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## Opinion Article

# Local community involvement as a basis for sustainable crocodilian management in Protected Areas of Central Amazonia: problem or solution?

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### Abstract

Amazon floodplains have a long history of exploitation of crocodilians, particularly of large species such as the black caiman (*Melanosuchus niger*) and spectacled caiman (*Caiman crocodilus*). Historically, legal but uncontrolled trade resulted in a drastic reduction of wild populations of both species, which eventually led to the collapse of the commercial trade. In 1967, prohibition of commercial use of wild fauna through changes in Brazilian and international laws allowed caiman populations to slowly recover across much of their original range. Several studies on caiman populations greatly improved knowledge about the species, offering scientific bases for crocodilian management in the wild. Although protective legislation should only be altered using extreme caution, the creation of Sustainable Development Reserves (SDR) at the end of last century made it possible to manage wildlife for commercial purposes, albeit under strict population monitoring regimes. This category of protected area was established to improve welfare of local communities and strengthen their participation in conservation. Along with involvement in caiman monitoring programs, the engagement of local hunters and buyers is essential for participatory management plans. Even with development of SDRs, monitoring of crocodilian populations is still restricted to a few State Reserves, and traditional knowledge of stakeholders has been insufficiently incorporated into management and monitoring activities. We believe that stronger participation of local actors can help to improve the experimental harvesting initiatives that have been carried out thus far by local authorities. Community-based monitoring programs, which reflect local reality, are being developed in a simple and cost-effective way.

**Key word:** Amazon, crocodilians, participatory monitoring, local community

### Resumo

A Amazônia possui um histórico de exploração de crocodilianos, principalmente as espécies jacaré-açu (*Melanosuchus niger*) e jacaretinga (*Caiman crocodilus*). No passado a caça legal e descontrolada levou a uma drástica diminuição das populações silvestres ao longo da distribuição natural das espécies, resultando em uma extinção comercial. Graças à proibição decidida pela legislação brasileira e internacional do uso e comércio da fauna, nas últimas três décadas as populações de jacarés estão se recuperando lentamente em muitas localidades. A criação de Unidades de Conservação da categoria Reserva de Desenvolvimento Sustentável e pesquisas científicas permitiram um melhor conhecimento da biologia e ecologia dos jacarés amazônicos e introduziram a possibilidade do manejo de fauna na região. A falta de réplicas nestas pesquisas e seus altos custos ainda limitam o conhecimento sobre o real potencial de exploração comercial de maneira sustentável. O conceito de manejar a fauna é novo para a maioria das comunidades ribeirinhas. O envolvimento de caçadores, associações locais, lideranças e comerciantes é fundamental para elaborar planos de manejo participativos. O monitoramento das populações de crocodilianos é limitado a poucas Reservas, e o conhecimento tradicional pouco considerado. Acreditamos que a inclusão efetiva e genuína destes atores locais pode levar a melhoria em abates experimentais e comerciais desenvolvidos até o momento por autoridades locais. No Amazonas, programas de monitoramento em bases comunitárias refletem a realidade local e estão sendo desenvolvidos de forma simples, com custos baixos e limitados.

**Palavras chave:** Amazônia, crocodilianos, monitoramento participativo, comunidade local

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## Introduction

Commercial and subsistence exploitation of crocodilians has a long history throughout their range, but so far no species has become extinct due to direct human exploitation [1]. The black caiman (*Melanosuchus niger*) and the spectacled caiman (*Caiman crocodilus*) are the largest caiman species (family Alligatoridae) in South America and have suffered extensive use in Amazonian floodplains, causing the collapse in their commercial trade in many localities. Medem [2] and Smith [3] reported that between 1950 and 1965, around 7.5 million caiman skins from natural populations were legally exported from the State of Amazonas in Brazil. During the past two decades, research on caiman ecology and conservation status in central Amazonia has greatly improved knowledge about the species, providing a basis for crocodilian management in the wild.

Despite the official ban on wildlife hunting in Brazil since 1967, caiman meat has been widely commercialized in the last three decades, representing the largest illegal trade of caiman meat in the world [4-6]. This uncontrolled threat highlights the need for new approaches to address the problems of crocodilian conservation and population management. The establishment of Sustainable Development Reserves (SDR) in 1996 made it possible to manage wild populations for commercial use, as long as programs are associated with population monitoring activities. This category of protected area seeks to improve local peoples' livelihoods and strengthen species [7]. Currently there are 15 SDRs in the state of Amazonas, covering approximately 9,870,000 ha, managed by the state Secretary of Environment and Sustainable Development (Secretaria Estadual de Meio Ambiente e Desenvolvimento Sustentável - SDS) and Center for Protected Areas (Centro Estadual de Unidades de Conservação - CEUC).

