improve food production on existing farmland without using harmful or expensive chemicals or damaging the environment. Working one-on-one with volunteer villagers, CEDAC began experimenting with a range of new crops and techniques around O'Som. The latter include the System of Rice Intensification, which has increased rice yields by up to six-fold elsewhere in Cambodia, using the same local varieties and without any chemicals or other costs (Uphoff *et al.* 2002).

The O'Som farmers have expressed satisfaction with the results so far and the commune was able to produce a much greater percentage of its own food in 2003 than since before the war (CEDAC 2003). Some families even produced a surplus. CEDAC trainers are continuing to spend at least 10 days per month in O'Som until at least end 2006, to teach, test and refine better food production and storage techniques.

The villagers are also currently receiving assistance to market agricultural produce and to develop other sources of income. O'Som Commune used to earn most of its income from harvesting wild cardamoms *Amomum krevanh*, which grow in the surrounding rainforests, and were the primary reason why villagers did not cut old-growth forests on their land in the past. We aim to reinstate the cardamom trade in 2004, to enable O'Som to generate a sustainable income of an estimated \$10,000 per year. The Commune has already begun joint patrols with local Forestry Administration rangers to protect the wild crop from raiders. We are looking at other ways to generate money, such as medicinal plants and ecotourism.

To help manage these natural resources and ensure that the income is handled fairly and transparently, a Commune Natural Resources Management Committee was democratically elected in 2003, and is undergoing training by project staff. A Commune Fund has also been established to ensure that a proportion of income will be re-invested in activities that benefit the community, such as a medical clinic, and for conservation.

Phase 5 - Management planning and implementation of the new crocodile sanctuary (2004-2006)

During Phase 3, the O'Som Commune unanimously agreed to establish a crocodile sanctuary in Veal Veng Marsh, which encompasses all of the areas inhabited by crocodiles during the dry season, and all known nesting sites. Negotiating this boundary was largely left to the Commune Natural Resource and Management Committee, which offered alternative land to the small number of farmers who claimed land ownership within the sanctuary. No direct payments were made. Some key regulations pertaining to the sanctuary, agreed during Phase 3 workshops, include those shown in Box 1. Several of the rules shown here were 'hinted' by our crocodile specialists, but their adoption was left to the Commune's choice.

Importantly, crocodiles will also benefit from strict protection outside of the sanctuary, and the Commune regulations forbid cutting of vegetation within 20 metres of any stream or river. Furthermore, the land use plan allocates a number of significant zones where no hunting or tree cutting will be permitted, including Spirit Forests (13,003 ha) and Wildlife Protection Areas (50,703 ha). The crocodile sites in the Koi and Krau Rivers fall into these categories.

In January 2004, the project team demarcated the crocodile sanctuary boundary with flagging tape and made sure that neighbouring landowners were happy with the boundary. Several farmers came forward to dispute certain sections, but these were resolved internally by the new Commune Natural Resource Management Committee. In most cases, the farmers were allocated better fields elsewhere.

At the time of writing (May 2004), work has begun on developing more detailed management guidelines for the sanctuary, addressing such issues as signage and permanent boundary demarcation, how to keep the CARERE-donated buffalo out, monitoring requirements, and wardening roles and responsibilities.

Box 1. Key draft regulations for the Crocodile Sanctuary (English version, January 2004)

5.2) Conservation of Siamese Crocodiles

Article 32) Areas For Crocodile Conservation: (291 ha)

To conserve the population of crocodiles in Veal Veng Marsh, the following areas have been set aside for Crocodile Conservation: Boeung Mluch, Chrolong Svay, Romeas Ngoarb, Trapaing Kok, Spean Smach, Trapaing Sroh, Trapaing Arng Phleung, Ptool Wat and Koh Treah [place names within the Marsh].

Article 33) Hunting, Possession and Sale of Crocodiles and their parts

- A) No hunting of crocodiles or all other forms of animals in the crocodile sanctuary area will be allowed.
- B) It is forbidden to buy, sell or trade crocodiles, crocodile eggs or products inside or outside the commune.
- C) Offenders caught carrying out the above offences will be reported to the appropriate authority for prosecution under national law.

Article 34) Fishing

- A) The use of gill nets and fishing with hooks is prohibited as well as all equipment described in Article 40 of these regulations.
- B) Permitted equipment - Fishing with Ungrhut (cone-shaped basket), Samnung (castnet) and Chneang (scoop) is permitted by commune members in the sanctuary area. Members must take care not to disturb crocodiles while fishing.
- C) The use of illegal fishing gear will incur penalties outlined under Article 36, 37 and 38 of the Fisheries Law.

Article 35) Preservation of Crocodile Habitat

- A) Changing of the crocodile habitat is not permitted. This includes
 - Cutting of trees or plants
 - Changing of water flow by digging new paddy fields, channels or building paddy bunds in the sanctuary.
 - Making camps or buildings.
 - Buffalo grazing in the crocodile reserve (if this occurs, observers should tell the owners to move buffaloes).
- B) Fires: No fires to be lit within 20 metres of the reserve boundary or within the reserve.
- C) Disturbance to nesting areas: There must be no disturbance to known nesting areas and/or nesting crocodiles. nesting crocodiles are not to be approached, and nests must not be touched.
- D) Collection of eggs: Crocodile eggs are not to be collected.

Discussion

Impact for O'Som Commune

This project is still a work-in-progress, but has already produced some clear, positive benefits for O'Som Commune. Not least of these are (a) identifying and acknowledging the community's rights to land and resources in this area, and (b) increased food production on existing farmland, both in terms of quantity and diversity. Within the first year of assistance from CEDAC, some of the participating families have produced a surplus of food to sell. One commune member, Mr Ut Krin, reported '*Our farming is better now than before [the project]. We use less land but still have enough yield to raise our families.*'

Some families have also benefited from increased income. So far, this has largely been direct, for example through project staff and guests paying for accommodation, transport and guides, but soon the commune will be generating income from the sales of crops and, if all goes to plan, wild cardamoms and perhaps other renewable natural resources. The cost of living with crocodiles is small - a few villagers complained about crocodiles breaking gill nets, but this should be mitigated by using other fishing techniques in the crocodile sanctuary (Box 1). Many families in O'Som Commune still lack enough food or money, however, and we must try to ensure that the benefits are shared.



Figure 4. Local fishing party in the proposed Ta Jiruk Crocodile Sanctuary in Veal Veng Marsh. The woven scoop baskets pose no threat to crocodiles and shall be permitted under the new regulations (Box 1).

The links between improving livelihoods and the continued survival of the crocodiles and other wildlife is being continually re-enforced, not only by project staff, but by villagers themselves. One family took the initiative to construct a brightly painted wooden guesthouse in 2002, which they named the '*Kropeu Meas*' or 'The Golden Crocodile'!

Impact for crocodiles and other wildlife

O'Som Commune members report that they have successfully prevented outsiders from taking crocodile eggs or hatchlings, simply by informing them of draft by-laws. Corroborating this, a motodop driver from Pursat town was recently heard complaining '*I used to take baby crocodiles from Veal Veng Marsh to sell, but now the people won't let me. There are lots of baby crocodiles there now, and I can only look at them*' (pers. comm. to Keo Nara). During routine monitoring by the CCCP field team in 2004, an unprecedented number of hatchling scats were recorded along fixed transects in the marsh (Boyd Simpson and Sam Han, unpublished data). Mr Som Lork, the Second Commune Assistant, said '*The crocodiles are increasing very much. When we go fishing with nets, small crocodiles are attracted to our fish.*'

We have also observed a conspicuous decrease in hunting and deforestation by the indigenous families. Remarkably, at their own initiative, O'Som villagers began forming joint patrol parties with the government rangers in 2003 to patrol the forests to exclude illegal hunters and loggers. Some worrying forest encroachment was observed by immigrant families near Chai Louk village in 2002 and 2003, but the commune leaders have ordered them to stop. Mr Chey Sem, Vice Chief of the Commune Natural Resources and Management Committee, commented that '*Now, no one dares to cut the forest or hunt wild animals, or to encroach on community land for housing or farming.*'

Applicability to other communities and crocodile populations

This pilot project with O'Som Commune demonstrates that it is possible to engage communities in protecting crocodiles, while also helping to solve their livelihoods problems. Here, the incentive to protect the crocodiles has been primarily

cultural, building firstly on long established taboos against harming crocodiles, and secondly on an appreciation that the animals have served as a ‘lever’ to gain new respect and extra help from NGOs and the government. In this latter regard, this project shares similarities with the promising community-based conservation programme for Philippine crocodiles in San Mariano Municipality, Luzon (Miranda *et al.* 2004).

Cambodia is considered the last ‘stronghold’ for Siamese crocodiles, with a total wild population of probably no more than 200 adults (Simpson and Han 2004). At least eight communes in Cambodia still have crocodiles living nearby throughout the year (Daltry *et al.* 2003; unpublished data, 2004). These animals are threatened by collection for farms and trade, and many populations are in additional danger of losing their wetland habitats: even in protected areas, the laws against clearing forests are stricter and more widely recognised than the legislation protecting wetlands from conversion to rice fields. Enlisting the cooperation of local communities in the protection of crocodiles and wetlands is therefore crucial to bolster, but not substitute entirely, more conventional tactics such as establishing protected areas and strengthening law enforcement.

While community-based approaches to wildlife conservation are still rare in Cambodia, it is worth noting that engaging communes in participatory land use planning and the management of wildlife and natural resources are very much in line with both the Cambodian Government’s emerging policy of decentralisation (eg Wehrmann and Sy 2002) and the National Biodiversity Strategy and Action Plan (Royal Government of Cambodia 2002).

The ‘O’Som model’ probably ought not be simply lifted and copied as a blueprint, however, because every community and area is different. The key to success is undoubtedly in the approach to finding the most appropriate solution to meet the local needs. This process must be genuinely participatory, build on the best available scientific information, be conducted at the community’s own pace, *and* have support from both the local authorities and national government. Table 1 summarises some of the key characteristics of the O’Som project. It is also likely that the best results will be gained with communities that are, like O’Som Commune, tightly knit and have lived in the same area for generations (Fox 2003).

