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## Sustainable use of ornamental fish populations in Peruvian Amazonia

Uso sustentable de poblaciones de peces ornamentals en la Amazonia Peruana

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## Sustainable use of ornamental fish populations in Peruvian Amazonia

### Resumen

Uso sostenible es un término frecuentemente utilizado cuando se habla de uso de recursos biológicos porque los recursos están disminuyéndose en todo el mundo. Para obtener manejo sostenible de un recurso, ciertas condiciones deben estar aplicadas: biología y ecología básica del recurso deben estar conocidas y basado en este conocimiento lineamientos de manejo pueden ser desarrollados; importancia social del uso del recurso y su importancia en la economía local y en el mercado internacional deben ser analizadas y entendidas; y gente local y usuarios del recurso deben estar involucrados en el proceso de manejo de recurso. Un estudio de caso sobre como estudiar uso sostenible de un recurso biológico está presentado, utilizando como ejemplo pesca de peces ornamentales en la Amazonía peruana. Dos especies de peces ornamentales fueron seleccionadas: *Pterophyllum scalare* (pez ángel) y *Symphysodon aequifasciatus* (pez disco) (Perciformes: Cichlidae). Las especies están amenazadas en su hábitat natural por sobre pesca y uso de métodos destructivos de pesca. La investigación fue realizada en dos lagos del río Nanay, un tributario del río Amazonas en la Amazonía peruana. Este estudio provee entendimiento de manejo sostenible de un recurso a través de: planes de manejo comunales del recurso; lineamientos y criterios de manejo y uso sostenible del recurso; evaluación de factibilidad de prácticas de certificación para el recurso; y promoción de pesca sostenible de peces ornamentales. Los resultados deben últimamente resultar en prácticas de uso sostenible para el beneficio de poblaciones locales - de animales y de gente. Palabras clave: Uso sostenido, peses, Amazonía Peruana.

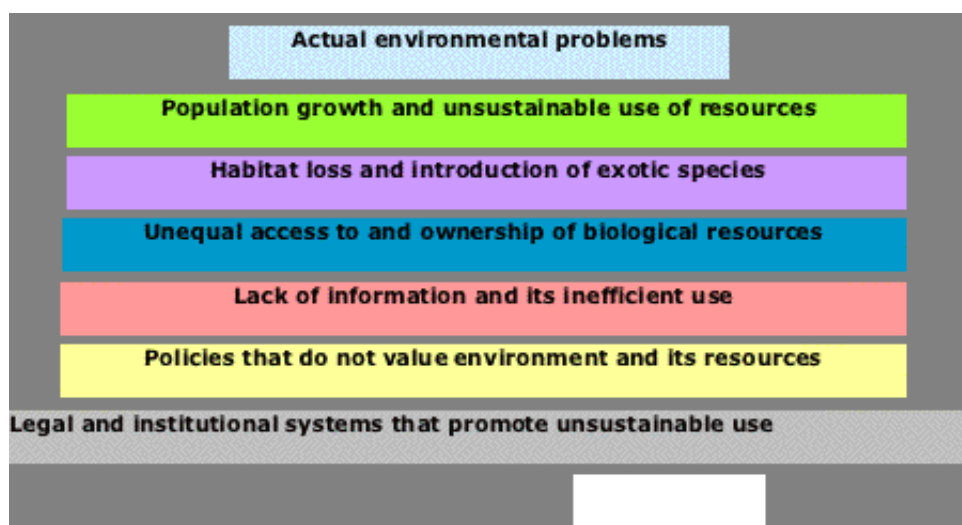
### Abstract

Sustainable use has become a term frequently utilized when use of biological resources is discussed because biological resources are diminishing everywhere. To reach the objective of sustainable management of a biological resource certain conditions need to be met: basic biology and ecology of the resource need to be known and based on this knowledge management guidelines can be developed; social significance of the use of the resource and its importance in the local economy and on the international market need to be assessed and understood; and local people and resource users need to be involved in the resource management process. A case study of how sustainable use of biological resources could be studied is presented, using ornamental fishery in Peruvian Amazonia as the research object. Two ornamental fish species were selected as research objects: *Pterophyllum scalare* (Angelfish) and *Symphysodon aequifasciatus* (Brown Discus) (Perciformes: Cichlidae). The species are endangered in their natural habitats because of over fishing and destructive fishing methods. The research was conducted in two lakes of the Nanay River, a tributary of the Amazon River in Peruvian Amazonia. This study provides understanding of sustainable management of a resource through: communal management plans for the resource; guidelines and criteria for management and sustainable use of the resource; evaluation of feasibility of certification practices for the resource; and promotion of sustainable ornamental fishery. The results obtained in this study should ultimately lead to sustainable use practices for the benefit of local populations – of animals and of people. Key words: Sustainable use, fish, Peruvian Amazon.