We discuss the development and evolution of local hunting legislation, scientific research, and initiatives for monitoring wild caiman populations. We also suggest useful ways to engage local communities in the development of management plans, resulting in sustainable use and conservation of caiman species together with socio-economic benefits.

## Legal framework

Commercial wildlife exploitation was outlawed in Brazil in 1967 (Law 5.197 of 03/01/1967) in hopes of reversing trends of wildlife population decline and local extinction. This measure allowed crocodilian populations to increase in several portions of their range. Article 02 of the United Nations Convention on Biological Diversity (<http://www.cbd.int/convention/text/>) states that sustainable use is "the use of components of biological diversity in a way and at a

rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations”.

In the last decade, changes in legislation have allowed legal implementation of wildlife management in the State of Amazonas within certain categories of protected areas. The Brazilian National System for Protected Areas (SNUC) and its regulatory legislation (Decree 4.314, of 22/08/2002) made wildlife management possible in Sustainable Development and Extractive Reserves.

The change in the conservation status of the black caiman from “Endangered” to “Least Concern/Conservation Dependent” by the International Union for Conservation of Nature (IUCN; [www.redlist.org](http://www.redlist.org)) occurred in 2000 as a result of population evaluation studies. In 2003, black caiman was also removed from the “Brazilian Official List of Species Threatened with Biological Extinction,” by the Normative Instruction N°3 of 27/06/2003 ([www.ibama.gov](http://www.ibama.gov)).

Under the new supporting legislation, in 2004 the Amazonas State agencies for Sustainable Development (SDS), Rural Production (SEPROR) and Forests (AFLORAM) carried out an experimental caiman harvest in the Mamirauá SDR [8], authorized by the Brazilian Institute of Environment and Natural Resources (IBAMA) with support from Mamirauá Sustainable Development Institute (IDSM).

In 2007, the black caiman was also upgraded to Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), allowing international trade of its sub-products, as was already permitted for the spectacled caiman.

In 2011, the SDS created a Caiman Working Group with the participation of governmental institutions, researchers and civil society to further discuss and propose ways to manage caiman populations in the wild. The working group recommended some rules for caiman slaughter and meat processing that should be included in the management plans of Protected Areas in Amazonas State; these rules became official in mid-2011 (Amazonas State Official Post-28/06/2011 and IN 001/2011 – SEPROR/CODESAV).

### Scientific research

One basic principle in wildlife use is that distinct populations do not respond in the same way to different management actions. Each species has its own niche and adapts differently to natural predation or commercial harvesting [7]. General extrapolations on caiman abundance applied from one area to another can result in errors during decision-making, whereby management authorities may risk the total failure of sustainable management (Da Silveira, pers comm.).

The majority of the studies on Amazonian caiman biology and ecology were carried out in Anavilhanas National Park [4,9], Mamirauá SDR [4,8,10-12], Piagaçu-Purus SDR [5-6, 12-14], Jaú National Park [15] and Abufari Biological Reserve [16]. Highly qualified scientists or graduate students undertook these studies with participation from local inhabitants, primarily as guides or field assistants.

In developing countries, scientific research projects are generally conducted for short periods (one to two years), with relatively high costs paid by external or governmental agencies [17]. Results may be accurate and precise, and clarify the conservation status of target populations with solid scientific bases, but reflect only local conditions that are

seldom replicable in other areas, and efficient natural resource management programs rarely follow.

### **Wildlife management schemes**

Wildlife use should consider several perspectives to achieve ecological, economical and social sustainability [18]. Along the Brazilian Amazon, sustainable use of fauna is a relatively recent experience for riverine peoples [19]. The community-based commercial fishery of pirarucu (*Arapaima gigas*), the largest fish in the America, has permitted a recovery of natural populations and represents a successful example centered on three key-points: 1) management is designed on local, sociocultural and historic factors; 2) it takes into consideration stakeholders as well as the resource; and 3) empowerment of local fishermen in the decision-making process is fundamental [20].

For crocodilians there are three known possible types of exploitation systems [21]:

- *Farming*: an intensive scheme, with the entire life-cycle closed and limited to captive farms, where reproductive individuals and juveniles are fed until slaughter;
- *Ranching*: semi-intensive scheme, where eggs are collected in natural conditions, and then incubated artificially; hatchlings are fed in captivity until they reach the minimum commercial size;
- *Harvesting*: the most extensive scheme, where reproduction areas are protected and wild adult individuals are harvested in their natural habitat.

Among these possibilities of caiman management, the third probably requires the least financial support from external and governmental agencies or from private investments. Beyond new economic opportunities, wildlife management is expected to generate additional benefits such as major community involvement, strengthening of social organization, and specific capacity-building opportunities for local people to conserve resources and natural habitats [7, 21]. We therefore believe that the *harvesting* scheme is the most appropriate for the Amazonian context, where an economic history of extensive use of crocodilians already exists.