In 2003, FFI and the Ministry of Environment embarked on a similar process with communities living inside the Phnom Samkos Wildlife Sanctuary and Phnom Aural Wildlife Sanctuary, as part of the Cardamom Mountains Wildlife Sanctuaries Project. At the time of writing, Conservation International and the Forestry Administration have also

Table 1. Comparison of this project with the classic Integrated Conservation and Development Project model in Asia (data from Wells *et al.* 1999).

| Short-term (usually 3 years) | Long-term (10 years +) |
|--|--|
| Weak understanding of ecosystem Variable understanding of local people Externally designed by experts | Founded on sound, if incomplete, ecological research Founded on detailed socio-economic research Internally designed in participatory manner |
| “Blueprints and log-frames’: solutions are prescribed and constrained by donor agencies Weak linkages between conservation and development | Adaptive: able to respond to new opportunities and challenges from month to month Linkages actively sought and encouraged (eg income from renewable forest products) |
| Large budget distorts local economies: eg ICDPs in Indonesia (N= 21): Mean: \$973,000 per project/year Mean: \$5.58 per hectare/year | Value for money. Modest budget is more in keeping with the local economy \$30,000-50,000/year \$0.18-0.29 per hectare/year |
| Technical input from short-term, highly paid consultants from overseas Weak on government support | Engage national organisations where possible, and experts based within the region who make repeated visits Strong government involvement (district, provincial, national) |
| Monitoring of project impact upon human livelihoods, but not biodiversity or environment Ignore other factors affecting biodiversity (ie assume local people are the only threat) | Monitoring of project impact upon human livelihoods <u>and</u> biodiversity and environment Directly tackling other factors (eg working with rangers to halt poaching by outsiders) |

begun replicating the O'Som approach with two more communes in the Central Cardamom Mountains (Sarah Milne, pers. comm.). Several of these communes have small numbers of wild Siamese crocodiles in their vicinity, and the programme managers are already keen to ensure that their needs are incorporated.

Project sustainability

Will there still be Siamese crocodiles living around O'Som Commune in ten, twenty or a hundred years? Will the Commune continue to gain a better standard of living, without compromising the natural qualities of Veal Veng Marsh and other crucial areas for wildlife?

It is sobering to note that many Integrated Conservation and Development Projects (ICDPs) have failed, at least in Asia. A recent World Bank report on 21 ICDPs in Indonesia, for example, concluded that even after spending \$130 million of foreign donor grants (in addition to substantial investments from the Government of Indonesia), hardly any could 'realistically claim that biodiversity conservation has been or is likely to be significantly enhanced as a result of current or planned project activities' (Wells *et al.* 1999)! Similar reports have emerged from Vietnam, where a number of serious design flaws were identified (Anon 2000).

Although the O'Som Community Conservation Project can point to measurable benefits (above), four years is not enough to prove whether this will be any more sustainable than the previous examples. Throughout every stage of project development, however, we have made every effort to avoid common design mistakes and made sure that the community feels a high level of project ownership. Table 1 summarises the main ways in which this project differs from some of its predecessors. We will continue to monitor the community and crocodiles every year in order to evaluate project impact and sustainability.

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Local People in Crocodylian Conservation - the African Context

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Abstract

Three species of crocodylian exist in sub-Saharan Africa together with 700 million people. Human populations are mostly rural and are growing rapidly. Wetland habitats are being degraded through settlement, agriculture and deforestation. There is a diversity of attitudes held rural African people towards crocodiles but this relationship is seldom a positive one. Most African countries have histories of pre-colonial, colonial and post-independence phases and all of these have contributed to the current state. All the species have been used for meat and/or skins at some point and other utilisation options for rural communities are limited. Recent work in DRC and Kenya illustrate the changes in crocodile populations, the use and abuse of these, the impact of human/crocodile conflict and the lack of effective regulation and technical capacity.

Introduction

Subject to likely future taxonomic revisions, Sub-Saharan Africa (south of approximately 15°N) and the Nile valley are occupied in suitable habitats by three species of crocodylians, the Nile crocodile *C. niloticus*, the African slender-snouted crocodile *C. cataphractus* and the West African dwarf crocodile *Osteolaemus tetraspis*. Each species has more or less specific habitat requirements, *C. niloticus* being a generalist that is hence most widespread, occurring in most aquatic habitats that have a suitable temperature regime. *C. cataphractus* and *O. tetraspis* are have more specific requirements for Equatorial swamp forest and riverine habitats. All the species play an ecologically important role as top predators and both in terms of individual body mass and biomass they are Africa's largest predatory species. Our knowledge of the ecology of the two smaller species is limited and our understanding of the status, detailed distribution, population dynamics and threats to all the African crocodylians leaves much to be desired.

The human population of Africa is broadly concentrated in same area, avoiding the arid zones of the Sahara, the horn of Africa and the Namib and Kalahari deserts. There are relatively high densities of human population in the Ethiopian highlands, in Nigeria and neighbouring countries, around the African great lakes and in the Rift Valley, in some cases over 300 people per km².

There are 38 countries in Sub-Saharan Africa covering a total of 23 million km². Nearly 700 million people, giving an average density of 30 people per km², inhabit this area. Most importantly the human population is increasing rapidly with the median age being less than 18 years old and the population growth rate in the range of 2-4% per annum. There are at least 600 distinct ethnic groups many of which still follow indigenous animist and tribal beliefs. While Africa is rich in resources these are often poorly managed and for the benefit of minorities, such that the average GDP pre capita for sub-Saharan Africa is many cases less than \$US 1000 per year.

The conservation of crocodylians therefore has to operate subject to this framework of human requirements. This paper is intentionally descriptive and aims to focus on the issues and challenges of conserving a predator that today conflicts with human interests in an environment where the classical philosophies of preservation and conservation may have restricted impact and the effective management of wild crocodylians is limited.

Local People and Attitudes

The vast majority of Africans live in a rural situation and pursue subsistence pastoralism, agriculture, hunting and fishing. Their settlements are often constrained by access to permanent water, which is taken from rivers, streams, dams and lakes as underground water and/or piped water are infrequently found. Communities living near water bodies draw water directly using buckets and containers and normally bathe and wash clothing directly in the river or lake. All livestock are watered directly from the water body. Opportunities for cash income generation are limited. There is often limited access to primary education facilities and only a small proportion of children receive secondary

schooling. Similarly rural health centres provide only limited services and may be separated by considerable distances. Roads and communication infrastructure in such areas is mostly rudimentary. In such situations the activities of most people are directed at provision of food and water for daily existence. The wildlife occupying such rural areas may be hunted or trapped as a source of food or in some situations the community sells concessions for sport hunting, however wherever wildlife actually or potentially interferes with human activity through incidental attacks, crop raiding or predation these individual animals or the species as a whole is regarded as a “problem animal”. Many of the activities of rural Africans described above expose them to risks of conflict with Nile crocodiles.

With the difficulties of survival under these circumstances and the relatively low levels of education, it should not be surprising that many people have a narrow focus on issues pertinent to their survival. Where wildlife actually or potentially makes their life more difficult their first desire is to have this wildlife removed permanently. The concept of wildlife conservation is therefore something of a luxury unless living with wildlife can be shown to bring some simple and tangible benefit.

The attitudes of people in Africa towards crocodiles can be seen in three phases; pre-colonial, colonial and post-colonial. In the pre-colonial period, ie approximately pre-1900, there were significantly smaller human populations than exist today, communications were limited to word of mouth and all travel was on foot or by boat. It is apparent that local people were well aware of the presence of crocodiles and the danger that they sometimes posed. In areas where crocodiles were known to be aggressive (eg the Shire valley, Malawi) there are records of barriers being constructed and used to protect points for the collection of water. In other areas, for example along the Congo River, crocodiles were not apparently regarded as a threat at all.

In pre-colonial times there appears to have been a strong ritual and spiritual significance attached to crocodiles. To some extent this remains to the present day. For example, in some areas people believe that the spirits of their ancestors may reside in certain crocodiles. Some families and clans may identify a species of animal, including the Nile crocodile as their “totem”, in this case no clan member may harm or eat an animal of that species. In parts of West Africa trial by ordeal was used by tribal chiefs to judge guilt in people accused of various crimes, this included the crossing of crocodile “infested” waters by the accused. There is a widely held belief that witchdoctors and witches can tame crocodiles and use them for their craft, in which case a crocodile attack may be the result of being cursed by the witchdoctor or an enemy who has hired the witchdoctor for this purpose. There are also various beliefs that some crocodile body parts have medicinal value and that the bile and the brain are extremely poisonous. Certain tribes are traditionally accustomed to eating crocodile meat and their eggs while others will not touch it.

In the colonial period, extending from approximately 1900 to 1960, there was an influx of missionaries, hunters, traders and administrators of western European origin. They provided the first written record of the existence of crocodile populations in Africa and of the relationship between local people and crocodiles. The colonials, with little knowledge of crocodiles and discovering that they sometimes attacked and ate humans, judged them to be vermin and “disgusting and ungentlemanly”. The colonial period was characterised by attempts to eradicate crocodiles, initially as vermin and later to facilitate the development of commercial fishing, particularly on the African Great Lakes, as it was believed that the abundance of crocodiles consumed so much fish as to render commercial fishing unviable. This later developed into hunting specifically for the skins to provide a ready and lucrative market in Europe. This hunting effectively collapsed in the 1950s as most accessible populations had been severely diminished.

The status of crocodiles and their conservation in the post-colonial period since the 1960s has been well documented in the scientific literature. The wildlife conservation authorities of newly independent African countries inherited a situation in which many crocodile populations were at low density and that compared to the large mammalian species such as elephants and rhinoceros, the conservation of crocodiles was a low priority. Since then there has been considerable growth of the human population occurring concurrently with a recovery in the populations of crocodiles. There has also been significant development of rural areas, facilitating habitation of new areas and improving communications such that the reporting of incidents of conflict with crocodiles is more frequent. Many of the spiritual aspects of the pre-colonial era have been retained. The efforts made by people in earlier times to protect themselves by consistent use of barriers etc appears to have been replaced by a modern reliance on assistance from the authorities to remove the crocodiles.

Crocodiles and their Management - or the Lack of It

The post-colonial era has also seen the development of sustainable use of wildlife as a means to provide rural people with the simple and tangible benefits referred to above in order to persuade them to conserve. In relation to crocodiles,

the process of ranching was first seen as a suitably robust means to achieve this through payment of a levy on all crocodile eggs collected in community land. Various other options with better returns but greater technical requirements have since been proposed. The demand of the market for extremely high quality skins and the narrow profit margin for producers has led the evolution of ranching/farming into a highly technical process that is now not well suited to community projects with limited funds and technical expertise. Ranching also has negligible impact on the population of crocodiles resident in an area.

