

Aquarium fisheries as a non-timber forest product: experiences from conservation through community development in North Rupununi District, Guyana

Bicknell J.¹ & Chin C.²

¹ School of Biological Sciences, University of East Anglia, Norwich NR4 7TJ, UK

Corresponding author. Email: j.bicknell@uea.ac.uk; jake.bicknell@googlemail.com

² Iwokrama, 77 High Street, Kingston, Georgetown, Guyana, South America

SUMMARY

Deforestation is one of the major global conservation issues. Solutions are being sought to tackle this ongoing forest loss, including establishment of initiatives to provide new sources of income for local communities that promote the sustainable use of forests in the interest of biodiversity conservation. One such project 'Iwokrama', demonstrates how tropical forests and associated habitats can be sustainably used.

In the central Guyana wetlands of the Rupununi, illegal fishing of arapaima *Arapaima gigas*, had led to a huge reduction in its numbers. Iwokrama responded by initiating the Arapaima Management Plan in 2002. This highlighted the need for another source of local income from fisheries, and a business that undertakes sustainable-harvest of fish for the aquarium trade was developed. Harvesting of a few selected fish species is carried-out by members of the local community who are paid a daily wage. Fishing methods target individual species to avoid incidental by-catch. Four species are primarily caught as they are numerous in the Rupununi and are of high trade value. To ensure ecological and economical sustainability, catch per unit effort is monitored; where this begins to drop for any given species, harvesting is suspended and the population is allowed to recover before harvesting resumes. The project has developed into a self-sustaining business, managed by the community themselves. During 2005, the project reached financial sustainability with current profits of over US\$3,000 feeding back into local community initiatives.

BACKGROUND

In recent years conservationists have sought innovative methods for biodiversity conservation, for example through the sustainable use of natural resources and payment for products derived from them. The concept of sustainable development not only involves products, but also people. Community integration into these kinds of practices is fast becoming essential in realising the goals of such projects, providing benefits for indigenous peoples and ensuring long-term sustainability. Valuing non-timber forest products (NTFP) may be essential in modern conservation practice to mitigate the proximate causes of deforestation, by providing opportunities that yield economic benefits from the resources that local people rely on. In tropical forests, NTFP's include organic honey, natural latex, bamboo, butterfly pupae (Gordon & Ayiamba 2003)

and aquarium fish (Bicknell 2004, Bicknell *et al.* 2005, Chao & Prang 2002). This paper details the lessons learned and reports the successes of an aquarium fish project in the context of NTFP's, and the potentially important role of sustainable development in contemporary biodiversity conservation practices.

Iwokrama: The Iwokrama International Centre for Rainforest Conservation and Development (Iwokrama) forms an international partnership between Guyana and the Commonwealth, to demonstrate how tropical forests can be sustainably used and how this benefits both local communities and biodiversity conservation (Watkins 2005). The 371,000 ha Iwokrama Reserve in central Guyana is situated at the frontier of the Amazon and Guiana Shield eco-regions. The area comprises high biological diversity including the jaguar *Panthera*

onca, harpy eagle *Harpia harpyja* and giant river otter *Pteronura brasiliensis*. It also holds one of the world's largest freshwater fish, the arapaima *Arapaima gigas* (Castello 2004). On Iwokrama's southern border lie the Rupununi wetlands which cover 8,000 km². With approximately 500 fish species these wetlands contain possibly the highest freshwater fish diversity on the planet, for an area of its size (Watkins *et al.* 2005); exceedingly high when compared with other South American drainage systems, such as the Pantanal, which contains around 260 fish species, yet is approximately 15 times larger (S  arez *et al.* 2001).

In 2003, Iwokrama initiated a sustainable, community-based aquarium fisheries business in the North Rupununi. The project forms and tests a model for the utilisation of aquarium fish as an NTFP, and as a means of income generation for indigenous communities. This business comprises an alternative livelihood for local communities, providing a substitute for practices that are detrimental to biodiversity conservation. Fish communities are highly sensitive to forest disturbance and therefore the business that has been established also serves as a direct incentive for the conservation of forests and local fishery resources.

