

PRODUCTIVE CHAINS OF AMAZONIAN SOCIOBIODIVERSITY AND ECODESIGN OPPORTUNITIES BRAZILIAN CROCODILIANS AS A WORKING MODEL

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Human population growth has increased the demand to adopt intensive production systems, which associated with other socio-economic (development) activities have determined the elimination or modification of natural ecosystems and the subsequent loss of biological richness. Formal attempts to overcome such problems began in the mid-19th century, when the establishment of national parks, reserves and protected areas in Europe, North America and, subsequently, around the world began. At the same time, at the national and international levels, laws for the protection and control of the environment were developed, aiming at the conservation of resources. However, the trend has not been reversed; the human population continues to grow, natural habitats continue to disappear and natural wildlife populations continue to decline. There was then a need to develop new wildlife conservation strategies.

The idea of “conservation through intelligent use” originated in Europe and North America at the beginning of the 20th century (GILBERT; DODS, 1992). Despite the limitations of scientific knowledge, it was believed that wild populations could be conserved if they were used for the benefit of society at a rate

lower than their respective growth rates. More recently, the idea of “conservation through sustainable use” has been widely disseminated and is recognized as an important strategy to promote the conservation of natural habitats and the preservation of biodiversity (GRIGG et al., 1995). Wildlife production systems are now conceived as part of a global sustainable development policy that considers environmental conservation as a component of socioeconomic development (IUCN/UNEP/WWF, 1980; 1991). The idea is that species that bring tangible benefits to society will have a greater chance to being properly managed and, consequently, conserved. On the other hand, resources not valued by society will have a greater chance to be destroyed or replaced by other forms of land use.

Wildlife has been used for different purposes, including commercial, recreational, scientific, aesthetic and for spiritual reasons. If the major goal is the conservation of biodiversity contained in natural ecosystems, it is necessary to incorporate the different types of use into conservation strategies. There is a consensus that, in one way or another, society has always made, has been making and will always make use of wild species. However, there are controversies about which forms of utilization are compatible with conservation and whether the results of a certain type of management are effectively working as a conservation tool. The controversy is particularly accentuated when the arguments to stimulate conservation are based on economic justifications since, in this specific case, utilization and conservation are not related in a simple and direct way.

Those who advocate that commercial use of wildlife can work as a conservation mechanism argue that: 1) the system offers opportunities to increase land productivity through diversification of means of production; 2) it is consistent with traditional indigenous culture; 3) it helps conserve genetic heritage; 4) it creates new agricultural markets; 5) it helps stabilize markets of fauna products; and 6) it represents an opportunity to redirect land use, especially in areas considered inappropriate for traditional agricultural systems, bringing benefits to local communities and promoting rural development (HUDSON et al., 1989). On the other hand, those opposed to the idea argue that commercial activity involves many interests and it is more likely that management will reflect market interests rather than ecological or conservation issues (GEIST, 1993; THORBJARNARSON, 1999). Furthermore, based on historical experiences, natural resources are almost always overexploited and conservation purposes are difficult to achieve due to the complexities and peculiarities of biological systems (each new problem means learning about a new system), the difficulties in obtaining optimal levels of exploitation, which in most cases are only obtained through trial and

error, and the prospects of rapid enrichment that lead to overexploitation (GEIST, 1985; LUDWIG et al., 1993). The arguments in favor and against commercial use as a conservation mechanism should be seen as hypotheses that need to be tested under rigorous field experimentation, where biological and socioeconomic factors are necessarily included in the evaluations.

MANAGEMENT FOR CONSERVATION AND SUSTAINABLE USE OF BRAZILIAN CROCODILIANS

Brazil is in a privileged position to promote the use of wildlife as a mechanism of conservation and sustainable development. The large areas of tropical wetlands, the vigor of populations of species of recognized economic value and the socioeconomic scenario favoring environmentally intelligent products are some of the main factors that contribute to the country assuming a prominent position in the world production of wildlife products (COUTINHO; CAMPOS, 2011).