The removal of crocodiles in the form of a harvest for the skins and meat can also be sustainable if properly managed. This can have the positive aspects of reducing the number of large crocodiles that are the cause of most conflict incidents and at the same time generating an income to the community from the sale of their skins and other products.

Human/crocodile conflict, the degradation of crocodile habitat as a result of human activity and the commercial trade in crocodile meat for urban human consumption are the most significant threats to crocodylian conservation for the current decade. All relate to the interaction between humans and crocodiles. All require professional management by national wildlife authorities.

In Africa there is a significant problem with professional management of crocodile issues by most of the national wildlife authorities. Such management requires both capacity and motivation. The capacity requires the provision of both suitable staff and equipment and training for knowledge and skills. The budgets of most national wildlife authorities simply do not provide for either.

In the absence of such management, the status and future of crocodile populations is unpredictable. Two recently investigated examples illustrate this.

At Lac Mai Ndombe in west, central DRC, spotlight surveys over 66 km revealed only 8 Nile crocodiles, giving an estimate of density of 0.2 crocodiles/km of shoreline. This lake was reputed to have held a significant population up to the mid-1960s. Approximately 400 hunters, originating from Senegal and other West African countries reportedly occupied the area between 1968 and 1972, hunting intensively for the skins of Nile crocodiles. In the same area there is now a large “bushmeat” market at which the meat and eggs of *C. niloticus* are highly valued. It is suggested that the uncontrolled harvest has led to a situation now where the population is being held at a very depressed level by the continued occasional offtake of adults and eggs. There is also a significant trade (est. 5000/yr) in the same market of *O. tetraspis* for local consumption and to supply the markets in Kinshasa and Brazzaville.

By contrast, in the lower reaches of the Tana River in Kenya, under equally minimal management, the crocodile population appears to have grown. Spotlight surveys of 228 km gave an estimated density of crocodiles for the whole area of between 10 and 17 crocodiles/km, approximately 50% higher than estimates made between 1988 and 1995. This population is responsible for significant conflict with humans; there were 44 cases of death or major injury between January 2000 and August 2003, the majority of victims were under 20 years of age and most attacks occurred after 1500 h while the victim was engaged in washing clothes or bathing or collecting water.

The CSG needs to assist in addressing the problems of professional management referred to above with the aim of improving the status of Africa’s largest predator.

Using Crocodiles to Teach Taxonomy: A Web Based Approach for High School Science

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Abstract

The Ellen Trout Zoo in Lufkin, Texas, USA, in partnership with Lufkin High School, has developed a laboratory/technology exercise that focuses on teaching the use of a dichotomous key. High school students in the state of Texas must pass the Texas Essential Knowledge and Skills (TEKS) test to graduate. The use of dichotomous keys is one of the skills tested in the science section of that test. It was determined that the eleven species of crocodylians housed at the Ellen Trout Zoo would be a good group to develop the exercise around because of the diversity of the collection and the conservation issues facing these reptiles. A general introduction to taxonomy begins the exercise with students identifying animals to class. Then using a series of photographs that exemplify the morphological characteristics that separate the eleven species housed at the zoo, students key out eleven “mystery crocodylians”. The exercise is to be posted on the zoo’s website. This will provide a distance learning experience to a variety of audiences, regardless of location.

Introduction

In the fall of 2003 the Ellen Trout Zoo, Lufkin, Texas, was contacted by Kristi Jones, a high school science teacher, to assist in the development of a laboratory manual exercise to teach the use of a dichotomous key. The manual was to be developed using local businesses and facilities to provide “real life” example of science concepts tested at the high school level. This project was part of a master’s degree program.

The State of Texas Education Agency requires that students be tested to evaluate students’ skills in a variety of areas, including science. Students are tested at grade level 8, 10 and 11. The concepts are outlined in the Texas Essential Knowledge and Skills objectives. In the section 8 Science concept states: “The student knows applications of taxonomy and can identify its limitations. The student is expected to:

- (A) collect and classify organisms at several taxonomic levels such as species, phylum, and kingdom using dichotomous keys.”

With 11 species of crocodylians as part of our animal collection (Table 1), this was an opportunity to introduce students to these fascination and endangered reptiles.

Table 1. Species of crocodylians held at the Ellen Trout Zoo, Lufkin, Texas.

| | |
|------------------------------|--|
| American Alligator | <i>Alligator mississippiensis</i> |
| Chinese Alligator | <i>Alligator sinensis</i> |
| Spectacled Caiman | <i>Caiman crocodilus</i> |
| Dwarf Caiman | <i>Paleosuchus palpebrosus</i> |
| Smooth-fronted Caiman | <i>Paleosuchus trigonatus</i> |
| American Crocodile | <i>Crocodylus acutus</i> |
| Morelet’s Crocodile | <i>Crocodylus moreletii</i> |
| Mugger Crocodile | <i>Crocodylus palustris</i> |
| Cuban Crocodile | <i>Crocodylus rhombifer</i> |
| Siamese Crocodile | <i>Crocodylus siamensis</i> |
| West African Dwarf Crocodile | <i>Osteolaemus tetraspis tetraspis</i> |

Methods

An introduction to taxonomy was written which included historical background information on the binomial nomenclature and Carl Linnaeus. Students are then asked to look at a series of photographs of zoo animals and classify them to the class level. Students then move from this general exercise to an explanation of a dichotomous key.

An in-house key was developed for the eleven species of crocodylians housed at the Ellen Trout Zoo (Appendix 1). The purpose of this key is to teach high school students and is not meant to be a definitive key on crocodylians. Existing keys to crocodylians were consulted to evaluate characteristics that are easily observed. (Brazaitis 2001; CITES 2000). Teachers are encouraged to bring classes to the zoo to observe animals first hand, but budget or scheduling restraints may prevent them from actually coming to the zoo. Therefore a set of photographs depicting each of the eleven species was developed. Basic morphological attributes of the species housed at the zoo were identified and digitally photographed. Characteristic morphological structures (ie nuchal scales, post-occipital scales and whorls) were outlined and labeled on the appropriate photographs. Three to five photographs of each species were taken. Photographs included profiles of the animals' head, toes, and scalation on back, sides, and tails to illustrate the components of the key. A "mystery number" was assigned to each species for organization of the photographs and a way to evaluate the student's skill at following the key through to the correct scientific name of the crocodylian. To help insure that students actually follow the key, an answer key is not supplied in the exercise. Teachers must contact the zoo educator to get the answers and this also provides the zoo with feedback on who and how many teachers will be using the key.

The original format for the exercise was to be part of a laboratory manual to be distributed to teachers in Angelina County, Texas. The school districts in this county range from Lufkin Independent School District with an enrollment of 8200 students to Zavalla Independent School District with an enrollment of only 430 students and possess a range of resources. The project of developing a laboratory manual was abandoned when one of the teachers dropped out. It was then decided that the exercise would be reformatted to be placed on the zoo's website (www.ellentrouzoo.com). This new format eliminated the printing costs, provided a technology component to the program and provided an access to a wider audience.

Results

Currently, the high school teacher who is working with the zoo is testing the key with her 10th grade students. Evaluation and adjustments will be completed in time for the 2004-2005 school year.

Plans are also being formulated to expand the program to include natural history of the crocodylians in the zoo's animal collection. This will also outline conservation issues facing these reptiles.

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Appendix 1. Key to the crocodilians of Ellen Trout Zoo

- 1A. Mandibular teeth (lower jaw) fit inside the maxillary (upper jaw) teeth and are hidden when the jaws are closed 2 family Alligatoridae.
- 1B. Mandibular teeth fit between the maxillary teeth and remain visible when the jaws are closed3 family Crocodylidae.
- 2A. Not more than 6 large nuchal scales arranged in a cluster 4 genus *Alligator*
- 2B. At least 8 large nuchal scales arranged in a cluster 5.
- 4A. Eight longitudinal rows of large scutes; webs between toes; green iris; more than 22 teeth on one side of lower jaws *Alligator mississippiensis*.
- 4B. Six longitudinal rows of large scutes; no webs between toes; brown iris; less than 22 teeth on one side of lower jaw *Alligator sinensis*.
- 5A. No bony ridge connects the front corners of the eyes, brown iris 6.
- 5B. Bony ridge connects the front corners of the eyes (like a bridge on glasses), green iris *Caiman crocodilus*.
- 6A. Only one row of post occipital scales *Paleosuchus trigonatus*.
- 6B. Two rows of post-occipital scales *Paleosuchus palpebrosus*.
- 3A. Snout short (about as long as snout is broad); brown iris, upper eyelid is ossified and is smooth *Osteolaemus tetraspis*.
- 3B. Snout is one and one-half times the length of the skull at the front corner of the eyes; green iris; upper eyelid is wrinkled and partially ossified 7.
- 7A. Large scales on sides are irregular in size and arrangement 8.
- 7B. Large scales on side are uniform in arrangement 9.
- 8A. Four large nuchal scales with two small scales along side and two behind the large ones *Crocodylus acutus*.
- 8B. Six large nuchal scales 10.
- 9A. On sides of the tail there are irregular, small scales between whorls and scales along sides of tail and there are no spots on the mandible ... *Crocodylus siamensis*.
- 9B. On sides of the tail there are no irregular, small scales between the whorls and scales along sides of tail and there are spots on the mandible *Crocodylus rhombifer*.
- 10A. Nuchal scales are the same size *Crocodylus palustris*.
- 10B. Nuchal scales are not the same size *Crocodylus moreletti*.