This project serves as a fisheries alternative to the overexploited arapaima fishery, as well as unregulated timber harvesting. Over the last three decades, illegal, but highly profitable, harvesting of arapaima, led to a huge reduction in its numbers. Iwokrama acknowledged the troubles and in response initiated the Arapaima Management Plan in 2002. There was therefore a need for another source of income from fisheries, and the aquarium business was born.

ACTION

Funding: Initial funding came from the UK's Department of International Development Sustainable Human Development Support. This financed the development of a holding station, core equipment, and logistics for the first two harvest periods. Funding for further project development was acquired from the Netherlands Committee for the IUCN (NC-IUCN), Tropical Rainforest Programme.

Community integration: Iwokrama facilitated the formation of the North Rupununi District Development Board (NRDDDB) as a sub-regional NGO representing 14 communities (approximately

3,000 people) within and around the Iwokrama Reserve. The NRDDDB is an indigenous community-based organisation, headed by village leaders and other community members from the North Rupununi District, and is responsible for ensuring the interest of communities in terms of development activities taking place in the District. The NRDDDB are responsible for the logistical management of the aquarium business and the management of profits for the benefit of the North Rupununi communities. Iwokrama provides technical expertise and acts as a link with exporters and international interests.

Species: With funds from the NC-IUCN, Iwokrama commissioned market research in Europe to identify species of market potential in the aquarium industry and establish fair pricing standards. The project concentrates on Loricariid catfish which are of high value on the international aquarium trade. Due to their high value, harvesting levels can be kept low whilst maintaining financial sustainability. Four species are primarily targeted as they are numerous in the Rupununi; (*Hemiancistrus sp.*, *Pseudacanthicus leopardus*, *Hypostomus sp.*, *Ancistrus sp.*).

Harvest methods: Harvesting is carried-out by members of the local community, for which they are paid a daily wage, and employment is shared evenly between interested parties. Indiscriminate fishing methods such as seine netting are not condoned by this project because of the by-catch of non-target species. Fishing methods are therefore targeted towards individual species. Loricariids can be caught using a method locally called 'hogging'; during the day these fish reside in hollow rocks and dead trees, these are lifted above the water level, whereby the fish jump out and into a net held below. This method minimises impacts; unwanted catch and gravid fish are returned to the water unharmed. Harvest periods usually occur in two week stints and approximately every two months, taking place only during the dry season when fishes are found in higher concentrations in the rivers. The rainy season therefore serves as a recovery period for fish populations, and coincides with most spawning activities. Fishing efforts are dispersed throughout locations along a 20 km stretch of the Rupununi River, with each location harvested once per harvest period. Captured fish are kept in a holding station until the shipment is delivered to the Guyanan capital for export, purchased directly from the NRDDDB by the exporter.

CPUE: In an effort to ensure ecological and economical sustainability, catch per unit effort

(CPUE) is monitored. This forms spatial and temporal data of off-takes used to estimate the impacts of harvesting on wild fish populations. These data are used to make management decisions for the business in the interest of sustainability. Where CPUE begins to drop for any given species, harvesting is suspended and the population is allowed to recover before harvesting is resumed.

CONSEQUENCES

Sustainability: After the initial donor-funded phase, the project developed into a self-sustaining community-based business headed by the NRDDB. During 2005, the project reached financial sustainability and continues to export fish to international markets, with current profits of over US\$3,000 since the commencement of the project feeding back into local community initiatives. Iwokrama continues to provide technical expertise, monitor output and provide management recommendations where needed.

CPUE varies considerably between species. *Hemiancistrus sp.* (Fig. 1a) has seen increases in CPUE, and is one of the highest valued fishes in the area. There may therefore be capacity for harvesting levels of this species to increase. In contrast however, CPUE for *Pekoltia sabaji* (Fig. 1c), decreased significantly, until catch was suspended during 2005, after it was concluded that harvest levels were too high. The trend for most species is similar to that of *Pseudacanthicus leopardus* (Fig. 1b), which shows no trend in CPUE. It is therefore likely that harvesting rates for these species are currently sustainable.