### Introduction

Sustainable use has become a term that is very frequently used in many contexts when use of biological resources is discussed. There is a reason for that, not only because it has entered the international legislation through the Convention on Biological Diversity (1992) and especially through the call for fulfilment of the Convention objectives: 1) conservation of biological diversity, 2) sustainable utilization of its components, and 3) equitable sharing of benefits derived from genetic resources of biological diversity (Convention on Biological Diversity, 1992). The use of the term stems also from the fact that biological resources are diminishing everywhere (UNEP, 1995), even in

areas where they were once thought to be very abundant, as it is the case of Peruvian Amazonia. There are many pressing global environmental problems that have also become reality in Peruvian Amazonia (Figure 1). Here some of these problems are discussed. Globally the population growth has become one of the most alarming problems and also affects conservation efforts in Peruvian Amazonia as the population continues to grow. This growth is apparent in the big cities, like the city of Iquitos, the largest city in Peruvian Amazonia with approximately 350 000 inhabitants, and also in rural areas, as is the case along the Iquitos-Nauta highway with a very high population growth that has dire consequences to the surrounding nature (Wahl *et al.*, 2003). This is very much due to the dependence of the rural people on the resources provided by nature: more people means more pressure on the already diminishing resources. Use of these resources is also very seldom sustainable as rural poor try to get their living out of the available resources. Also the city dwellers use the biological resources extensively as many obtain their income by extraction of biological resources with hardly any heed to their sustainable use as people think that the resources are bountiful and practically limitless.



**Figure 1. Presentation of some global environmental problems that have become reality in Peruvian Amazonia. Modified from UNEP. 1995. Heywood, V.H. (exec. ed.). Global Biodiversity Assessment. United Nations Environmental Programme. University Press, Cambridge, Great Britain. 1140 pp.**

**Figura 1. Presentación de problemas ambientales globales ahora reales en la Amazonía Peruana, modificada de UNEP. 1995. Heywood, V.H. (exec. ed.). Global Biodiversity Assessment. United Nations Environmental Programme. University Press, Cambridge, Great Britain. 1140 pp.**

One of the most alarming environmental problems is the loss of habitats due to different kinds of development activities, such as construction, and conversion to other types of land use. Loss of habitats affect a great number of animals, plants and micro organisms associated with a certain habitat and can even lead to a loss of unknown species, as might well be the case in Peruvian Amazonia where a great deal of biodiversity is still unknown and have hardly even been studied.

Also introduction of exotic species can affect native species; this is the case of tilapia fish in Amazonia where great caution is being taken to avoid that tilapia specimens escape from fish farms. Sometimes though current legislature might even promote unsustainable use of biological resources and actually promote biodiversity loss. For example, recently Province of Loreto in Peruvian Amazonia, decided to start promoting tilapia farming in its jurisdiction in order to provide food for the province inhabitants. This was done without consultation of fishery authorities or conservation and research institutions and shows lack of knowledge and care of nature by the political authorities.

This has to do very much also with lack of information, not just lack of care. Information on biodiversity and possible effects of different actions do not reach the decision-makers that make decisions on the basis of erroneous information or even lack of information. If information exists, it is not used efficiently as it is very often scattered in different institutions that jealously guard their information. This is very much the case in Peruvian Amazonia.

One of the biggest problems is also the unequal participation of different actors in the access to and ownership of biological resources. Especially this problem becomes very clear in the Allpahuayo-Mishana Reserved Zone in the vicinity of Iquitos where local people living within the protected area claim that outsiders come to use their resources and leave them with nothing. These outsiders are people living in the city that extract and commercialise biological resources, such as timber, fish, palm thatch, etc., as their business. This creates serious conflicts between them and the local people as local people are depended on the biological resources for their subsistence.

These environmental problems cause great concern and ways need to be found for the mitigation and prevention of these problems. Sustainable management practices, environmental education and market awareness are some of the ways to mitigate these problems. Through sustainable management practices care can be taken of not extracting amounts of resources that are not sustainable in the long run. Also environmental education is needed in order to raise awareness in the users for the correct methods of resource use that do not lead to their depletion. Market awareness can mean a so called "green markets" where consumers require products and resources that are known to come from managed areas. This demand is then translated to production of such resources.