Developing Crocodylian Education in Public Schools: Promoting Awareness and Conservation

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This presentation will, first, examine the theoretical role that each of three entities can play in developing environmental education in public schools. These three entities and their respective contributions are 1) the local community with its special needs determines the priority of content and approach, 2) the Crocodile Specialist Group provides the scientific knowledge, material, and field sites, and, 3) the State (and local) Department of Education contributes the appropriate formatting of curriculum. Two modes of presentation, interpretive and educational (cognitive), are then overviewed with the goal of integrating the modes while at the same time accommodating the four learning styles of the students. The second part of the presentation consists of a sampling from a model unit entitled "The Incredible Survivors: The American Alligator and the American Crocodiles." This unit designed for use in public school will illustrate a variety of media as well as integrating the scientific knowledge with current theory and practice in teaching critical thinking. Such student-centered activities as activating competencies and categories, using universal intellectual strategies, creating superordinate and subordinate concepts, and infusing problem solving will be demonstrated. The presentation will conclude with a discussion of the use of this content and approach beyond the classroom. Environmental education resources such as Exploring the Oak Savanna, Cuba's Societal Component, National Key Deer Refuge Manual, and the Florida Keys Environmental Story Resource and Teacher's Manual will be highlighted. A number of handouts and resource bibliographies will be distributed. Sample environmental curriculum will be available after the presentation and at the Poster Sessions.

Devolving Crocodile Conservation to the Local Level: the Case of Philippine Crocodile Conservation in the Municipality of San Mariano, Northeast Luzon, the Philippines

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Abstract

A small and fragmented Philippine crocodile *Crocodylus mindorensis* population survives in the remote rivers and creeks of the municipality of San Mariano, Northeast Luzon. The local government unit has played a pivotal role in the in-situ conservation strategy for this critically endangered endemic crocodilian. Defying cultural prejudice, it has declared the Philippine crocodile as the flagship species of the municipality. Municipal ordinances were passed prohibiting the killing of crocodiles and establishing a municipal crocodile sanctuary. So far the results have been promising: people in San Mariano do no longer see crocodiles as dangerous pests but as something to be proud of. The purposively killing of crocodiles, the most important and direct threat for Philippine crocodiles, has virtually stopped. The Philippine crocodile conservation program in San Mariano appears to be a success story in the legislative efforts to devolve power and authority of the national agencies to the local level. However, the long-term effectiveness of this approach for crocodile conservation is still uncertain. In this paper we describe the challenges facing a local government that aims to protect crocodiles in remote areas characterized by poverty, insecure land tenure, violent insurgency, and a contemporary history of rapid resource depletion.

Introduction

The Philippine crocodile (*Crocodylus mindorensis*) is a small freshwater crocodilian endemic to the Philippines. Intensive commercial hunting, unsustainable fishing, and habitat loss have decimated the population below critical threshold levels throughout the Philippine archipelago (Ross and Alcala 1983; Ross 1998; van Weerd and van der Ploeg 2004). The Philippine crocodile is classified as Critically Endangered (Hilton-Taylor 2000).

Responding to this alarming situation, the national Philippine government established an ex-situ conservation program in 1987: the Palawan Wildlife Rescue and Conservation Center (PWRCC). The PWRCC is formerly known as the Crocodile Farming Institute (CFI). The Japanese International Co-operation Agency (JICA) provided financial and technical support to establish the crocodile farm from 1987 to 1994, amounting to a total of \$US1.5 million. Captive breeding was considered the only hope for survival of the species (Messel *et al.* 1992; Banks 2000). The PWRCC has successfully bred the Philippine crocodile in captivity but no crocodiles have been re-introduced to the wild. Negative community attitudes towards crocodiles and the absences of any form of effective protection of the species and its habitat make the re-introduction of *C. mindorensis* extremely difficult (Banks 2000).

The Department of Environment and Natural Resources (DENR) is the mandated government agency for environmental protection. The Protected Areas and Wildlife Bureau (PAWB), one of six bureaus under the cabinet secretary of the DENR, is tasked with the protection of the country's wildlife, including its crocodiles. The DENR is located in Manila and decentralized to the 12 administrative regions, and subsequently to the Provincial Environment and Natural Resource Offices (PENRO), and the Community Environment and Natural Resource Offices (CENRO). The PAWB is decentralized to regional sub-offices, called Protected Area and Wildlife Sections (PAWS). Aside from proposing several wetlands as crocodile sanctuaries, the PAWB does not have an *in-situ* conservation program for the Philippine crocodile. Although there is no specific national legislation protecting crocodiles in the Philippines, there are several national policies that offer a legal framework for the protection and *in-situ* conservation of *C. mindorensis* (Box 1).

However, there are various problems that hamper the implementation of a national conservation program for the Philippine crocodile. The main act that would protect the species nationwide, the "wildlife act" (Republic Act No. 9147 of 2001, see box 1), is currently not being implemented because the accompanying Implementing Rules and

Box 1: A legal arsenal for Philippine crocodile conservation

A series of Presidential Declarations (PD), issued by President Ferdinand Ramos during the so-called Martial Law period (1972-1986), gives some legal protection to the critically endangered Philippine crocodile and its freshwater habitat:

- a. PD No. 1152, the Philippine Environment Code, calls for a rational exploitation of threatened wildlife resources. Chapter II-Wildlife, Section 29 identifies measures for rational exploitation that include: (i) regulating the marketing of threatened wildlife resources; (ii) reviewing existing rules and regulations on exploitation and formulating guidelines for systematic and effective enforcement; and (iii) conserving threatened species of fauna, increasing their rate of reproduction, maintaining their original habitat, habitat manipulation, population control in relation to the carrying capacity of any given area, banning indiscriminate and destructive means of catching of hunting them” (Oposa 2002: p.13). Take note of the apparent internal discrepancies in the clauses. These are, however, outside the scope of this paper;
- b. PD No. 2146 requires an Environmental Impact Statement (EIS) for all activities in areas “which constitute the habitat for any endangered species of indigenous Philippine wildlife” (Oposa 2002: p. 21);
- c. PD No. 1067, the Water Code of the Philippines, identifies the basic legal principles related to the appropriation, control and conservation of freshwater resources. Article 51 specifies that “the banks of rivers and streams and the shores of the sea and lakes throughout the entire length and within a zone of [...] twenty meters in agricultural areas, and forty in forest areas are subject to the easement of public use” (Oposa 2002: p. 437). Article 74 states that “swamps and marshes which are owned by the state and which have primary value for waterfowl and propagation of other wildlife purposes may be reserved and protected from drainage operation and development” (Oposa 2002: p. 439);
- d. PD No. 705, the Revised Forestry Code of the Philippines, and subsequent amendments, redefined the use of, access to and control over public forests. Section 16 specifies that “strips of mangrove or swampland at least twenty meters wide, along shorelines facing oceans, lakes and other bodies of water, and strips of land at least 20 meters wide facing lakes, may not be classified as alienable and disposable land” (Oposa 2002: p. 84).

The People’s Power Revolution of 1996 created an atmosphere of radical policy reform in the field of natural resource management and environmental protection (Vitug 2000). The following national policies relevant for crocodile conservation were enacted after 1986:

- a. Republic Act No. 7586, the National Integrated Protected Areas System (NIPAS) Act of 1992, defines the terms of establishing protected areas in the Philippines. Hunting of wildlife is prohibited in habitats of rare and endangered animals under NIPAS, except in some specific circumstances (for example for traditional or religious purposes of indigenous communities). A large part of San Mariano falls under the Northern Sierra Madre Natural Park, which is one of the 10 priority sites in the NIPAS Act (see below under Republic Act. No. 9125).
- b. Republic Act No. 9147, the Wildlife Resources Conservation and Protection Act of 2001, usually referred to as the “Wildlife Act” aims to: “(i) conserve and protect wildlife species and their habitats; (ii) regulate the collection and trade of wildlife; (iii) Pursue, with due regard to the national interest, the Philippine commitment to international conventions; (iv) initiate or support scientific studies on the conservation of biodiversity” (Oposa 2002, p.117). The Republic Act specifically mentions the jurisdiction of DENR over crocodiles and other wetland species; the Department of Agriculture (DA) on the other hand has jurisdiction over all declared aquatic critical habitats and all aquatic resources.
- c. Republic Act No. 8485, otherwise known as the Animal Welfare Act of 1998, regulates the treatment of captive animals. The killing of crocodiles, the Act specifies, can only be done “through humane procedures” (Oposa 2002: p.171). No difference is made between *C. porosus* and *C. mindorensis*.
- d. Republic Act No. 8550, the Philippines Fisheries Code of 1998, ensures the rational and sustainable development, management and conservation of the fishery and aquatic resources in Philippine waters and protects the right of local fisherfolk. Chapter 2, Section 11, mentions that the “Department shall declare closed seasons and take conservation measures for rare, threatened and endangered species in concurrence with concerned government agencies” (Oposa 2002: p. 385). Note that this Act is to be implemented by the Department of Agriculture (DA). All other Acts in this box fall under the jurisdiction of DENR. Also contrary to the other Acts presented here is the clear definition of terms provided in the Act. Endangered, rare and/or threatened species are defined as “aquatic plants, animals [...] in danger of extinction as provided for in the existing fishery laws, rules and regulations of the Protected Areas and Wildlife Bureau of the DENR and in CITES” (Oposa 2002: p. 380).
- e. Republic Act No. 9125, the Northern Sierra Madre Natural Park Act of 2002, is of special importance for San Mariano. The forested areas of San Mariano were largely identified as strict protection zones in the general management plan of the NSMNP. A crocodile habitat management zone was also identified in San Mariano, which encompasses the watersheds of the Catalangan and Disulap rivers within the park (DENR 2001). However, most crocodiles in San Mariano are found outside the park and buffer zone boundaries.

Regulations (IRR) have not yet been accepted. The DENR is a huge bureaucratic organization plagued by budget deficits. There is as of now no national government funding available for Philippine crocodile conservation. Environmental law enforcement by the DENR is usually weak and sometimes corrupted. An overriding policy framework for Philippine wetlands is absent (DENR and UNEP 1997).

There are other possibilities to implement crocodile conservation activities. The Local Government Code of 1991 (Republic Act No 7160) devolves much decision power to local governments. It transforms local governments from mere administrators to managers of communities. They can adopt their own local legislation. Local governments can enter into agreements with NGOs and People Organisations (POs). Local governments can adopt their own natural resource utilization laws and can offer local protection to threatened species through municipal ordinances. The devolved function of government agencies, among them the DENR, provides the municipal authorities, in theory at least, with considerable influence over Philippine crocodile conservation.

A short history of crocodiles in San Mariano

The municipality of San Mariano covers an area of 1469.5 km² in the eastern part of Isabela Province. It consists of a small town, San Mariano, and 36 villages, locally called barangays, in the sloping foothills of the Northern Sierra Madre Mountains. Three main rivers dissect the municipality: the Catalangan River, the Disabungan River and the Pinacanan de Ilagan River.

