# *Darwin Initiative Annual Report*

**Important note:** *To be completed with reference to the Reporting Guidance Notes for Project Leaders: it is expected that this report will be about 10 pages in length, excluding annexes*

**Submission Deadline: 30 April**

## Darwin Project Information

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| Project Reference | 20-001 |
| Project Title | Managing the landscape-scale sustainability of Amazonian freshwater fisheries |
| Host Country/ies | Brazil |
| Contract Holder Institution | University of East Anglia (UEA) |
| Partner institutions | SDS/CEUC, ICMBio, UFAM, INPA, UFRN, ASPROC, AMARU, COLPESCA (all in Brazil) |
| Darwin Grant Value | £91,172 (Year 1)<br>£253,508 (3 years) |
| Start/end dates of project | 1 July 2013 – 31 April 2016 |
| Reporting period | Annual Report 1: 1 July 2013 – 31 April 2014 |
| Project Leader name | *Prof Carlos Peres (UEA)* |
| Project website | Not yet available |
| Report author(s) and date | Carlos Peres and João Vitor Silva |

## 1. Project Rationale

Around one third of all vertebrate species worldwide are freshwater organisms. With rapidly increasing human populations, freshwater bodies and wetlands are rapidly becoming the most threatened ecosystems worldwide, particularly in the tropics. Lowland Amazonia supports the largest expanses of seasonally flooded forests, the largest and most valuable freshwater fishery, and the most species-rich fish fauna on Earth. Aquatic vertebrates (including fish, turtles and crocodilians) provide ~75% of the animal protein demands of rural Amazonians, who consume 369 – 800 g of fish person$^{-1}$ day$^{-1}$, the highest per-capita fish protein intake recorded anywhere. Consequently, inland fisheries along major tributaries of the Amazon continue to be severely overexploited, particularly high-value large-bodied slow life-history species that are highly desirable by commercial extractivists. Yet basic life-history data and stock-recruitment relationships necessary to implement effective quantitative fisheries assessments and management are still lacking.

This Darwin Project aims to develop a spatially-explicit set of guidelines to inform landscape-scale fishery management protocols that can be applied to any major watershed across all lowland Amazonian countries. In particular, we have been using a network of 83 large oxbow lakes and 97 sandy fluvial beaches along the second-largest white-water tributary of the Amazon to (1) consolidate 'fishing agreements' to zone the spatial structure of commercial and subsistence fishing activities; (2) understand the relationship between spawning biomass and fish recruitment, and how these stock-recruitment relationships depend

on baseline environmental variables such as lake size, productivity, and macrophyte cover; (3) understand the demographic importance of 'no-take' areas (i.e. strictly protected lakes and fluvial beaches) in maintaining a sustainable fishery and the spatial dynamics of commercial fishing boats; (4) resolve political conflicts between commercial and subsistence fisheries; and (5) assist government agencies in both developing exploitation management protocols for commercially valuable fish and *Podocnemis* turtle species and dealing with key human-wildlife conflicts in aquatic ecosystems.

This study (effectively ongoing for only 10 months) has been conducted along a 492-km section of the Central Juruá basin within and around two contiguous sustainable-use forest reserves (Figure 1). The Juruá River is the second-largest white-water tributary of the Amazonas River (Solimões), within the ~1.6 million $km^2$ State of Amazonas, Brazil. The area contains two main forest types: seasonally flooded (*várzea*) forests along the river channel and higher elevation (*terra-firme*) forests which are never exposed to the seasonal flood pulse; and unlikely other major tributaries of the Amazon, these floodplain forests are relatively intact (Figure 2). The alternating wet and dry seasons and corresponding fluctuations in floodplain water-level are between January and June, and August and November, respectively.

The federally-managed Médio Juruá Extractive Reserve (RESEX Médio Juruá) was created in 1997. Situated on the left bank of the river (5º33'54"S, 67º42'47"W) this 253,227-hectare reserve is inhabited by nearly 2000 people living across 13 well-established communities. The more sparsely populated state-managed 632,949 hectare Uacari Sustainable Development Reserve (RDS de Uacari) (5º43'58"S , 67º46'53"W), which was created in 2005, is inhabited by some 1200 people across 32 communities. Local livelihoods in both reserves are sustained primarily by floodplain and river channel fisheries, subsistence agriculture and nontimber forest products, such as oils, seeds and palm fruits. Although these two reserves have very different higher management structures, they represent a continuum of human population density and are virtually identical in their natural environments and the extractive livelihood patterns of local communities. We therefore decided to work with both of these reserves even though this involves a much larger area and doubling the amount of project bureaucracy and communication with environmental agencies.