### **Monitoring**

Monitoring has been defined as “the systematic measurement of variables and processes over time” [22] and represents a scientifically sound, empirical basis for setting annual harvesting quotas, resulting in an adaptive management [21]. Effective monitoring of managed populations and their ecosystems should be integrated to achieve successful management programs [19].

In Amazonas State, caiman populations have been monitored for abundance, size structure, nesting biology and poaching in Mamirauá, Piagaçu-Purus and Uacari SDRs, in all cases with active collaboration between researchers and local communities. When financial resources are limited, a monitoring program should have simple methods, be cost-effective and capable of sustaining itself with little external aid, and should reduce the time from data sampling to management action [23].

Good examples of community-based use and monitoring of wildlife have already proven their efficiency, for either subsistence or commercial purposes [24-25]. Due to the existing sociocultural differences throughout the region regarding the use of caimans, clear

mechanisms should be created to optimize the economic benefits to hunters, to limit and transform illegal activities, and to promote and strengthen biodiversity-sustainable use in the region [26].

### **Participative management**

Local communities, scientists and governmental authorities should invest in combined actions for sustainable management, particularly when this option represents the most efficient way to achieve their respective goals [27]. According to Townsend [28], there are five levels of local involvement in participatory management programs, ranging from a passive posture where communities wait for government actions, to activities organized autonomously by local community associations [28]. Schemes suggested by Danielsen et al [17], and crocodilian population monitoring carried out within Amazonia, suggest that local interest gradually increases with time. Reflecting the real local demand for management actions, concepts of community empowerment are being discussed with hunters, local buyers, conservationists and government agencies, all of whom participate in an integrated manner.

Rigorous capacity-building and the involvement of local people improve data precision and expand detection of managed population trends over the years [19]. Paralleling scientifically conducted research, some communities have begun to monitor caiman reproductive areas. Nesting localities, in the case of crocodilians, are essential as population source areas [12, 29]. Additionally, simple methods are needed for nocturnal surveys that incorporate local traditional knowledge and experience of caiman hunters to devise possible harvest quotas. As a consequence, new guidelines for the use of managed territories are being constructed based on monitoring programs: suitable protection areas are indicated and proper zones for sustainable harvesting are identified, based on abundance and accessibility of valuable individuals.

However, persistent problems exist, like the difficulty of local communities to sustain a participatory monitoring system along with all their other social responsibilities. This challenge needs to be overcome. Another frequent obstacle is that programs are dependent on continuous external subsidies, and when these diminish or end the community-based monitoring drastically shrinks. Although government agencies and the private sector are often interested in supporting management related activities, economic incentives for local residents' participation are minimal. Regional authorities have done little to maintain the local, community-based management incentives. In the last decade, government support has been limited to a few unsuccessful commercial harvesting endeavors and to promoting engagement with the private sector, the main purpose of which is to profit from the commercialization of natural resources.

### **Implications for Conservation**

Our experience with community-based activities in SDRs shows that the motivations of local monitors are strongly related to caiman management success and to the possible new income that this activity may bring. Government should support local participation in the long term, considering the likely economic, social and environmental benefits of a science-based community management of crocodilian populations. In the short term, the contribution of the scientific community should be limited to collecting and providing information to legislative authorities on the validity of management practices that are undertaken by local participants. For these reasons, management must be considered as experimental and adaptive during its first years.



Approximately 19 million hectares of Amazonas State are Protected Areas, 50% of which allow the use of natural resources. Nevertheless, even with one of the largest crocodilian populations in the Americas and with a considerable existing body of research on management of wild population, Brazil lags behind other South American countries like Bolivia [30-31], Venezuela [32-33], Argentina [34] or Colombia [35] in terms of implementing management programs. Brazil's main failing is that recent laws encourage and regulate caiman management in the Amazonas State, but do not reflect the local reality of hunting or consuming caiman products.

Communities should be consulted and traditional knowledge of riverine populations about caiman hunting should be included in the monitoring, harvesting and commercialization processes. Inclusion of traditional expertise from local residents is highly recommended [25], since they will be the main beneficiaries of large-scale conservation actions. Although simple and efficient methods are being developed; the costs of autonomous wildlife management are presently excessive for a local community. Furthermore, participating communities need capacity-building training courses and regular meetings to exchange knowledge and experiences with other local associations engaged in sustainable harvest of crocodilians throughout Amazonas State.

A management plan for crocodilian wild populations should consider economic subsidies for integrating scientific research, systematic monitoring, efficient enforcement, social organization and regional productive values that will discourage illegal trade. Management results must be monitored, validated and/or corrected by professionals funded by scientific institutions. Efficient management programs depend on engagement of local stakeholders, who benefit by participating in caiman population monitoring and subsequent commercial harvesting. This alternative to caiman poaching will inform new public policies that can be adapted to other areas. At the same time, it will give greater autonomy to local communities to use their natural resources and conserve the crocodilian species of the Amazon basin.

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