The Philippine crocodile used to be common in the wetlands of San Mariano. Early Spanish accounts talk about the “crocodile infested rivers” of the province of Isabela. The indigenous peoples of the area, the Agta and Kalinga, lived in low density in the foothills of the Sierra Madre. They depended heavily on the rivers and streams for fish, but had very limited impact on the crocodile population. These indigenous communities still have strong cultural taboos on eating crocodile meat, and in many cases attach supernatural powers to the animals. In 1896, the Spanish colonizers established an administrative center on the convergence of the Pinacanan and Disabungan Rivers, and called it San Mariano. It marked a turning point in the political control of the area and the fate of the Philippine crocodile.

After the Philippine Revolution of 1898 and under the new colonial administration of the United States, San Mariano experienced an influx of Christian Ibanag migrants (Huigen 2004). This group claimed the best agricultural lands along the extensive riverbanks and flood plains for the cultivation of upland rice, root crops, vegetables and bananas. The Kalinga and the Agta were respectively assimilated or pushed further into the forests. Crocodiles were associated with the devil and regularly killed, but human population density was too low to severely threaten *C. mindorensis*: in 1939 there were 7046 people in San Mariano.

Large-scale commercial logging of the vast forests in the municipality began after the Second World War. With the construction of Maharlika highway in the 1960s, linking northern Luzon with Manila, logging corporations quickly expanded their operations to the Sierra Madre. During the logging boom from 1969 to 1992, 22,000 ha of primary dipterocarp forests were logged annually in the region. Large groups of impoverished immigrants from the densely populated Ilocos area followed the logging companies and settled in the region. As of today, the majority (53%) of the people in San Mariano are of Ilocano origin (Huigen 2004). The pioneers can still recall the days that crocodiles were widely distributed in San Mariano; in the 1960s people still regularly observed large crocodiles in the Pinacanan and Disabungan Rivers. The frontier attitude of these days led to rapid and destructive resource extraction (de Groot 2003). Like everything else during those ‘years of plunder’ (Broad and Cavanagh 1993), crocodiles were mainly seen as a commodity. In the 1970s, commercial hunters from Mindanao systematically searched the river systems of the municipality killing crocodiles for hides (Oudejans 2001). The violent insurgency during the Martial Law Years (1976-1986) also had a negative effect on crocodile population. There are several cases in which members of the Armed Forces or of the communist New Peoples Army (NPA) killed crocodiles to safeguard the local people from these supposedly dangerous creatures or to provide food for isolated rebel camps. A widespread possession of firearms made crocodiles more vulnerable to humans.

After democracy was restored to the country by the People’s Power Revolution of 1986, the new constitution introduced major policy reforms. In response to the centralized and autocratic government of Marcos, when the small and well-connected elite in Manila profited from resource destruction, local governments were given more autonomy. Civil society blossomed, and a wide variety of environmental non-governmental organizations (NGOs) advocated environmental protection and rural development, a process that was also fuelled by renewed international attention (Van den Top and Persoon 2000; Vitug 2000). In San Mariano, several NGOs concentrated on the protection of the Northern Sierra Madre Natural Park that was established in 1997. These efforts were concentrated on the mountains and remaining high elevation forest. The plight of the Philippine crocodile, found in low elevation areas outside the park, was ignored, simply by the fact that nobody knew about its existence in the municipality. Social and economic changes continued to threaten these remnant crocodile populations. Dynamite, cyanide or electro fishing regularly killed crocodiles. Freshwater habitat was rapidly converted in agricultural lands fueled by a strong growing human population; in 2000 San Mariano had 40,995 inhabitants (Huigen 2004).

As a result, the crocodile population collapsed and only a very small and fragmented population of Philippine crocodiles survived in remote areas of the municipality. Inaccessibility and remoteness seem to have offered some form of protection to these crocodiles. In one locality, Disulap River, the presence of limestone cliffs and underwater caves provide excellent hiding places. More important, however, seems to be the presence of indigenous communities. In two localities, Dunoy Lake and Dinang Creek respectively, the Agta and Kalinga could have easily killed the Philippine crocodiles had they wished so. Traditional belief systems and resource use practices have prevented the killing of crocodiles. This is in stark contrast to the wetlands used and controlled by Ibanag or Ilocano farmers. The latter groups, like most people in the Philippines nowadays, regard crocodiles as a dangerous pest to be exterminated or as a delicious snack (Banks 2000).

Crocodile conservation in San Mariano

In March 1999, Mr. Samuel Francisco, a fisherman from the village of San Isidro, accidentally caught a Philippine crocodile hatchling in Disulap River. This accidental by-catch triggered crocodile surveys and conservation attention.

The Northern Sierra Madre Natural Park Conservation Project (NSMNP-CP), an integrated conservation and development project aimed at preserving the Northern Sierra Madre Natural Park, spearheaded the conservation activities for *C. mindorensis* in San Mariano. Surveys were carried out to determine the distribution and population size and structure of the crocodile population. Three breeding sites were identified: (a) Disulap River, (b) Dunoy Lake, and (c) Dinang Creek (van Weerd 2002) with a current (May 2004) population of 23 non-hatchling crocodiles. See Tarun *et al.* (these proceedings), for detailed information on Philippine crocodile distribution and population size in Northeast Luzon. After the phase-out of the NSMNP-CDP in 2002, crocodile conservation activities were continued by the CROC project, now an official Philippine NGO named Mabuwaya Foundation. Both projects relied heavily on the partnership with the Local Government Unit of San Mariano to implement crocodile conservation activities in this municipality. See Van Weerd (2002) and Van Weerd and Van der Ploeg (these proceedings) for an overview of crocodile conservation actions by both projects.

Innovative approaches: the role of the local government unit

A regional Philippine Crocodile Workshop that was held in San Mariano in May 2002 brought together different stakeholders to design a long-term conservation strategy for *C. mindorensis* in the Northern Sierra Madre. Crocodiles and people share the same wetland resources in San Mariano. All identified crocodile localities have people living nearby and in some cases, such as along Dinang Creek, all land surrounding the wetland has been converted into agricultural land. Resettling people from crocodile inhabited areas would not be accepted by the local people and local government in the Philippine sociopolitical context. A conventional conservation program, based on minimizing people-crocodile interactions and complete protection of crocodile habitat, is therefore not a possibility. Instead, an in-situ conservation approach was designed to address the direct threats facing the wild populations: (a) hunting for fear, food or fun, (b) the use of unsustainable and illegal fishing methods, and (c) loss of breeding and basking sites due to agricultural encroachment. The strategy focuses on the establishment and management of crocodile sanctuaries with the consent and cooperation of local people. Through a negotiation process with the local community, in the form of public consultations, specific management terms are defined that mitigate adverse effects of crocodile conservation on rural livelihoods - and vice versa. A community protection group (Bantay Sanktuwaryo), composed of local people would monitor the sanctuary and enforce its rules and regulations (van Weerd and General 2003). This people-first, or community-based, approach fits neatly in the national conservation rhetoric of the DENR, of the national government and of civil society in general after the People's Power Revolution of 1986.

Disulap River crocodile sanctuary

On 7 September 2001, the municipal council of San Mariano approved municipal ordinance No 01-17, declaring the upper 10 km of Disulap River a municipal Philippine crocodile sanctuary. Public consultation meetings with the local government and the community had preceded the proclamation of the protected area. During these meetings it was tried to balance conservation goals with the developmental needs of the community. The boundaries of the sanctuary were negotiated upon and it was decided to limit fishing, hunting and agricultural activities in the sanctuary. The issue drawing most discussion was the establishment of a buffer zone on both sides of the river. Here, no agricultural activities would be allowed in order to restore crocodile habitat, protect the riverbanks from erosion, and minimize disturbance and human-crocodile interactions. After negotiations, a 10 m buffer zone was proposed and unanimously supported by the local people. Note that according to the Water Code of the Philippines (PD No. 1067, see box 1), a 20 m strip along all water bodies is supposed to be "subject to the easement of public use". This code is

not being enforced at all throughout the country and very few people are aware of its existence. It illustrates the difficulty the national government has in implementing its own laws. The communities near Disulap River did not accept a 20 m buffer-zone and since we depend heavily on community support we decided to settle with 10 m.

The regulations of the sanctuary include: (1) no hunting or disturbing crocodiles and other wildlife, (2) no destructive fishing methods, (3) no cultivation and infrastructure development in the buffer-zone (4) in the buffer-zone: no deforestation and in currently cultivated areas reforestation has to take place, and (5) nesting areas can be closed for entry.

The municipal council of San Mariano also approved the following ordinances:

1. Municipal Ordinance No. 1999-025, prohibiting the collection and annihilation of the Philippine crocodiles in the municipality.
2. Municipal Ordinance No. 2000-002 declaring the Philippine crocodile as the flagship species of the municipality.

Dinang Creek crocodile sanctuary

The declaration of a second sanctuary, Dinang Creek, is currently being prepared. Several community consultations were held and Dinang Creek proves to be more difficult than Disulap River. The community is asking for tangible benefits from crocodile conservation and does not settle with arguments of intrinsic value, pride, the role of crocodiles in maintaining healthy ecosystems and wetland conservation in general. One of the main issues in Dinang Creek is land ownership. None of the farmers cultivating the area surrounding the creek has an official land title. Declaring a crocodile sanctuary with a buffer-zone which would include some currently cultivated land is seen as “land grabbing”. Land grabbing: acquiring a title over land which has been cultivated by somebody else (usually by wealthy outsiders who have the right political connections), is a serious problem in the Philippines that is heavily opposed by remote farming communities who usually can not do anything about it if it happens. In these communities, there is considerable support for communist rebels, the NPA, who oppose land grabbing with violence.

We therefore had to look into possibilities to provide land titles for the farmers along Dinang Creek first. We supported a land survey which has been carried out by the DENR and a land possession map has been prepared, a prerequisite to acquire titles. The application process for titles has started. Supporting the acquisition of land titles not only creates goodwill and fair land distribution. Farmers who own the land they cultivate are much more likely to invest in it. Currently, corn is the main crop cultivated along Dinang Creek that requires considerable inputs in the form of fertilizer and pesticides/insecticides which eventually end up in the creek. Deforestation to create more Cornfields adds to erosion. Farmers in San Mariano are very much willing to shift to agro-forestry, a form of agriculture that increases the farmer’s income and which is much more environmentally friendly. However no farmer is going to invest in such a long-term project if ownership over his land is not secure.

