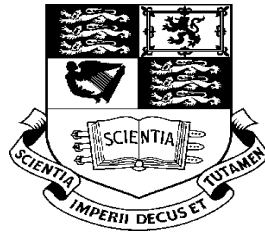




Darwin Initiative for the Survival of Species

Annual Report

***Fisheries Management for Biodiversity
Conservation in the Brazilian Amazon***



Imperial College

London UK



Instituto de Pesquisa Ambiental da Amazonia

Belem Brazil

1. Darwin Project Information

Project title	<i>Fisheries Management for Biodiversity Conservation in the Brazilian Amazon</i>
Countries	<i>UK, Brazil</i>
Contractor	<i>Imperial College, London</i>
Project Reference No.	<i>08/126</i>
Grant Value	<i>£ 121,347</i>
Start/Finishing dates	<i>01/04/99-30/06/02 (including agreed 3 months extension)</i>
Reporting period	<i>01/04/01-31/03/02</i>

2. Project Background

While public interest has concentrated on the destruction of the Amazon rainforest, another great tropical frontier, the Amazon floodplain, is also under increasing pressure. Though comprising only a small fraction of the basin, the floodplains of the Amazon river system have an importance in terms of biodiversity, economic activity, and the ecological services that the floodplains perform that far outweighs their relative area. The sustainable development of fisheries plays a key role in the conservation of floodplain biodiversity, firstly because the Amazon fish stocks are the most diverse found in any river system in the world, and secondly because the fisheries depend on the ecological services of the floodplain system and provide a major economic incentive for the conservation of this key habitat.

Amazon floodplain fisheries are currently under threat from two sources: direct fishing pressure and habitat modification. Over the last 30 years, Amazon fisheries have undergone dramatic changes. The introduction of modern fishing technology, combined with the growth of urban and export markets, have led to unprecedented pressure on Amazon fish stocks. Stocks of several commercially important species are considered overexploited, and locally many other species are also under excessive pressure. Amazon fisheries are exploited commercially by mobile, mostly urban-based fishers, and for subsistence by local communities in the varzea. The expansion of commercial fishing has resulted in increasing levels of competition and conflict between the two groups, and communities have increasingly sought to restrict the exploitation of local floodplain fisheries through community management schemes.

If present trends continue, the likelihood is great that Amazonian fisheries will follow the same path of overexploitation that other major river systems of the world have experienced, resulting in the progressive impoverishment of the fish fauna and ultimately the collapse of the regional fishery. Habitat modification for transport, flood control, cattle ranching etc. is potentially a far greater threat to floodplain biodiversity, including the diversity of fish stocks, than excessive fishing pressure. However, the sustainable development of the fisheries and the consequent generation

of a substantial economic rent from the intact floodplain system may in itself provide an important incentive to conserve floodplain habitats.

This is a critical period in the process of fisheries development, and the future of amazonian fisheries will depend in a large part on the policies which are developed and their effectiveness in reconciling the complementary objectives of conserving biodiversity and taking advantage of the long term productive potential of the floodplain ecosystem. While considerable research effort has been expended on understanding the ecology of amazon fisheries, the economics of fishing and fisheries management has received little attention. As a result, biological conservation needs have been identified, but a limited understanding of the actual fisheries has proved a major obstacle to the development of effective conservation policies.

This project will contribute to the development effective conservation policies through the evaluation of alternative policies in terms of their likely impacts on fish stocks and the levels of direct and indirect income and employment generated by the commercial fisheries. In this way, the project will also quantify the economic benefits to be derived from development policies which seek to maintain the productivity of fisheries and the ecological integrity of floodplain habitat.

3. Project Objectives

The central objective of the project is the evaluation of fisheries management approaches to the conservation of floodplain (varzea) habitats and the associated biodiversity. The project recognises that the sustainable development of commercial fisheries is of key importance to biodiversity conservation in the varzea systems, in particular with respect to the conservation of varzea habitats upon which the fishery depends and to which it adds economic value.

This principal objective will be addressed through the achievement of a set of discrete outputs as follows:

- (1) Analysis of the economic strategies of the different types of commercial fishers
- (2) Analysis of the responses of fishers to alternative management measures
- (3) Analysis of the role of the fisheries sector within the amazon regional economy.
- (4) Development of a bio-socio-economic model to predict the responses of fisheries to alternative management regimes
- (5) Evaluation of management regimes

Note that these outputs have been broadened from those included in the original memorandum to include commercial as well as subsistence fishers.