Crocodylians are widely distributed throughout the Amazon region and may reach high densities in some preferential habitats (MARIONI et al., 2013). The sustained use of these natural stocks has the potential to add value to the land, generate income and jobs in the countryside and in the cities and act as an incentive for the conservation of natural environments, as well as representing opportunities for the redirection of land use, especially in forests and floodplains, as well as in areas inappropriate for the implementation of intensive agricultural production systems.

The Brazilian Amazon was in the near past responsible for the production of millions of crocodylian skins, which represented an important source of resources for the country and especially for local communities. Currently, even having one of the largest crocodylian stocks on the planet, Brazil participates with a small portion of the international market and the volume of legal business in the domestic market is still inexpressive.

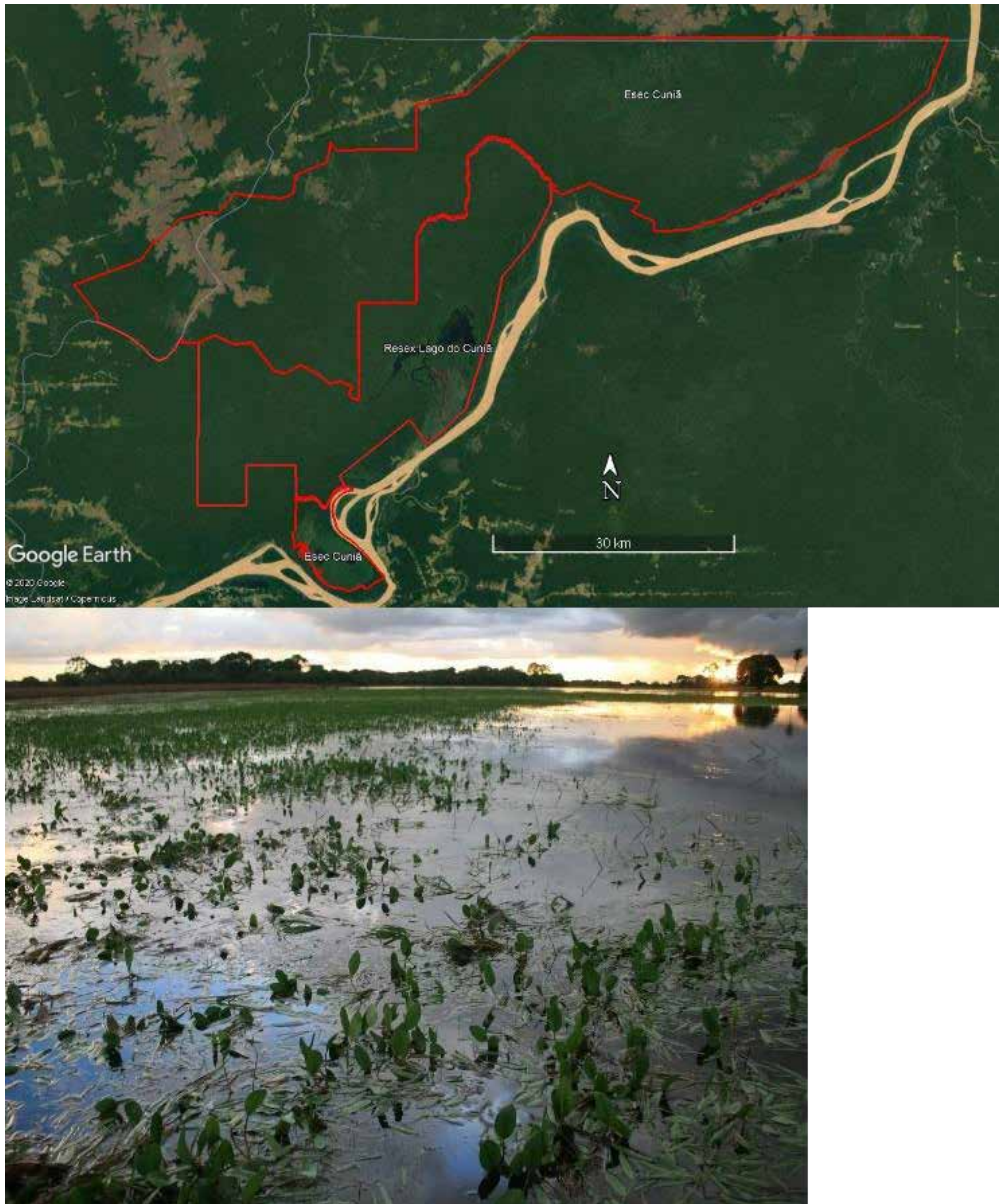
In order to reverse this situation, government and civil society entities are investing great efforts to organize and develop the production chain of the Brazilian crocodylians, promoting management programs that are economically viable and ensuring that conservation goals are achieved. However, this is not a simple task. It is necessary that all stages of production chain be examined in an integrated way. The production, the processing, the inputs, the marketing of the products and the monitoring system must be articulated from a research