In order to reach the objective of sustainable management of a biological resource a certain set of conditions need to be met:

Basic biology of the resource in question needs to be known.

Based on this knowledge management guidelines can be developed.

Social significance of the use of the resource needs to be assessed and understood.

Importance of the resource in the local economy and on the international market needs to be understood.

Local people and resource users need to be involved in the resource management process.

In this paper a case study of how sustainable use of biological resources could be studied is presented, using ornamental fishery in Peruvian Amazonia as the research object.

Case study species

Two ornamental fish species were selected as the case study research objects, both species belong to the family Cichlidae (Perciformes): *Pterophyllum scalare* (Angelfish) and *Symphysodon aequifasciatus* (Brown Discus). These species inhabit similar habitats in Peruvian Amazonia and can fairly easily be studied at the same time as they are fished in the same manner: caught at night using small hand nets with flashlight illumination.

Both of the fish species in concern are iteroparous substrate breeders with peculiar life cycles. In the case of the Angelfish, both parents invest on the care of their young by guarding them and fanning oxygen-rich water on the spawn. Both parents stay with the offspring 1-3 weeks after their hatching. The Discus fish share the same parental care pattern. In addition, the Discus parents secrete a solution rich in hydrocarbons which the developing fry feed on, off of their parents.

These two species were selected as the study objects as virtually all current information on them comes from aquarium studies and very little is known of these species in natural conditions. As they are widely popular and well known ornamental fish species in the world, there is always a demand of these species in the international market of ornamental fishes, thus making them important species in the local economy. They are also a local resource; neither species is found elsewhere but in Amazonia.

These two fish species in question are endangered in their natural habitats because of over fishing and use of naturally derived rotenone as a destructive fishing method. According to the local fishermen, especially the populations of Brown Discus have diminished alarmingly in the past years and it is not anymore found in the areas that it was still commonly found about ten years ago. The use of rotenone harms the adult fish by destroying the mucus membranes of their gills and digestive track; also it practically kills all invertebrates and fish larvae in the area where it is applied. Adult fish can survive several days after receiving a dose of rotenone and might not die until they are sold to the international trade. The aquarium traders in the city of Iquitos in Peruvian Amazonia are more and more aware of this problem and customarily wait for several days until they pay for the fishes to the fishermen in order to avoid mortality later on by rotenone poisoning, and especially to avoid shipping rotenone poisoned fish to international aquarium fish dealers in order to maintain good reputation of their products in international trade.

Study area

The case study was conducted in two lakes of the Nanay River, a tributary of the Amazon River, in the vicinity of the city of Iquitos, a centre for ornamental fish trade in Peruvian Amazonia. From Iquitos ornamental fish are sent to aquarium dealers in Lima, the capital of Peru, or in Miami, Florida, USA. The study area on the Nanay River is part of a new protected area, Allpahuayo-Mishana Reserved Zone, which was established in 1999 to protect a unique forest mosaic ecosystem of white-sand forests and a characteristic black water ecosystem (Alvarez et al. 1999; Alvarez & Juvonen 2003). As it harbours the largest concentration of white sand forests in Peruvian Amazonia and one of the most interesting black water ecosystems, the Allpahuayo-Mishana Reserved Zone has become one of the most important protected areas for biodiversity in the region. This black water ecosystem is the watershed area of the River Nanay where this case study research was conducted.

#### Case study research objectives

The case study aims to take part in the ongoing discussion on economic use of natural populations of plants and animals in developing countries and particularly in the tropics. This is one of the focal questions in management of biological resources. This research is oriented towards analysing how sustainable ornamental fishery in the floodplain of the River Nanay in the Northern Peruvian Amazonia may help to raise the economic value of a natural-condition floodplain. This study also provides important basic information on two economically valuable ornamental fish species and recommendations for their management that can orient the management plan of the Allpahuayo-Mishana Reserved Zone. These objectives can be reached through a careful examination of different aspects of the study objects. The following are the integral parts of this research:

Study of basic biology and ecology;

Study of local socio-economic aspects;

Study of international market aspects and global trends.

Basic biology and ecology: Life cycle and floodplain environment characteristic

During the year 2002 and 2003, a substantial material was collected on the two Cichlid fish species in question. This material provides the basis to study the basic biology of these species in order to study them in their natural environment. In this study basic biology parameters of Brown Discus and Angelfish were studied in the wild through a year long monitoring and fishing period. The life cycle parameters of the species were analysed in order to obtain data on critical bottle-necks during the annual cycle. Parameters such as reproductive behaviour and foraging behaviour were studied, along with aspects of habitat use. Also, the research aimed to study theoretical questions related to life cycle ecology of tropical fish in general.