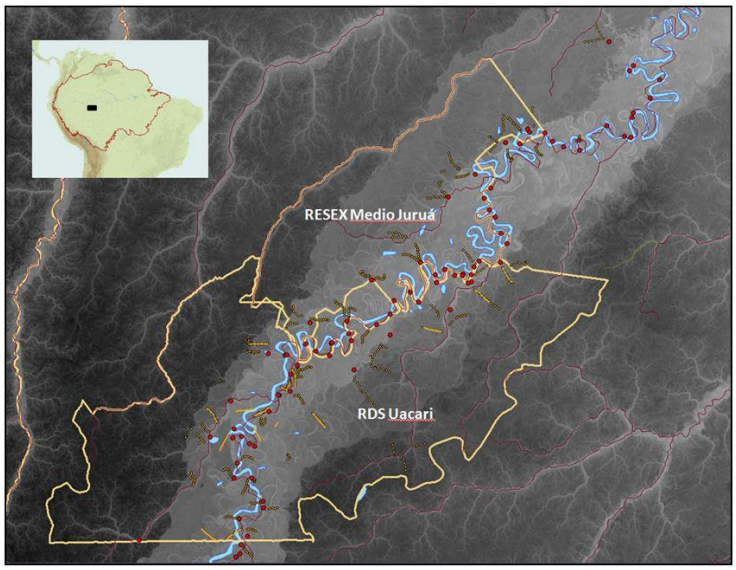



**Figure 1.** Core study area of Darwin Initiative Project 20-001 along the Juruá River of Western Brazilian Amazonia. Local communities within the two focal forest reserves are indicated by red circles.

**Figure 2.** *Aerial views of* terra firme *and* várzea *forests in the Médio Juruá region.*

## 2. Project Partnerships

A notable feature of this project is the strong and welcoming working relationship with the institutions involved in the management of natural resources in the project area. This partnership has been built by utilising the lengthy field experience of our staff in the area, and collaborative ties with certain individuals that now go back as far as 7 years. As the project has been designed considering the demands of the partners, it was relatively easy to build a strong partnership considering both bottom-up demands and top-down constraints. Next, we describe our partners as following:

**A- SDS/CEUC** – Secretaria do Meio Ambiente e Desenvolvimento Sustentável do Amazonas e Centro Estadual de Unidades de Conservação (http://www.sds.am.gov.br).

This state institution is based in the state capital (Manaus) and is responsible for the bewildering task of managing a large number of state-level protected areas across the State of Amazonas. This partnership is strategic and fundamental to the project objectives, because SDS/CEUC hopes to be able to roll out the applied knowledge generated by our project to other sustainable use forest reserves within Amazonas. All project activities undergo a technical evaluation by this partner, who is given ample freedom to discuss the proposals and objectives. In addition to legal support to work within their jurisdiction, SDS/CEUC also helps with the logistics of the project as it occasionally provides small boats for field activities.

**B- ICMBio** – Instituto Chico Mendes de Conservação da Biodiversidade (http://www.icmbio.gov.br/portal/)

This federal government institution is responsible for managing the federal protected area where we work (RESEX Médio Juruá). We also have a strong relationship with this partner which participates in the project in a similar way to SDS/CEUC. All project activities are sent to and analysed by this partner. This will also become a strategic partner as the project advances because, with ICMBio's oversight, it will be possible to eventually scale up and apply the management models that can be achieved with this project to other protected areas in the other eight states of Brazilian Amazonia, other than the state of Amazonas.

**C- UFAM** – Universidade Federal do Amazonas (http://www.ufam.edu.br/)

The Universidade Federal do Amazonas is the oldest in Brazil. It is an important partner of the Project because project members based therein are responsible for the freshwater turtle ecology & management component of the project. Through *Projeto Pé de Pincha* (http://pedepincha.com.br/) UFAM has been studying the ecology and management of freshwater turtles for 15 years, and this project has enabled these activities to be extended to the Juruá. They will contribute knowledge on the seasonal movements, foraging ecology, and

management freshwater turtles, proposed by our project. These activities are intimately linked to zoning and protection of fluvial beaches along the Juruá during the critical egg-laying season of two large-bodies species of *Podocnemis* turtles.