Progress

4.1 Progress prior to beginning of reporting period

Following initial reviews and data collection on the commercial fisheries, a project review meeting with the Brazilian partners was held in November 1999. Current fisheries management issues in the Amazon were discussed in depth to focus the project on key issues. Government policy now favours local community management of floodplain fisheries, but the overall benefits and costs of such schemes and consequences for biodiversity conservation are poorly known. This was highlighted as a key issue to be investigated in the project.

In order to evaluate the impacts of community management agreements on economic benefits generated by the fisheries and the resultant incentives for conservation, information on fishing patterns and related socio-economic data for local communities is required in addition to the existing data on urban-based commercial fishers. This requirement has broadened the project considerably from its original focus on commercial fishers. An extensive household survey covering 18 varzea communities was designed and implemented. Interviews covered details of fishing activities and catches as well as agricultural and other activities, asset ownership, and basic social characteristics. The survey allows a rigorous evaluation of the effects of management agreements on the productivity of local fisheries. The survey was continued into the present reporting period with a

Socio-economic data collected on commercial fishers landing in four major ports of the basin (Tefe, Manaus, Santarem and Belem) have been analysed to establish the degree of regional differentiation in key fleet characteristics and in economic efficiency. The characterisation and economic analysis of regional commercial fishing fleets has been completed as planned, and a paper submitted. This first basin-scale analysis of Amazon fisheries has identified regional differences between the fleets with important implications for management. The fishing industry in the lower Amazon around Santarem is unusual in that it consists predominantly of rural-based owner/operators, who are affiliated with a formal industry organisation (Colonia) and 40% of whom have sources of income other than fishing. These characteristics have obviously facilitated collective action in rural areas towards community management of fisheries, and indeed such agreements are exceptionally common in the area. By contrast, commercial fleets in all other regions consist predominantly of urban-based fishers, boats are usually skippered by persons other than the owner, levels of affiliation to formal organisations are lower, and less than 20% have alternative sources of income. These characteristics pitch the commercial fishers in opposition to local management initiatives. However, there are indications that commercial fishing is increasingly being taken up by varzea residents in the upper Amazon, so that the urban dominance in this area may diminish. The economic analysis shows that overall, the fishery is characterised by diminishing returns to scale, i.e. the smaller boats are more economically efficient overall. Furthermore, the partial income elasticity of labour is much higher than that of capital, indicating good potential for local varzea fishers with limited access to capital. Both these results imply comparatively good prospects for locally-based fishers in varzea areas where capital is scarce and labour relatively abundant. The short-run production function analysis also showed significant regional effects on returns even when all differences in inputs had been accounted for. This may reflect differences in the overall level of exploitation and resulting stock abundance, an issue that will be further investigated with the full bio-economic model.

4.2 Progress during reporting period

4.2.1 Activities

Activities during the reporting period have concentrated on the following areas: a survey to quantify the overall contribution of the fisheries sector to the regional economy, household surveys in rural communities to quantify the impacts of co-management agreements on local resources and household economics, and a scoping workshop to inform policy scenarios to be evaluated in the last phase of the project.

4.2.2 Results

Fisheries sector study

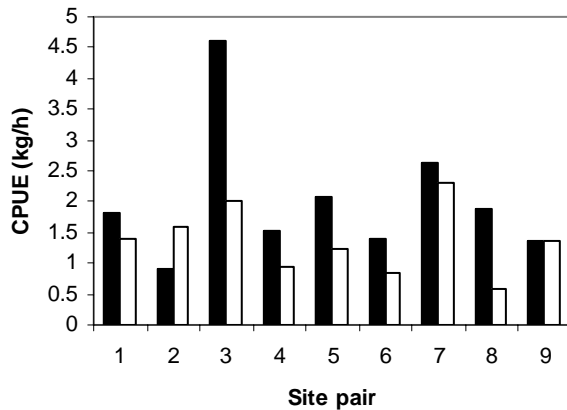
A survey of the fisheries post-harvest and support sector in the Amazon basin was completed and analysed. The objective of this study was to determine the economic importance of the fisheries support sector along the Amazon and Solimões river. This was done by estimating total income and employment in support and processing sectors (fish processing plants, fishing equipment stores, gas stations, restaurants, ice factories, and shipyards). Results show that the fishing support sector generates an income of 120 million US\$, and 8000 jobs. The largest share of this (70% of income and 50% of jobs) is generated by the fish processing plants. The total income in (cash and in kind) generated by fishermen has been estimated at about 200 million US\$, giving a gross product of the sector of about 320 million US\$. Hence the support and processing sector adds substantially to the economic value of the fisheries sector in the Amazon.