Lessons learned: It is likely that many of the experiences encountered on this project are applicable to other projects with the aim of utilising aquarium fisheries as an NTFP (Bicknell *et al.* 2005). Some however, will be relevant within the wider context of community integrated biodiversity conservation, and sustainable utilisation. The longstanding relationship between Iwokrama and the community enabled trust, buy-in and eventual ownership of the idea and process. However, while communities believed in the concept, the benefits may not have always been fully appreciated across parties, perhaps as a result of a lag in the

visualization of monetary benefits. Although it is the intention that benefits be experienced by all, in reality direct benefits may only reach a few individuals.

Arapaima Management Plan: Arapaima numbers have increased since the adoption of the management plan, and efforts are being made to establish a sustainable harvest of this species for the future (Fernandes 2006).

Conclusions: With the increasing problem of deforestation throughout the tropics, solutions are being sought to tackle rapid habitat loss, and provide new sources of income which promote the sustainable use of forests in the interest of biodiversity conservation. With an ever increasing human population, and the transformation from subsistence livelihoods towards western economic culture, natural resources in developing nations are suffering greater pressure than ever before. Carbon offsetting, by purchasing large tracts of forest, will not solve the problems of over-exploitation of forests alone, because direct benefits may not be seen by the people who rely on those resources. The funds gained from carbon offsets might therefore be usefully directed to provide economic benefits from natural resources, by initiating businesses which promote the sustainable use of such resources.

This project emphasises the reasons to further support the development of community-based initiatives that use NTFP's, and serves as a template for community-based initiatives elsewhere, the foundations of which are likely applicable to the sustainable use of NTFP's throughout the developing world. The aquarium trade in the Rupununi is somewhat fortunate due to the abundance of the high-value, low-volume Loricariid catfish, which are key to the project's financial stability. The North Rupununi communities previously lacked custodial ownership to river resources, and the aquarium fisheries business and the adoption of the Arapaima management plan are two significant pilot projects that show the potential for promoting community custodial rights to riverine resources. The integration of the community from the inception was fundamental in ensuring the long-term sustainability of the project. Continual monitoring by Iwokrama is essential in regulating ecological impacts.