**D- INPA**- Instituto Nacional de Pesquisas do Amazonas (https://www.inpa.gov.br/)

INPA is the largest tropical ecology research institute in the world and has extensive research experience in Amazonia (although most of the activities are concentrated around Manaus in the Central Brazilian Amazon). INPA has been providing the laboratory structure for all limnological analysis, and more recent research ties have been formed with fish ecology and fisheries researchers. INPA will also provide an MSc level student (Talles Colaço, to be co-supervised by Prof CA Peres and Dr Sidineia Amadio) who will work on ecology and management of Tambaqui (*Colossoma macropomum)* and its closely related species, Pirapitinga *(Piaractus brachypomus),* the commercially most important fish species in the Juruá fisheries (Fig. 3).

**E- UFRN** – Universidade Federal do Rio Grande do Norte (http://www.sistemas.ufrn.br/)

UFRN has recently excelled in Brazil in the area of ecology. As a counterpart, UFRN provides a Brazilian doctoral scholarship to a core project member. His dissertation involves the management of aquatic resources of the Juruá floodplains and the field and lab work are being funded by this project.

**F- ASPROC** – Associação dos Produtores Rurais de Carauari (http://www.asproc.org.br/)

ASPROC is the strongest local partner of the project, and operates as a spokesperson for local natural resource users because it is a grassroots, community-based organization which was borne out of local demands following the emancipation of former rubber tappers from powerful rubber landlords and local trade monopolies and middlemen. ASPROC is co-leading several programs of natural resource management, which are guided by a constant dialogue with project members. This partner strongly supports work on the ecology and management of the iconic *Arapaima* fish, and helps us build a close relationship with community leaders. The *Arapaima* ecology and management program has become a key cornerstone of the project, and is intimately related to the oxbow lake ecology and management components of the project.

**G- AMARU** – Associação dos Moradores das Reservas (http://amaru.org.br/)

Similarly to ASPROC, AMARU co-organizes the practice of resource management in rural communities where our project has been implemented. This is also a key local partnership for the implementation of our activities. AMARU is closely in touch with local communities, and constantly helps us think about the demands and needs of the local population, so we can build our goals based on two important, but often diametrically opposite challenges in modern conservation science and practice: biodiversity conservation and improving the standards of living of traditional populations.

**H- COLPESCA** – Colônia de Pesca de Carauari (Cooperative/Sindicate of Fishermen of Carauarí)

The township of Carauari operates as a convergence point for a fleet of over 800 variable-sized fishing boats that largely trades chilled fish with a few wholesale buyers, which export large amounts of fish to large urban markets such as Manaus (2 million people). This partner is vital to the success of our work, and it was an enormous political challenge to initially earn their trust and then encourage them to collaborate with our project, likely due to suspicion and resentment of outside researchers who may be mistrusted for blowing the proverbial whistle on commercial fishing activities. There is a large historical conflict in the Juruá, where COLPESCA fishermen often violate property rights and transgress community boundaries of oxbow lakes located in protected areas in order to plunder fish stocks. Our project is opening the doors for a more

formal dialogue and through our project COLPESCA commercial scale fishermen are presently working with local subsistence fishermen living within the project reserves. We intend to support and develop a fisheries protocol that avoids or minimises stakeholder conflicts, promotes the population recovery of harvest-sensitive fish stocks, and allows the wide acceptance of a large-scale spatial mosaic of locally-enforced fishing activities and fishing rights, whereby the land(water)scape stock renewal and source-sink dynamics can compensate for depletion effects induced by varying deployment and selectivity of fishing practices. This is crucial because fish has now become the largest earner of monetary revenues in the Carauari municipal county, and commercial fishermen, who are themselves destitute and oppressed by powerful merchants up the trade chain, cannot be entirely excluded from the basin-wide spatial equation of fishery management. They also represent an important electorate, thereby harnessing support from local politicians.