and development perspective. In this context, particularly in the promotion and development of products, the participation of ecodesign professionals assumes a highly relevant role (PEREIRA et al., 2019).

CASE STUDY: LAGO DO CUNIÃ EXTRACTIVE RESERVE – STATE OF RONDÔNIA

The Lago do Cuniã Extractive Reserve (Resex Cuniã) is a sustainable use reserve located in the municipality of Porto Velho, in the left shore of Madeira River, state of Rondônia (Figure 1). Local communities are composed of 90 families, distributed in four distinct residential areas within the reserve. The main sources of income are fishing, Brazilian nuts, açaí, andiroba and copaíba fruits and familiar agriculture. Natural crocodylian populations of black caimans (*Melanosuchus niger*) and jacaretinga (*Caiman crocodilus*) are robust, reaching high densities (> 100 individuals/km of shoreline).

Figure 1 – Resex Cuniã's map, Rondônia, highlighting the high availability of water environments



Source: Google Earth image and Coutinho (2002).

In March 2004, the first meeting was held with the Cuniã communities to address the management of caimans as an additional alternative for generating employment and income, in addition to promoting the conservation of species

and their respective natural habitats. The meeting was attended massively by members of the communities and, as a result of the discussions, there was consensus that the main objective of crocodilian management in the Resex should be oriented towards sustained commercial use as an alternative for socioeconomic and environmental development.

As a result of this decision taken unanimously by the communities of Cuniã, it was necessary to implement a set of integrated actions, aiming at the organization and development of a new value chain in Resex. In order to attend this demand, a program was conceived according to the perspective of research, development and innovation, where commercial management, research and monitoring activities could be conducted in an integrated manner, aiming to guarantee the bases for the sustainability of socio-biodiversity productive chains. Among the different lines of work are the training of community members, the implementation of standardized production techniques, processing and marketing of products and, especially, the generation of bioeconomic bases for the practice of good crocodilian management in Resex. Moreover, the idea is that the experiences acquired in Cuniã can be replicated in sustainable use conservation units serving as an example for future projects in other national biomes, with aptitude for crocodilian management (Figs. 2 and 3).

In 2011, the production activities began and the Cuniã management became the first initiative that culminated with the environmental license to harvesting crocodilians in a sustainable use conservation unit in the Amazon. Cuniã warehouse was also the first industrial crocodilian processing plant in the Amazon, certified by the Service of Sanitary Inspection of the city of Porto Velho, Rondônia. According to the guidelines provided in the Normative Instruction of the Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio No. 028/2012), besides extractive reserves, harvesting crocodilians in natural habitats can also be implemented in federal national forests and reserves of sustainable development.