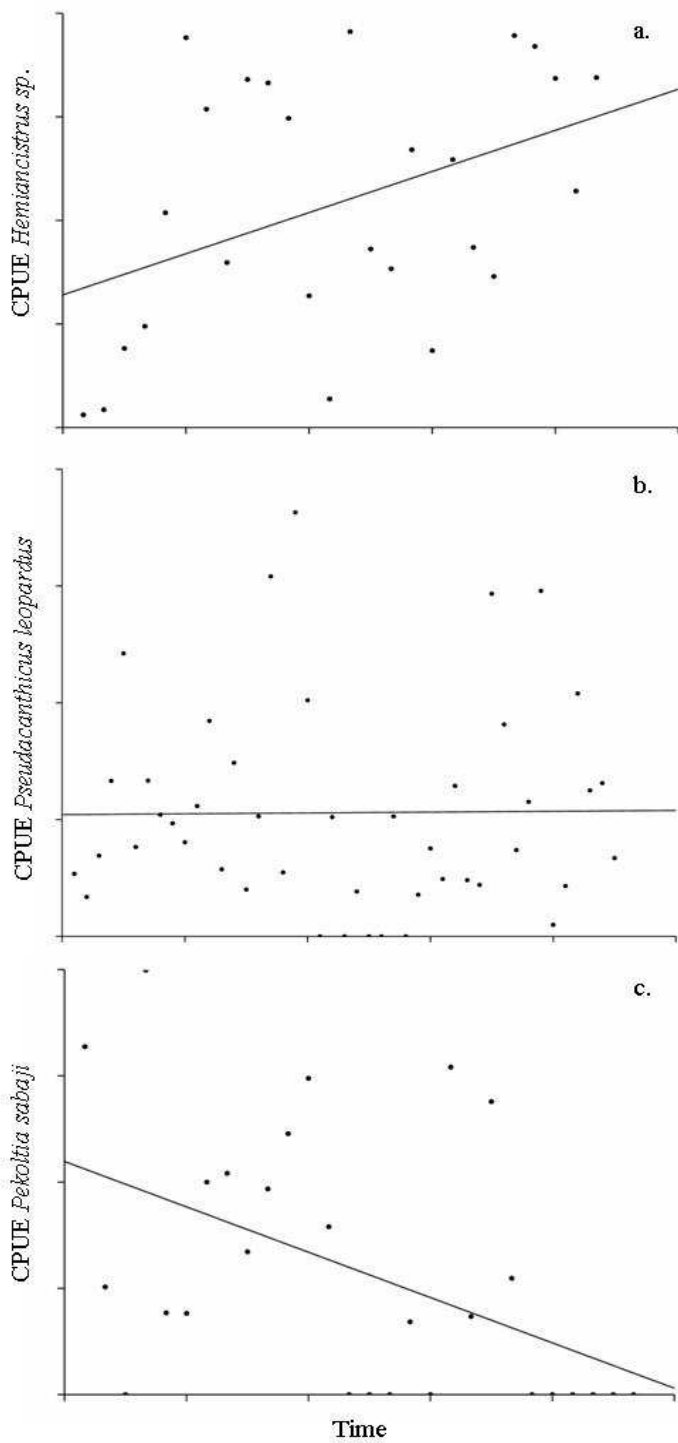


Figure 1. Catch per unit effort (Catch/effort) against time over one harvesting year. a. *Hemiancistrus sp.* (Pearson correlation: $r = 0.41$, $n = 26$, $p = 0.035$), b. *Pseudacanthicus leopardus* ($r = 0.01$, $n = 45$, $p = 0.945$), and c. *Pekoltia sabaji* ($r = -0.471$, $n = 28$, $p = 0.01$). Effort is calculated as # harvesters + session time + # of nets, rocks or dead wood (see harvest methods). One point represents one harvesting session, lasting up to two hours. Time represents the chronological order of each harvesting session.

ACKNOWLEDGEMENTS

The authors wish to thank everybody at the Iwokrama Centre, Rodney Davis and his harvesting team, the NRDDDB, Micheal Patterson, Tejshree Tiwari, Samantha James, Damian Fernandes, and especially Dr. Graham Watkins who conceived the idea.

REFERENCES

Bicknell J. (2004) Sustainable, community-based aquarium fishes in the North Rupununi, Guyana. *OFI Journal*, **44**, 22-24.

Bicknell J., Patterson M. & Tiwari T. (2005) One year on... Community-based aquarium fisheries, Guyana. *OFI Journal*, **48**, 26-28.

Castello L. (2004) A method to count Pirarucu *Arapaima gigas*: fishers, assessment, and management. *North American Journal of Fisheries Management*, **24**, 379-389.

Chao N.L. & Prang G. (2002) A decade of Project Piaba: reflections and prospects. *OFI Journal*, **39**, 24-27.

Fernandes D. (2006) "More eyes watching..." Community-based management of the Arapaima

(*Arapaima gigas*) in central Guyana: "Survival of the Commons: mounting challenges and new realities". 11th Conference of the Int. Assoc. for the Study of Common Property, Bali, Indonesia, June 19-23, 2006. <http://dlc.dlib.indiana.edu/archive/00001894/>

Gordon, I. & Ayiemba W. (2003) Harnessing butterfly biodiversity for improving livelihoods and forest conservation: The Kipepeo Project. *Journal of Environmental Development*, **12**, 82-98.

Súarez Y.R., Petere M. Jr., & Catella A.C. (2001) Factors determining the structure of fish communities in Pantanal lagoons (MS Brazil). *Fisheries Management and Ecology*, **8**, 173-186.

Watkins G. G. (2005) The Iwokrama Centre and forest: Introduction to special papers. *Proceedings of the Academy of Natural Sciences of Philadelphia*, **154**, 1 - 5.

Watkins G.G., Saul W., Holm E., Watson C., Arjoon D. & Bicknell J. (2005) The fish fauna of the Iwokrama Forest. *Proceedings of the Academy of Natural Sciences of Philadelphia*, **154**, 39-53.

For more information about the Iwokrama project please see:

www.iwokrama.org/business/aquariumfish.htm

Conservation Evidence is an open-access online journal devoted to publishing the evidence on the effectiveness of management interventions. The pdf is free to circulate or add to other websites. The other papers from Conservation Evidence are available from the website www.ConservationEvidence.com