This basic biology information is crucial for development of management guidelines. All the basic biology information is important in order to make more accurate management plans for these important resource populations.

In this research, relations of these fish species ecology to their environment were studied on a long-term basis. Main aspects of practical management of these species and their ecosystem were looked into, including what are the critical points in their life cycles and their relation with the river dynamics in the floodplain of the River Nanay. These aspects are all important in fishery management, e.g. the results will help to establish closed fishing seasons at certain times of the year, if need be, to protect breeding sites, and to make recommendations as to sustainable fishing methods and practices. This knowledge forms the scientific basis that allows recommendations to be made on management plans for these species.

The research was carried out in coordination with two riverside communities, Yuto and Tarapoto, local fishermen, the National University of Peruvian Amazonia (Universidad Nacional de la Amazonía Peruana, UNAP) and the Research Institute of Peruvian Amazonia (Instituto de Investigaciones de la Amazonía Peruana, IIAP).

#### Local socio-economic aspects

One of the most crucial aspects in management of the protected area is to commit the local people to conservation, through concrete benefits derived from it (Langholz 1999). This could be done by providing alternative sustainable livelihoods for the people inhabiting the protected area. Ornamental fishery is estimated to bring an annual turnover of more than USD 20 million in Amazonia and may thus provide an alternative to the current destructive uses of Amazonian floodplain forests (e.g. selective logging, carbon burning), provided that it becomes sustainable in nature. Sustainable ornamental fishery provides an

interesting option for local communities, especially as many local fishermen already master the skills needed in the ornamental fishery. What are needed are partnerships between the fishermen and the urban aquarium whole sellers and traders to provide products coming from managed areas within the protected area to international markets.

During the study, local fishermen, aquarium fish whole sellers and traders, governmental authorities and communal leaders and fishermen were interviewed on questions related to fisheries in the area in order to provide insights to the importance of ornamental fishery of the two study species in the local economy and social context.

International market aspects and global trends

An important issue of fishery management is also finding national and international markets for these resources (Crampton 1999; Lazarte Farfán 2000). This is also important from the socio-economic point of view as a great number of the local people receive a large part of their income from fishing, so these resources well managed can secure the future for many local people (Soregui & Montreuil 1998). There are about 250 species of fish of which 20% are used for consumption and 25% are part of the international ornamental fish trade.

This research makes it also possible to study modern concepts in conservation biology and their application to ornamental fish trade in Peruvian Amazonia, especially in relation to demonstrate locally and regionally what possibilities a healthy ecosystem has in providing ecosystem services and what are their economic benefits (Pierce & Moran 1994). Also, the applicability of the Ecosystem Approach (Work Programme under Convention on Biological Diversity) is analysed. Ornamental fishes in their natural environment can work as a case study when approaches to management of natural systems as a whole are being studied. This study also provides insights into understanding of their role in this ecosystem. The study will enable a development of indicators and criteria for fishing and trade practices and look into possibilities of certification, for example applicability of certification in coral reef fisheries and non-timber forest products and forest certification.

Expected results of the case study

This study should provide understanding of sustainable management of a resource through the following results:

Communal management plans for the resource;

Guidelines and criteria for management and sustainable use of the resource;

Evaluation of feasibility of certification practices for the resource;

Promotion of sustainable ornamental fishery in Peruvian Amazonia among local fishery authorities, local communities, aquarium whole sellers and traders and the general public.

## Conclusions

The case study aims to take part in the ongoing discussion on economic use of natural populations of plants and animals in developing countries and particularly in the tropics. This is one of the focal questions in management of biological resources and a crucial one in the conservation and sustainable use of biodiversity. Also, the research aims to provide insights into questions related to life cycle ecology of tropical fish in general. The study addresses such topics as basic biology and ecology of Brown Discus and Angelfish, critical points of their life cycles, management plan proposals, certification issues, trends and tendencies of ornamental fish trade and a description of the socio-economic reality of the ornamental fishermen and the fish trade in the Peruvian Amazonia. The results of this research can be used as material for the management plan of the Allpahuayo-Mishana protected area.

The results obtained in this case study research of two ornamental fish species are aimed at promoting sustainable management practices, environmental education and market awareness in Peruvian Amazonia and ultimately lead to sustainable use practices for the benefit of local populations – of animals and of people.

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