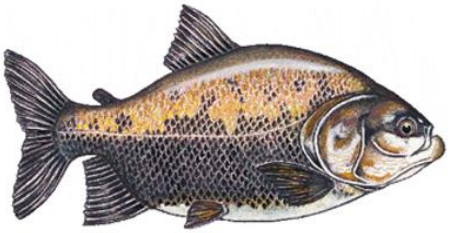
a)  b) 

**Fig. 3.** *Colossoma macropomum* (a) and *Piaractus brachypomus* (b). Source: IBAMA/PNDPA

# 3. Project Progress

## 3.1 Progress in carrying out project activities

### Output 1: Local empowerment and consolidation of an oxbow lake management system across the entire study landscape

At first we conducted a detailed mapping effort of the most important fishing environments and sites both within and outside the protected areas, along the 500 km of the Juruá river where the project roaming activities are based. These environments include lakes, perennial streams, floodplains, the anastomosing system of paranãs and leveés, and others freshwater environments. This is a vast area because the floodplains throughout our study region (which are inundated by a persistent flood pulse lasting some 6 months of the year) exceeds 40 km in average width. At present we have mapped over 300 sites where important local fisheries and fishing activities can occur.

We have implemented a household-level survey of all types of aquatic resources extracted across ~400 households distributed across 35 local communities. These samples will become part of a strong database and it will enable us to investigate fisheries best-practices and the biological and landscape characteristics of key fish stocks. Based on a systematic series of local interviews, we selected 64 key oxbow lakes, which have experienced different levels of fishing pressure according to broad management category classes, and are characterized by different geochemical and limnological attributes that presumably control fish productivity (although this is being investigated). Many environmental variables have been collected in these lakes: we sampled a total of 64 oxbow lakes (size range = 3 – 550 ha) and this was repeated during both the dry and wet seasons. Environmental (limnological and spatial) variables (covariates) that were measured included: distance to the nearest community; distance to the Juruá river channel; distance to the nearest urban center (Carauari); shape and perimeter; water transparency; temperature; sediment load; conductivity; chlorophyll concentration; dissolved oxygen, and key macronutrients (nitrogen and phosphorus availability).

We hypothesize that these variables largely control the baseline variation in fish productivity for both subsistence and commercial fisheries along the Rio Juruá as oxbow lakes represent critical feeding and spawning habitat for several commercially important fish species. These

limnological variables may therefore interact with some of the lake management issues that form the core of the spatial zoning of harvesting areas that we are trying to understand.

**Output 2. Design, local empowerment, consolidation and expansion of the spatial management system addressing freshwater turtles and ovipositing sites on fluvial sandy beaches**

The protection of sandy beaches forms a key practice of river turtle management and have allowed the successful emergence of over 150,000 hatchlings per year of two species of freshwater turtles (*Podocnemis expansa* and *Podocnemis unifilis*), since 2007 (and this was largely instigated by our previous Darwin Project: Ref No. 16-001). The problem is that these sandy beaches are inside the protected areas, therefore any co-benefits of protection will become very localized and serve the interests of local communities that are already advantaged by other protected areas benefits. We therefore aim to expand a number of project activities to areas outside those two reserves.

At first, we mapped all protected and unprotected beaches along the main Juruá river channel to consider a proposal of sand beach protection using a landscape scale approach. We then began a negotiation scheme with fishermen living outside the protected areas with the help of the local Fishermen Coop (COLPESCA). It turns out that these fishermen were also very interested in initiating the protection of sandy beaches outside formal protected areas. However, we had the added challenge of the financial sustainability of these expanded activities given the project resources, because the continuous beach vigilance effort carried out by our so-called “beach monitors” had to be paid for in cash or in kind (i.e. food supplies) and at that moment we do not yet know which institution, if any, could cover these costs. We are currently contemplating whether we can pay for this ourselves, as there is little subregional interest to fund or promote sustainable use activities outside formal protected areas.

Over the next year, we are going to quantify the ecosystem scale effects of the sandy beach protection to other groups of vertebrates (in addition to turtles) as well as key ecological processes like predation and competition. We will also implement a study of the ecology and movements of freshwater turtles which are highly seasonal in these floodplain environments.