To further solicit community support, four wells have been built at strategic locations along the creek. All water needed by the community was being taken from the creek. These wells will minimize people-crocodile interactions, will provide clean drinking water and will minimize pollution of the creek with washing detergents. The wells will have painted crocodiles on them, reminding users everyday of the fact that it is there because of the crocodiles. The community has agreed with crocodile sanctuary establishment. Once land titles have been awarded the municipal council will propose a new ordinance declaring Dinang Creek the second Philippine crocodile sanctuary in the municipality.

The declaration of Dinang Creek as crocodile sanctuary is a partnership between the Mabuwaya Foundation and the municipality of San Mariano. The consultations were carried out by municipal representatives and staff from the NGO. Costs of the activities are shared as well. Rural development (the main goal of the municipality) and crocodile conservation (the main goal of the Mabuwaya Foundation) can thus be achieved in an integrated fashion.

The Narra Project

A similar project is undertaken by a multi-partnership of the municipality of San Mariano, WWF Philippines, the People’s Organization of the village of San Isidro and the Mabuwaya Foundation. The Native Advocacy for Rural Reconstruction and Agroforestry (NARRA) Project won a small grant from the Worldbank in December 2003 and aims to reforest denuded areas along crocodile habitat in San Isidro. Reforestation will be done with native trees of which seedlings will be collected in nearby remaining forest. In addition, native fruit trees will be planted which will

benefit the local community within 5 years. The local government provides logistical support and will construct a farm to market road. WWF and the Mabuwaya Foundation deliver technical support and some additional funding. The People's Organization, which is the main beneficiary of the project, will provide labor. This simple and inexpensive project benefits both the local community and the crocodiles in nearby Dunoy Lake and Disulap River. Perhaps most importantly it shows local communities in a tangible way that there are benefits connected to crocodile conservation: the Worldbank provided the grant because crocodile conservation is one of the objectives of the project.

Issues

Major issues that remain to threaten the recovery of crocodiles in San Mariano are:

Law enforcement: Not everybody is respecting the local ordinances that protect the Philippine crocodile in San Mariano and the rules and regulations of the crocodile sanctuary. Not everybody is aware of these ordinances and some people simply do not care. Law enforcement is weak. San Mariano has only 24 policemen and these are mainly active in population centers, not along the 10 km Disulap River crocodile sanctuary or in other remote parts of the municipality. Crocodile protection by DENR personnel is hampered by the lack of operational budget, confusion about legislation protecting the crocodiles, a lack of knowledge and awareness among DENR personnel regarding crocodiles (see Van Weerd and Van der Ploeg, these proceedings) and the lack of directions from higher up regarding crocodile protection. A possible solution is the creation of para-legal community protection groups (Bantay Sanktuwaryo). These groups have to undergo a basic training in law enforcement and have to be accredited by the DENR to become official. A community that is empowered to protect its own natural resources from abuse by outsiders is more likely to act on this than unmotivated or incapacitated national law enforcers. Awareness raising campaigns have to ensure that everybody within the community itself is convinced of the need to protect crocodiles and wetlands. Difficulties arise if there are still community members who continue illegal activities such as dynamite fishing or killing of crocodiles, and if the local protection group would not act on this. In that case a national law enforcement agency, police or DENR, would still have to be called in.

Tenurial security and unsustainable land use practices: San Mariano is very much an "open access" municipality. There is little control on land use and on the creation of new cultivated areas. Immigration from land seeking farmers from other provinces, nowadays mainly from Ifugao Province, continues. These settlers look for areas not yet occupied and generally practice slash and burn farming in the "frontier" area, the strip of land between the intensively cultivated and usually titled lands near San Mariano town and the steep forested slopes of the Northern Sierra Madre. The permanent crocodile localities in San Mariano are found in this frontier area as well. Farmers in this area do not officially possess the land they cultivate, the process to get land titled, or to obtain stewardship over lands that are officially classified as forest land, is bureaucratic and expensive. They therefore do also not invest in a shift to more sustainable and environmentally friendly farming such as agro-forestry. Another issue is that these generally very poor farmers would not have the means to do so would they wish to. The LGU is assisting in land titling and in the shift to sustainable land use, among others through trainings and technical assistance. Funding is limited though and the lack of tenurial security and the use of unsustainable land use practices remains a threat to crocodiles, the environment in general and the economic prosperity of frontier farmers. Limiting immigration is a very difficult issue to discuss in the Philippines but is certainly needed to prevent further degradation of the frontier area and crocodile habitats.

Inadequate national support: All LGUs in the Philippines receive national funding, the so-called Internal Revenue Allotment (IRA) and collect municipal taxes. Crocodile conservation activities should normally be funded and implemented by the DENR but as mentioned before, there is no government budget for this. The LGU is bound to rules on budget items and cannot spend large amounts on crocodile conservation.

Discussion

The devolution of powers from the National Government to the Local Government Unit, formalized in the Local Government Code of 1991, offers an excellent opportunity for effective crocodile conservation in the Philippines in the absence of a sound national government crocodile conservation program. Local governments can adopt their own municipal legislation protecting crocodiles and crocodile habitat. The crocodile conservation program in San Mariano, a partnership between the local government and NGOs, has led to promising results: the number of crocodiles killed in the municipality has decreased from 13 in 1998 to 1-3 per year since crocodiles became locally protected in 2000. The number of non-hatchling crocodiles has increased from 12 in 2000 to 31 in 2003. Unfortunately, in 2004 only 23 crocodiles were counted, the decrease is possibly attributable to a strong typhoon that hit San Mariano in

July 2003 causing massive flashfloods. Disulap River has been declared a municipal crocodile sanctuary, the first real protected area for the Philippine crocodile in the country. Several issues remain, the most important being the lack of law enforcement and the widespread occurrence of unsustainable land use practices. We believe that in upland areas of the Philippines, where poor farmers and crocodiles share the same area, only integrated conservation and development (ICD) offers prospects for successful crocodile conservation. Creating tangible benefits from crocodile conservation to local communities is of great importance to win and sustain local support. Partnerships of local governments, NGOs and local communities can lead to inexpensive, effective ICD programs that benefit both crocodiles and people.

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Proposal for the Sustainable Use of the Spectacled Caiman (*Caiman yacare*) in Indigenous Lands of the Bolivian Amazonia

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Abstract

Population evaluations of the Spectacled Caiman (*Caiman yacare*) were carried out between 1999 and 2000 in the Tacana Indigenous Land, in the Beni River basin (Bolivian Amazonia). The relative abundance of the Caiman was determined around five communities using night counts. The population density ranged from 2.03 to 123.78 individuals/km of shore, and an overall population structure of Class IV individuals (≥ 180 cm Total Length) of 25.6% was determined. These population characteristics suggest that sustainable use through annual harvests is possible for this region. Participative community workshops in 2003 enabled a community management program that incorporates aspects of fair benefit distribution (among communities, supra-communal organization, and direct harvesters of the resource), communal organization (associations of caiman managers), control of the evaluations and harvests, and commercialization of the resource in the national market. This proposal presents an alternative for managing this resource that promotes greater administrative transparency, and promises increased benefits for the direct harvesters. This management model can also contribute to the process of improving the National Program for Spectacled Caiman, developed by the Ministry of Sustainable Development, to achieve a true sustainable use of the species. Nevertheless, internal control mechanisms and the harvest by people from outside the indigenous land require further discussion.

Introduction

In Bolivia, the pilot program for sustainable use of the Spectacled Caiman (*Caiman yacare*) started in 1995 with the project “A Programme for the Sustainable Use and Management of Caiman in Bolivia” (King and Godshalk 1997; Godshalk 1994). In 1997, this program promulgated the “Regulation for the Conservation and Use of the Caiman (*C. yacare*)” for Santa Cruz and Beni Departments. This same year the experimental phase of Caiman Management Plans was developed and applied at cattle ranches in the Beni Department.

Once concluded the experimental phase and incorporated the modifications, in 2000 the new “Regulation for the Conservation and Use of the Caiman” in ecological regions established by Ravenstein (2000) of CESO/SACO - Canada started. In 2002, a new evaluation of the Program was conducted by adjusting the regulation that is working currently.

Through this process, since June 2000, the Wildlife Conservation Society (WCS) and the Indigenous Council of the Tacana People (CIPTA) have been working together to formulate and to implement a Strategy for Sustainable Development in the Tacana Indigenous Land using the Management of the Natural Resources, and structured through a zoning based on the current and potential use of the communities, expressing their own perspective of how to use the Indigenous land.

Starting from the verification of the necessity of developing initiatives of management of the natural resources and the new Strategy, in 2000, WCS and CIPTA agreed to support a thesis for the evaluation of the populations of Spectacled Caiman in the Tacana Indigenous Land. During the first evaluation of the water bodies in the communities of the Ixiamas region, no population of Caimans was found for harvest. However, during the 2001 evaluation in which the study was extended to the communities found along the Beni River, various populations of Caimans with a good population size were found and were considered to be able to be harvested in a sustainable way (Ríos 2003).

On the other hand, in 2002, the Prefecture of the Department of La Paz began the process of legal harvest of caimans and evaluated the population status of the Spectacled Caiman in the northern part of the Department. Two of the

areas evaluated were Tacana communities located along the Beni River, inside the Tacana Indigenous Land.

By virtue of all the efforts taken, it was considered convenient to establish a process of sustainable use of Caimans in the Tacana Indigenous Land, based on the scientific studies and under a regulatory system and communal and supra-communal controls. These controls should work with the aid of the competent authority, which are organized at the community level and assumes specific responsibilities for the conservation and the commercial use of the Caiman. The communities are constituted in juridical body with obligations according to law and at the same time are the direct beneficiaries without middlemen. This can be achieved with the support of the CIPTA and the technical and scientific advices of the WCS-Bolivia.

Study Area

The project will be developed inside the Tacana Indigenous Land, which is found in the Abel Iturralde Province at the north of the La Paz Department. The Tacana Indigenous Land has a requested extension of 769,891 ha (Ríos 2003), of which 325,327 ha have been entitled up to the date (Fig. 1).