The project has the participation of a multidisciplinary team from several institutions, such as the ICMBio, Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (IBAMA), Empresa de Assistência Técnica e Extensão Rural do Estado de Rondônia (EMATER-RO), Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA), Universidade Federal de Minas Gerais (UFMG), Fundação Biodiversitas (FBio), which establish the project as the first in Brazil to manage natural populations of crocodilians in the Brazilian Amazon.

Figure 2 – Resex Cuniã communities members' training meeting and the group specialized in capturing crocodilians within the reserve



Source: Coutinho (2002).

Figure 3 – Research related to crocodilian management, conducted by Resex Cuniã communities members



Source: Coutinho (2002).

MANAGEMENT PRODUCTS AND ECODESIGN OPPORTUNITIES

The main products obtained from crocodilian management at Cuniã Reserve are meat and skin. The skins are then processed to become leather.

The meat is directed to local markets, being totally consumed in the region. The presentation of the product in the market opens an opportunity for the application of ecodesign concepts for being a product characterized as organic, coming from sustained management and without the addition of any chemical agent.

Unlike the meat, the life cycle in the leather line is more complex, requiring considerable investments of financial and technological resources (Figure 4).

Initially, the skins go through the curing process in Resex itself, which consists of the removal of residues remaining from skinning work, and subsequent addition of sodium chloride, bactericides and fungicides, aiming for the best conservation of the skins. Then, the hides are sent to national and foreign tanneries, where they are submitted to tanning and finishing processes.

Figure 4 – Meat selling in a Porto Velho supermarket and skin conservation work made by Cuniã communities' members



Source: Coutinho (2002).

The use of crocodilian skins began in the middle of the 18th century with the development of tanning techniques in France and Italy (ROTH; MERZ, 1997). Despite the long tradition in its use, this material is difficult to tan due to the presence of intradermal bone plates (osteoderm), which attributes relatively greater difficulty to the processes. Thus, the full use of skins by the tanning industry requires knowledge about the calcium content inside the skin, which in turn is closely linked to the animals' diet and different types of management (JACINTO et al., 2008).

In addition, the tanning process includes the use of several toxic agents with high polluting potential. Therefore, the treatment processes of waste generated by the tanning industry require the application of advanced technologies to treat organic compounds and heavy metals.

Regardless of the issues related to the production and processing of hides, the natural characteristics of the leather give it a high commercial value for ensuring the manufacture of sophisticated and high-quality products (Figure 5). In this matter, the use of ecodesign concepts is of great relevance.

Crocodilian leather is still considered the “diamond” of hides. Its classic use has been associated to the most sophisticated brands of the international fashion environment. The main products are bags, shoes, belts and various clothing. Likewise, the international furniture industry applies leather in several articles, among them, armchairs, stools, tables and chairs.

However, the use of Brazilian crocodilian leather can assume a much more comprehensive dimension. The resistance, durability, comfort sensation and its unusual visual aspect open a wide perspective for the development of new products and alternative uses for the leather coming from the sustained management of crocodilians. In this sense, the partnership between the Laboratório de Estudos Integrados em Arquitetura, Design e Estruturas of the Escola de Arquitetura from the Universidade Federal de Minas Gerais and the Centro Nacional de Pesquisa e Conservação de Répteis e Anfíbios from the Instituto Chico Mendes de Conservação da Biodiversidade has generated very fruitful results regarding the evolution of the uses of leather of the species of native Brazilian fauna, as well as the training of specialized technical staff (PEREIRA et al., 2019). It is worth highlighting here the urgent need for clarification of public opinion about the importance of wildlife management as a mechanism of conservation of natural environments.

In synthesis, the application of ecodesign concepts, techniques and methodologies represent an important tool to guarantee the success of socio-biodiversity productive chains. These, in turn, promote the conservation of traditional knowledge and cultures, territories and natural environments. Thus, ecodesign is an effective tool allied to the maintenance of forests and floodplains and of all Brazilian biological richness.

Figure 5 – Leather of black caiman (*Melanosuchus niger*) from Resex Cuniã management project



Source: Coutinho (2002).

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