**Output 3. Design, local empowerment, and expansion of the management system addressing *Arapaima* fisheries in both oxbow lakes and the river channel**

Results are still very preliminary but so far we have found a dramatic effect of community-based management on arapaima population size. Arapaima fish are piscivores and quasi-apex predators within oxbows. They also yield high ecological, economic and cultural value to Amazonian true floodplains and are iconic elements of these environments. In the past adults could attain up to 4 m in total length and >200 kg in weigh (Fig. 4), though currently large specimens rarely exceed 2.5m and 90kg due to overfishing. Arapaima management is increasing in the Amazon, and has high potential to become an important tool for biodiversity conservation and improve the quality of life of local communities. Arapaima management is a strong window of opportunity to harmonize the interests of biodiversity conservation with the goals of poverty alleviation. As such, protected oxbow lakes have recently become something similar to a bank account. Considering all the management rules, we found an average of around US$9,000 available in these lakes in arapaima catches alone, cand this value can increase every year as we enhance lake protection with the help of local communities and our partners.

Fig. 4. An adult male Pirarucú (Arapaima gigas), reaching 4m in length.

Our project has been providing technical training to both artisanal and commercial fishermen of the central Rio Juruá region. The arapaima dry-season counts last year, for example, was carried out across 80 lakes and was an excellent opportunity to train young fisherman without

experience in arapaima management. This is also an opportunity to disseminate project philosophy and collaborative spirit. We also conducted arapaima counts outside both of our target reserves. This was a good opportunity to involve outsiders in the process of natural resourcemanagement. We provided technical training to the leader of the *colonia de pesca* (COLPESCA) in Carauari and over 20 fisherman who live in three local communities outside the reserves.

We started a multilateral negotiation process to extend the implementation of the fishery management protocol to disadvantaged areas outside the reserves. This was a huge challenge because fishing communities outsider the reserves not have the same level of social organization that the fishermen who live in protected areas have. So we are trying to provide technical support from the bottom up to implement the system of lake protection outside communities, although much remains to be done. At the moment, we have improved the protection of only 6 large lakes which provide both subsistence and traded catches for three communities, including around 60 people. This will be developed in Year 2 of the project.

**Output 4. Design and establishment of a conflict-resolution management plan considering large vertebrates perceived to be "problem species" including key apex predators (e.g. *Pteronura* and *Melanosuchus*)**

We started a research project with Black Cayman, a large apex predator that grows to nearly 6 m in the Medio Juruá region. This represents a key human-wildlife conflict in much of lowland Amazonia. Black caimans have maimed or claimed the lives of some 10 people in our section of the Juruá over the last 7 years, and they represent a large deterrent to extractive activities in several problem areas. At first, we trained a local assistant who sampled more than 70 areas, including lakes, the main river and tributaries. Another project staff member is also recording data on a daily basis on the effects of cayman attacks on fishing gear, especially gill-nets. Our surveys so far have shown that around 18% of the fishing nets are destroyed by caymans to the point where they can no longer be used; the nets are very expensive and this represents a large cost to both subsistence and commercial fishermen. This largely explains the higher mortality (and lower abundance) of black caymans near important fishing areas.

The abundance of black cayman increases with increasing distances from the main urban centre, where there is a higher concentration of fishermen. At this writing we do not have sufficient details about this situation because the data is being collected but we are planning to analyze the data next year on different dimensions of human-cayman conflicts and consider practical recommendations. The data about the ecology and population recovery of Giant Otters (*Pteronura brasiliensis*) will be collected during the dry season this year.

**Output 5: Empirical and theoretical tests of management protocols and expansion into other river basins of Brazilian Amazonia and other Amazonian countries**

This output refers to the compilation of all project results and further modeling of these results for other localities. We started this goal, collecting the data and doing the first set of preliminary analyses. However, we are planning to consolidate this output in the last year of the project.

**Output 6 (NEW OUTPUT): Local training in biodiversity monitoring and waterbird conservation**

For a number of reasons we included a new output in our project. The interesting relationship between aquatic birds and fisheries is very strong but poorly understood. Some bird species can take advantage of fishing activities, while populations of other species can decline due to competition or opportunist hunting. Moreover, most of this lacustrine avifauna are piscivores (fish consumers) and may serve as indicators of fish availability**.** We are therefore attempting to unify the ecological study of wetland birds and participatory monitoring.