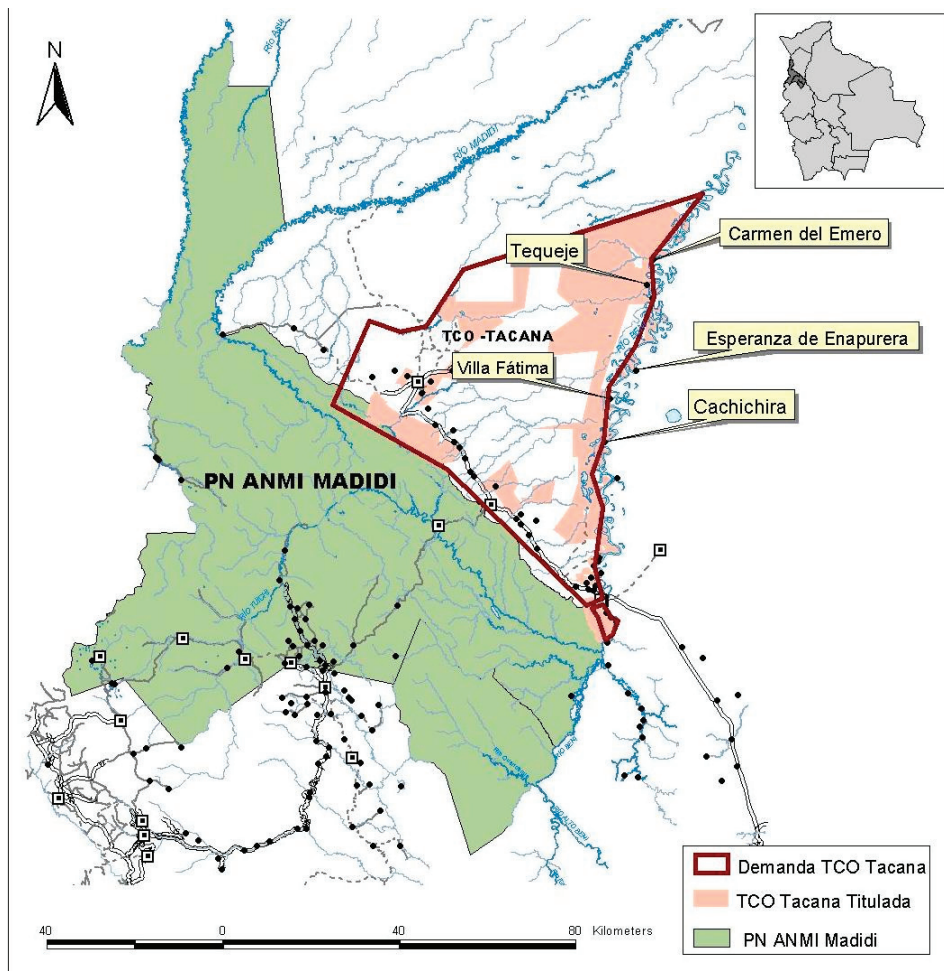


Figure 1. Map of the Tacana Indigenous Land, Provincia Iturralde, Department of La Paz.

In accordance with Ríos (2003), the area where Caiman populations have been recorded with possibilities of commercial use is the east part of the Tacana Indigenous Land and is located in the canton of San Buenaventura (toward the east of the Tacana territory).

This area belongs to the Amazon basin, inside of the sub-basin of the River Beni, and presents periodic floods by the overflow of the local rivers, which defines an ecosystem of flooded plains (Ríos 2003).

The watercourses of this region are originated from the Andean mountains or from savanna, which influences their chemical composition and associate biota. The river with the biggest flow in the area is the Beni, which has an Andean origin. There are also many meanders in the region (Ríos 2003).

A humid tropical climate is found with a short period of drought in this area. A rainy season lasts from November to May and dry season lasts from June to October. The annual precipitation is 2500 mm; however, considerable fluctuations of the annual precipitation are found from year to year (Ríos 2003).

The average temperature is 27°C with a reduced seasonal and daily temperature variation, except during the cold fronts or “surazos”, which cause a considerable decrease in the temperature and are frequent during the dry season (Ríos 2003).

The population found in the area of the pilot project is mostly of the Tacana ethnic, but members of other ethnics also exist. In the area ten communities are found in the alluvial plain along the Beni River. These communities have a communal area, and an area of use of natural resources (Ríos 2003).

Methods

For this implementation phase, the thesis by Ríos (2003) was used as baseline. This document presents a list of communities in the Tacana Indigenous Land, where exhaustive evaluation of the abundance and population structure of the Caiman in the different water bodies was conducted. The communities selected for this study were those where the populations of the Caiman could be used for the commercial purpose. These were the communities of Carmen del Emero, San Antonio de Tequeje, and Cachichira, all of which are found along the Beni River.

The information provided by Ríos (2003) was supplemented with some censuses conducted at the communities of Villa Fátima and Esperanza de Enapurera, by the Prefecture of La Paz in 2002, which are found in the report “Study of Zoning and Evaluation of the Caiman Populations (*Caiman yacare*) in the Department of La Paz”.

To calculate the abundance of Caimans, the index of abundance was used for water body (lagoons, lakes, rivers, and streams) provided by Ríos (2003) and Prefecture of La Paz (2002). If both studies evaluated the same water body, the average of the index of abundance was calculated. Later the total perimeter of the water body was calculated using ARC VIEW GIS 3.2. Once estimated the total perimeter, the number of Caimans per km of riverbank was projected.

Results

The population size and age structure at the area of each community is reported in Tables 1-5. A total population of 9297 caimans was found, with an overall population structure of Class IV individuals (≥ 180 cm Total Length) of 25.6%. According to Bolivian law, with this data, it would be possible to calculate a harvest quota of 427 individuals.

Table 1. The population size and age structure of Spectacled Caimans at the community of Carmen del Emero.

| Water Body | Density (per km of shore) | Perimeter (km) | Estimated Population Size | Proportion of Class IV | No. of Class IV Indiv. | Harvest Quota Class IV |
|---------------------|------------------------------|-------------------|------------------------------|---------------------------|---------------------------|---------------------------|
| Arroyo Undumo | 14.97 | 25.0 | 374.25 | 22.73 | 85.07 | 21 |
| Laguna Japón | 51.66 | 13.8 | 712.91 | 7.21 | 51.40 | 13 |
| Lago Barrientos | 76.32 | 6.0 | 457.92 | 8.34 | 38.19 | 10 |
| Lago Juan Carlos | 65.79 | 11.4 | 750.01 | 7.32 | 54.90 | 14 |
| Laguna Bibosal | 44.97 | 8.4 | 377.75 | 0 | 0 | 0 |
| Laguna Tacuaral | 37.04 | 12.5 | 463.0 | 23.26 | 107.69 | 27 |
| Lago San Pedro | 7.0 | 17.9 | 125.30 | 16.67 | 20.89 | 5 |
| Laguna Sicuri | 20.32 | 7.5 | 152.36 | 25.0 | 38.09 | 10 |
| Río Beni (Sector 1) | 2.03 | 46.1 | 93.58 | 33.33 | 31.19 | 8 |
| TOTAL | | | 3507.08 | | | 110 |

Management Plan

The general objective of the Management Plan proposed for the “Sustainable use and management of the Caiman (*Caiman yacare*) in the Tacana Indigenous Land, Iturralde Province, Department of La Paz”, is that the communities of the Tacana Indigenous Land will be able to realize a sustainable use of the Caiman (*Caiman yacare*) with larger environmental, economic, and community benefits (Aparicio 2003).

Table 2. The population size and age structure of Spectacled Caimans at the community of San Antonio del Tequeje.

| Water Body | Density (per km of shore) | Perimeter (km) | Estimated Population Size | Proportion of Class IV | No. of Class IV Individ. | Harvest Quota Class IV |
|---------------------|------------------------------|-------------------|------------------------------|---------------------------|-----------------------------|---------------------------|
| Arroyo Tequeje | 18.12 | 25.0 | 453.0 | 18.84 | 85.35 | 21 |
| Lago Flojo | 55.2 | 15.8 | 872.16 | 23.08 | 201.29 | 50 |
| Laguna Miti | 50.22 | 4.2 | 211.93 | 24.24 | 51.37 | 13 |
| Laguna Supa | 13.65 | 4.73 | 64.56 | 21.28 | 13.74 | 3 |
| Río Beni (Sector 2) | 5.72 | 37.7 | 215.64 | 20.75 | 44.75 | 11 |
| TOTAL | | | 1817.30 | | | 98 |

Table 3. The population size and age structure of Spectacled Caimans at the community of Esperanza de Enapurera.

| Water Body | Density (per km of shore) | Perimeter (km) | Estimated Population Size | Proportion of Class IV | No. of Class IV Individ. | Harvest Quota Class IV |
|---------------------|------------------------------|-------------------|------------------------------|---------------------------|-----------------------------|---------------------------|
| Lago Corpus | 123.78 | 5.6 | 77.17 | 0 | 0 | 0 |
| Lago Redondo | 12.32 | 9.4 | 115.81 | 35.72 | 41.37 | 10 |
| Río Beni (Sector 3) | 3.88 | 41.9 | 162.57 | 27.04 | 43.96 | 11 |
| TOTAL | | | 355.55 | | | 21 |

Table 4. The population size and age structure of Spectacled Caimans at the community of Cachichira.

| Water Body | Density (per km of shore) | Perimeter (km) | Estimated Population Size | Proportion of Class IV | No. of Class IV Individ. | Harvest Quota Class IV |
|----------------------|------------------------------|-------------------|------------------------------|---------------------------|-----------------------------|---------------------------|
| Laguna Moa | 24.39 | 41.8 | 1019.50 | 27.56 | 280.97 | 70 |
| Laguna Colorada | 15.22 | 10.8 | 164.38 | 21.11 | 34.70 | 9 |
| Laguna Majal | 25.39 | 6.9 | 175.19 | 36.61 | 64.14 | 16 |
| Laguna 3 Hamacas I | 14.20 | 0.9 | 14.06 | 63.64 | 8.95 | 2 |
| Laguna 3 Hamacas II | 33.82 | 4.3 | 145.43 | 41.57 | 60.45 | 15 |
| Laguna 3 Hamacas III | 27.37 | 2.3 | 62.95 | 40.82 | 25.70 | 6 |
| Laguna Sayuba | 20.61 | 12.06 | 248.56 | 36.90 | 91.72 | 22 |
| Río Beni (Sector 5) | 3.88 | 41.9 | 162.57 | 27.04 | 43.96 | 11 |
| TOTAL | | | 1992.63 | | | 151 |