Data from this survey are being integrated with economic data collected on the mobile commercial and local (subsistence and commercial) fishing industries to obtain an estimate of the total value of the fisheries sector in the Amazon. The value of this sector is being compared with the value of industries that threaten the ecological integrity of the varzea system and therefore fisheries productivity, such as logging and cattle ranching. Preliminary results suggest that the sustainable benefits from the fisheries sector may well exceed those provided by the other sectors. A paper has been prepared for submission, pending a final review of the comparative information on the value of the logging and ranching industries.

Impacts of co-management agreements on lake fisheries

A survey was conducted in 18 paired communities with and without co-management agreements (i.e. 9 pairs of a co-managed and non-managed fishery each). Rules in co-managed fisheries typically comprised restrictions on the use of gill nets, daily catch limits and limits on the size of boats. A total of 259 households (13 or 18 per community) were surveyed to estimate local fishing effort and catch. Non-managed fisheries were subject to additional fishing by external commercial boats which could not be quantified independently, but has been accounted for in the analysis. Results showed a reasonable degree of perceived and actual compliance within the communities with co-management agreements. The productivity (catch per unit of effort) of managed fisheries was significantly higher, by about 60%, than that of non-managed fisheries even though no significant difference in household fishing effort was detected. An empirical model relating fishing effort and yield per unit area was derived for a sub-set of lakes (both managed and non-managed) where lake area could be clearly delineated and fishing was carried out predominantly by communities covered in the survey (i.e. excluding lakes shared by several communities). Fishing effort explained much of the variation in yield between lakes. Managed lakes showed significantly higher levels of yield and productivity (by about 70%) than non-managed lakes for the same level of fishing effort. This difference is likely to reflect the additional, non-quantified fishing effort and catch by external commercial boats in

non-managed lakes. We conclude that the co-management agreements have brought significant yield and productivity benefits to the communities implementing them, largely as a result of reduced commercial fishing by outsiders. The yield predictive model derived in this study provides a quantitative tool for assessing effects of effort regulation within co-management fisheries.



Comparison of fisheries productivity (catch per unit of effort, CPUE) in communities with and without co-management agreements. Communities with (solid bars) and without (open bars) co-management agreements.

Policy workshop

A policy workshop was held during 27-28 November 2001 in Belem. The workshop brought together representatives of all major stakeholders (government, fisher and community representatives as well as scientists) to review management issues and strategies. The workshop also provided opportunities for stakeholders to identify specific questions to be addressed in the bio-economic modelling work and the final workshop. Previous workshops on Amazon fisheries management have focused on biological assessment problems rather than wider management and conservation issues. The workshop was arranged so as to allow different stakeholder groups to discuss and consolidate their perspectives on management and conservation issues in small groups before plenary synthesis sessions. This approach was much appreciated by stakeholders because it allowed a balanced representation of their interests.



Darwin Fellow Oriana Almeida synthesising results during the policy workshop in Belem.

Key issues identified in the workshop for consideration in the bio-economic analysis include the effects of co-management on the commercial and subsistence users of lake fisheries, the timing of closed seasons (regarded as unsatisfactory by fishers), the need to adapt management rules to account for regional differences in ecological and socio-economic characteristics of the fisheries, and lack of communication and cooperation between stakeholders in decision making. The project is well on its way to addressing many of key questions raised. The availability of a bio-economic model to evaluate management scenarios and the final workshop planned with a wide range of stakeholders are expected to contribute to improved communication between stakeholders.

4.2.3 Progress against milestones

Progress is outlined below against the project milestones defined for 2001/02, including outstanding milestones from 2000/01:

- 1) Analysis of the responses of fishers to management measures and other external conditions completed (2001 milestone). This milestone has been largely met, with the analysis of fisheries within the livelihoods context of floodplain residents being finalised at present.
- 2) Complete the analysis of role of the fisheries sector in the Amazon regional economy (2001 milestone). This milestone has been met.
- 3) First workshop. This milestone has been met.
- 4) Formulate Socio-economic sub-models. This milestone has been largely met, with the analysis of fisheries within the livelihoods context of floodplain residents being finalised at present.
- 5) Develop stock dynamics models. This milestone has been met. Some further work on the stock dynamics model for fisheries in the main river channel may be required as part of the continuing model development (see (6)).
- 6) Combine socio-economic and stock dynamics models. This milestone has not been met, but work is progressing well.
- 7) Evaluation of management strategies. This milestone has not been met, being dependent on the achievement of (6).
- 8) Second workshop. This milestone has not been met, being dependent on the achievement of (7).