To do it, we have sampled the local assemblages of some 30 bird species using aquatic habitats in both during the dry and the wet seasons in a total of 40 oxbow lakes. To make these surveys possible, 10 local field assistants ("*monitores*") were repeatedly trained to execute this form of participatory monitoring that now includes egrets, raptors, kingfishers, and other

piscivores in a systematic fashion. On the basis of this pilot work, we then decided that it would be feasible to repeatedly census only 31 oxbow lakes under different categories of protection over a 12 month period. With this in mind, we can make a large set of considerations about the effects of landscape, environmental and management factors in several groups, including migratory birds. Moreover, this new output enables the improvement of management techniques and terminology among local people, and increases community involvement in our activities.

**Output 7 (NEW OUTPUT): Seasonal movements of terrestrial vertebrates between floodplain (varzea) forest and upland (terra firme) forest**

We have conducted a strong camera-trapping effort targeting terrestrial wildlife populations along the Juruá floodplains in both terra firme and várzea forests at different times of year, and this work will go on for two annual cycles. A Brazilian MSc student from Universidade Federal do Pará (Hugo Costa) has been recruited to conduct this study. This work has been accompanied by a series of local interviews, and promises to uncover the poorly known lateral migrations between remote terra firme forests that are rarely hunted and potentially overhunted várzea forests, and hopefully also enhance our understanding of the spatial requirements of terrestrial wildlife using várzea forests, and ultimately the reserve Management Plans in areas used by local communities.

**Output 8 (NEW OUTPUT): Terrestrial wildlife depletion envelopes near local communities**

We have included a new set of research activities with the objective of understanding the relationship between community size, landscape context and game and nongame population sizes near local communities using a compinantion of camera-trapping, sign surveys, and local interviews. This is important because animal protein acquisition along the Juruá is a compensatory interplay of both hunting and fishing activities, with the potential of introducing seasonal relief by alternating protein capture between these activities. To date we have collected data along ~50 transects of up to 5 km each at increasing distances into remote areas from both varzea and terra firme forest communities. This project component includes communities both within and outside our focal protected areas. None of those data have been analysed yet, but we will be modelling the degree to which wildlife population abundance are depressed near local communities and what environmental factors most contribute to those distance-abundance relationships. Much of this field work is being conducted by British PhD student, Mark Abrahams (based at UEA).

**Output 9 (NEW OUTPUT): Protected areas, community management and food security**

We included a food security approach into our project to strengthen the ancillary benefits of community management. We have evidence that communities living inside protected areas have access to greater resource supplies including high value fish due to the lake protection system. On the other hand, outside communities cannot access these resource because these species maintain a low abundance outside. This output can be very important to reinforce the arguments about the importance of community-based management in local livelihoods. At this writing we are working on the questionnaire that we will be applied in the next dry season. A Brazilian MSc student (Julia Romero) currently based at Aarhus University, Denmark will be conducting this work.

## 3.2 Progress towards project outputs

**Output 1 Local empowerment and consolidation of an oxbow lake management system across the entire study landscape**

**Indicator 1: Background research leading to the development of a spatially explicit management protocol of community-based freshwater fisheries management.**

We began data collection on both artisanal and commercial fisheries. We spent a lot of time training staff members and implementing this component. We now have two people collecting fish landing data every day, which are intercepted from a commercial fleet of some 700 fishing boats stationed in Carauari. We are also collecting year-round data on subsistence fisheries from more than 400 households from 35 local communities along the ~492-km section of the Juruá River where we work, two days per week**.** We have just analysed the effect of community management in the arapaima population size and the results show us that the community management mode is a powerful tool for conservation. We still need to integrate the data about others groups, but apparently the effects of community management for arapaima benefit all others groups.

**Indicator 2: Data from limnological sampling of 83 spatially-explicit oxbow lakes during both the wet and the dry seasons.**

We collected water samples from 64 lakes during both the dry and wet seasons. The chemical and limnological analysis was carried out at the INPA Limnology Lab and this partnership will help us with understand about the role of primary production in floodplain lakes. The collaboration will contribute to the importance of understanding limnological effects on resource population distribution and abundance.