Table 5. The population size and age structure of Spectacled Caimans at the community of Villa Fátima. * These three lagoons are connected in the same system, so the results obtained from Lago Media Luna were extrapolated to Lago Tarene and Lago Ñato.

| Water Body | Density (per km of shore) | Perimeter (km) | Estimated Population Size | Proportion of Class IV | No. of Class IV Individ. | Harvest Quota Class IV |
|---------------------|------------------------------|-------------------|------------------------------|---------------------------|-----------------------------|---------------------------|
| Arroyo Tarene | 39.78 | 25.0 | 994.50 | 5.0 | 49.73 | 12 |
| Laguna Palizada | 3.57 | 5.0 | 17.99 | 50.0 | 9.0 | 2 |
| Lago Media Luna | 20.47 | 7.3 | 149.64 * | 22.43 | 33.56 | 8 |
| Lago Tarene | 20.47 | 7.3 | 149.64 * | 22.43 | 33.56 | 8 |
| Lago Ñato | 20.47 | 7.3 | 149.64 * | 22.43 | 33.56 | 8 |
| Río Beni (Sector 4) | 3.88 | 41.9 | 162.57 | 27.04 | 43.96 | 11 |
| TOTAL | | | 1623.97 | | | 49 |

The specific objectives are:

- Commercialize Caimans through the management plan that guarantees their long term availability and productivity.
- Strengthen the capacity of administration of the communities involved in the management of Caimans.
- Improve the quality of life of the families through the increment of their economic revenues.
- Foment the understanding and appreciation for Caimans at the community level through the participation in the management and the education.

The Management Plan presents five programs and seven sub programs with activities that should be developed in two phases (Aparicio 2003). The first phase, during two months in the 2003, is the implementation of the administration and is restricted to develop the Management Program and especially the sub-programs of harvest of Caimans and communal commercialization of the Caimans - distribution of benefits, and the control Program and communal protection, with the sub program of communal control of the process of the harvest. The second phase will have a two-year-duration (2004-2005), when all the programs and sub programs proposed in the Management Plan will be carried out (Aparicio 2003). All these programs are shortly described below:

1. Management Program

This program implies that the species will be subjected to the decisions and manipulations of the managers. To achieve this, it is important to combine investigation and harvest.

1.1. Sub-Program of Population Evaluation of the “Caiman”

For the implementation of the program during the pilot phase, between October and November, 2003, the information about population abundance (Prefecture of La Paz 2002; Ríos 2003) was used. However, for the next administrations new population evaluations should be carried out in the five communities involved in the Program to establish the annual harvest quota. For the development of this Sub-Program, technical personnel trained in each community will be required to carry out the evaluations and to guarantee the good field data.

The evaluations should be carried out according to the established schedule. Starting from the 2004 administration, it is expected to extend the harvest area with the objective of increasing the annual quota for each community. The objectives of this Sub-Program are:

- Evaluate the abundance and the age structure of the populations of Caimans annually in the harvest areas of each community.
- Establish whether the population of Caimans of each community should or not be subject to harvest for the year of the evaluation.
- Assign the harvest quota of Caimans for each community under management.
- Increase every year the number of water bodies subject to the evaluation of Caimans populations to determine their harvest potentiality.

1.2. Sub-Program of Harvest of “Caimans”

The harvest of wildlife is established in the Strategy of Sustainable Development of the Tacana Indigenous Land, respecting its zoning and based on the agreement with the five communities (Carmen de Emero, San Antonio de Tequeje, Esperanza de Enapurera, Villa Fátima, and Cachichira), which have expressed their interest of harvesting Caimans legally at the meetings organized in these communities in August 2003.

An appropriate use of Caimans will provide multiple benefits to the local residents; however, it is necessary to implement this Sub-Program in agreement with the effective normative to guarantee the sustainability of this benefit and to maintain the viable population of the species in the area. The distribution of the harvest quota inside the community will be established in a community meeting organized by its authorities. The objectives of this Sub-Program are:

- Achieve a sustainable harvest of Caimans.
- Achieve an efficient administration of the harvest process by the communities.

1.3. Sub-Program of Commercialization of the Caiman at a Community Level and Distribution of Benefits

One of the biggest problems that the native populations and rural communities face on commercializing their wildlife is their poverty, which could cause the overexploitation of wildlife to get immediate economic benefits. To avoid the overexploitation, it is necessary that the local population decides to be a part of the management programs and that they know that the benefits will not come immediately. It is essential that the local inhabitants will be the main beneficiaries of the economic values generated by the management of wildlife, because this can motivate them to use this resource in a sustainable way, guaranteeing their

conservation. The process of commercialization should be transparent and the community itself should be inspector of the commercialization. This will guarantee the fair and equal distribution of the benefits and will guarantee the continuity of the program. The objectives of this Sub-Program are:

- Increase the family income in the communities with committing the conservation of the resource.
- The communities that harvest Caimans should conduct a fair and equal distribution of the benefits.
- The communities involved in the program should conduct a good administration of commercialization of Caimans.
- Assure the best channels and commercialization mechanisms.

2. Program of Control and Communal Protection

Bolivian rules establishes the general and indefinite prohibition for the pursuit, capture, storing, and treatment of wildlife. However, in spite of this national normative and others of Departmental and communal character, illegal hunting have been observed frequently. This makes it necessary to implement this program to preserve the legal sustainable use of the Caiman that Tacana Indigenous Land wishes to carry out.

2.1. Sub-Program of Communal Control of the Harvest Process

The wildlife management doesn't guarantee its availability in the long term, given the prevailing economic and social conditions in Bolivia. It is indispensable to combine the actions directly related to the species management and actions that permit to control the appropriate execution of the harvest. The control conducted by the same harvesters will assure the correct application of the norms, procedures, and regulations of the management plan, including the restriction of the harvest in unauthorized water bodies, the illegal sale of leathers, and others.

The control mechanisms should be concerted in a communal regulation, so that these mechanisms have the acceptance of the harvesters and the harvesters themselves demand complement of these mechanisms. The objectives of this Sub-Program are:

- Guarantee the complement of the established dispositions in the Management Plan.
- Achieve a transparent harvest and legal commercialization of the Caimans in the Tacana Indigenous Land.

2.2. Sub-Program of Minimum Protection

The prohibition of harvesting Caimans outside of the Tacana Indigenous Land is necessary to guarantee the sustainable harvest and conservation of the species. The objective of this sub program is to avoid the illegal harvest by people outside of the program. This kind of illegal harvest can cause incorrect estimates of the harvest quota established for each community and can reduce the production of Caimans for the communities harvesters.

It is important to coordinate with the authorities: National Police and Ecological Battalion of the Armed Forces. These institutions have the legal right to conduct inspections, seizures, and other actions in the rural and urban areas close to the areas of Community Management. It is also fundamental to coordinate control efforts with the Prefecture of La Paz, which is the entity responsible for the harvest process at the Department level and responsible for making harvesters comply the effective normative on this topic. The objectives of this Sub-Program are:

- Control the effect of the human activity on the habitats and the populations of Caimans in the community.
- Control the illegal harvest of Caimans outside of the Tacana Indigenous Land.

3. Program of Scientific Investigation

The biological information of the species in the country is almost nonexistent. This makes it indispensable to implement the present program and to obtain the necessary technical and scientific data that allow us to make the management program works. The objectives of this Sub-Program are:

- Increase the knowledge about the biology and ecology of the Spectacled Caiman in Bolivia.
- Obtain the technical and scientific bases that allow to conduct the sustainable harvest of the Caiman in the Tacana Indigenous Land.

4. Monitoring Program

This program will allow to record the population dynamics of the Spectacled Caiman subject to management through a database that contains the information provided by the investigation, and the respective technical reports of the different programs and sub-programs of the Management Plan.

The communal authorities and the leaders of the CIPTA should have the information of the monitoring to make decisions to increase or decrease the harvest of the Caiman or to correct the errors that would be causing the reduction of their harvest quota. The objectives of this Sub-Program are:

- Register and evaluate the changes in the Caiman populations subject to Management.
- Have technical and scientific information necessary to take the most effective measures for the conservation and the management of the species.
- Improve the process of commercial harvest. This allows to take better measures to improve the economic benefit for the communities.

5. Program of Training, Environmental Education and Diffusion

The future of the species under management depends on the attitude that the society and people have on the process of sustainable use. Without the participation and the support of the local communities, any conservation project will be failed or their implementation will be very complicated. For this reason the programs of training, environmental education, and diffusion are essential to achieve this support.

5.1. Training Sub-Program

To avoid the errors made by the people related to the harvest of Caimans in other Departments of Bolivia, we will transmit the necessary information to the Tacana Indigenous Land, so that the communities can strengthen their organization and administration, distribute the economic income obtained by this program to the communal and supra-communal instances in a transparent system, and carry out a sustainable management of Caimans with the largest environmental, economic, and community benefit. The training of the harvesters of Caimans in the communities of the Beni River, concerning the laws and norms that regulate the process of sustainable use, should be a constant work in the Tacana Indigenous Land. The Sub-training Program should allow that the theoretical base is reinforced by the practical and objective application, increasing the knowledge of the local agents on the different processes of the management plan, to achieve the necessary support for its execution. The objectives of this Sub-Program are:

- Train the communities (those participating in the pilot project) about administrative, organizational, commercial, and legal aspects to guarantee the sustainability of the management and harvest of Caimans in the Tacana Indigenous Land.
- Train the harvesters of Caimans in techniques of evaluation and monitoring of Caiman populations.

5.2. Sub-Program of Education and Environmental Diffusion

The Non-Formal Environmental Education should direct their teaching programs to the inhabitants of the towns of San Buenaventura, Rurrenabaque, Ixiamas and the communities of the Tacana Indigenous Land.

The diffusion of the results and activities of this Management Plan will be directed not only to the communities that harvest Caimans but also at other Indigenous Lands and the Department of La Paz. This will constitute a fundamental step for the consolidation of the Pilot Project of harvest and sustainable Management of the Caiman.

The educational authorities of the communities will promote meetings among the technicians of the management program and the local professors and students, to show the ecological importance of the Caimans, their biological characteristics, and other aspects that can improve the opinion of the students concerning the