Although the last three milestones are outstanding as a result of a substantially broadened work plan, progress is rapid as the various threads of the project are coming together. We expect to meet all milestones within the agreed extension, and certainly by the time the final report is due in the end of September.

4.3 Workplan for final year of project

Two major activities are remaining for the final months of the project:

- 1) The full bio-economic model will be formulated and analysed in April-June 2002. This model will integrate the results of all previous analyses with existing stock dynamics data to allow the assessment of management strategies at a regional level.
- 2) Evaluation of management strategies through modelling and a stakeholder workshop in July/August 2002.

4. Partnerships

Collaboration with the Brazilian partner institution IPAM has remained excellent. IPAM staff have carried out field surveys in collaboration with London-based staff, and maintained contact with key stakeholders in fishing communities, government institutions and NGOs.

5. Impact and Sustainability

The project has interacted with a wide range of stakeholders, including local community organisations, commercial fisher's cooperatives, governmental and non-governmental organisations and the international PPG7 programme. The first project workshop was attended by representatives of all these organisations. The second workshop planned for July/August will involve all relevant stakeholders in discussions on project results and their policy implications. Workshop results will be documented in a concise policy paper in Portuguese.

After the end of the project, results will be further promoted and integrated into ongoing conservation work by the project's Brazilian partner, IPAM. IPAM has just received a 5 year grant from DFID/WWF to continue its work on the conservation of the varzea. IPAM will create a network of managed lakes that will be monitored continuously and will offer fisheries products from sustainably managed lakes for national and international markets. At the same time, IPAM received funding from PPG7 to create a centre for artisanal fishermen in the lower Amazon. The centre will offer courses on legislation, organization, fish biology, accounting, and processing, to strength the communities in preparing and implement fishing agreements.

Results from the current Darwin project proved vital policy and management support for the above initiatives, providing the first integrated analysis of the impacts of co-management agreements on the local fishers and mobile commercial fleets, and ultimately the value of fisheries production supported by the varzea environment.

The final modelling work in the project is carried out in direct collaboration with the federal environmental agency (IBAMA) and the PPG7 project, giving both organizations co-ownership of the results and thereby promoting adoption.

6. Outputs, Outcomes and Dissemination

Table 1. Project Outputs (According to Standard Output Measures)

Code No.	Quantity	Description
11B	2	Papers on the impacts of co-management agreements on lake fisheries, and on the role of the fisheries sector in the regional economy of the Brazilian Amazon submitted (latter paper pending final revision of comparative figures)
14A	1	Policy workshop 1
8	24	Weeks spent in the field in Brazil by UK staff

The paper on bio-economic modelling, the policy evaluation report and the final workshop have been delayed as explained above, but all outputs will be achieved by the deadline for final report submission.

The total time spent in Brazil by UK project staff has again been higher than planned, due to the additional survey work carried out in local communities.

Table 2: Publications

Type * (e.g. journals, manual, CDs)	Detail (title, author, year)	Publishers (name, city)	Available from (e.g. contact address, website)	Cost £
Journal Article	O.T. Almeida, D.G. McGrath and M.L. Ruffino (2001): The commercial fisheries of the lower Amazon: an economic analysis. Fisheries Management and Ecology 8:253-269	Blackwell Science	o.almeida@ic.ac.uk	-
Journal Article	O.T. Almeida, K.Lorenzen, and D.G. McGrath (2002): Commercial fishing in the Brazilian Amazon: regional differentiation in fleet characteristics and economic efficiency. Fisheries Management and Ecology 9 (in press)	Blackwell Science	o.almeida@ic.ac.uk	-
Conference paper	O. Almeida, K. Lorenzen & D. McGrath (2002) Impact of co-management agreements on the exploitation and productivity of floodplain lake fisheries in the Lower Amazon. Paper presented at the Ninth Biennial Conference of the IASCP. Zimbabwe. 17- 21 June 2002.	International Association for the Study of Common Property (IASCP)	www.iascp.org	-

7. Project Expenditure

Table 3: Project expenditure during the reporting period

Item	Budget	Expenditure
Salaries (specify)		
Rent ,rates heating lighting etc		
Office administration costs		
Capital items/equipment		
Others		
Total		

The project expenditure has remained in line with the agreed budget.

8. Monitoring, Evaluation and Lessons

Progress is being monitored regularly by the project partners.

9. Author(s) / Date

Dr Kai Lorenzen, 12 May 2002