**Indicator 3: Technical training Workshop deployed to both artisanal and commercial fishermen of the central Rio Juruá region; Technical training Workshop with key stakeholders including the Fishermen Cooperatives, municipal county administrators of fishing licenses, managers of sustainable-use protected areas, and representatives of SDS/CEUC and ICMBio)**

We conducted a training course for the fisherman living outside the protected areas. This training workshop was primarily about arapaima counts and was very important to promote an initial contact between different realities. In the protected areas it was easier to convince people about the importance of resource management, because they have already been exposed to this concept for several years, but the reality outside was very different and local villagers still need to see the positive aspects of management. We therefore introduced this understanding with a training workshop. The next step will be to increase the number of training courses not just for fishermen but also for other stakeholders.

**Indicator 4: Deliberations of negotiated settlement between commercial and artisanal fishermen thereby subsidizing a legal agreement ratified by the Fishermen Cooperatives of Carauarí and Eirunepé**

This indicator is dependent on previous results. We plan to do this in the second and third year of the project. This is the biggest challenge of our project. We started the negotiations, but first we have to solve decades of often violent conflicts. We therefore need better evidence from our work to enforce the actions and reinforce the agreement requirements. We will however maintain a positive engaging relationship with the municipal and state administration as well as the Fisherman Coop of Carauari, and we have every reason to think that we are gradually winning hearts and minds, and the cooperation of commercial fishermen and fish traders.

**Indicator 5: Preparation of the *Handbook of Community-Based Freshwater Fisheries Management Techniques***

This indicator depends on results from other project components, and the Handbook has been earmarked for the third year of the project.

**Indicator 6: Dissemination of the *Handbook* to all institutions involved in resource management, particularly concerning fisheries**

Once the *Handbook* is completed and published it will be distributed accordingly, with the help of our institutional partners.

**Output 2: Local empowerment and deployment of a freshwater turtle ecology and management programme**

A specific set of staff members are going in July 2014 to establish the actions necessary to achieve this goal. We now have all the GPS points of sandy beaches where ovipositing activity has been recorded and we are planning to:

- Carry out low-water season surveys of a large number of sandy beaches to examine the ecosystem wide ecological effects of sandy beach protection. This will include for a set of 12 protected and 12 unprotected beaches: counts of turtles nests; remote controlled drone aerial flights to survey beach birds; camera trapping along the beaches; counts of large fish along the river; and surveys of predator/scavenger activity.
- Sample oxbow lakes, to verify the effects of community management on the abundance of freshwater turtles of two species
- Carry out GPS telemetry of freshwater turtles during both the wet and dry seasons
- Carry out a capture-mark-recapture study of freshwater turtles
- Carry out household and market level surveys of any offtake of freshwater turtles
- Monitor the *P. expansa* turtle hatchling emergence at the end of the dry season from a set of 12 protected beaches.
- Record any other signs of wildlife activity on a 24/7 basis using the beach vigilance crew who enforce protection at the protected beaches.

**Output 3: Local empowerment and consolidation of *Arapaima* stock assessment and management program**

**Indicator 1. Initial presentation of subproject and training workshop to local artisanal fishermen from 35 local communities on *Arapaima* census techniques**

The project concept and activities was presented during two large meetings inside the reserves. Around 200 people were present and heard about the project. Moreover, the project was also presented during community visits for an additional 20 community leaders.

**Indicator 2. Training Workshop extension to key stakeholders outside the two protected areas (Fishermen Cooperatives, municipal county administrators of fishing licenses, managers of sustainable-use protected areas, and representatives of SDS/CEUC and ICMBio)**

We carried out a training course for the Fishermen Cooperative and fishermen outside the reserves, and we are currently organizing a complete course for other stakeholders.

**Indicator 3. Total number of protected oxbow lakes negotiated with commercial fishermen cooperative under mutually-agreed "fishing accords". These will be guarded during the dry-season, and will adhere to a sustainable offtake quota following a stock-recruitment assessment**

In addition to the core protected lakes, we have expanded protection to 6 other lakes which provide food and cash for three communities. The most important thing however is that the Fishermen Cooperative has approved our proposal and we will now attempt to increase the number of protected lakes outside the reserves. We surmise that this would bring very strong local benefits for the entire project study area. Ultimately, given the tangible local benefits of oxbow lake protection, we would like a contagion based model in which community-based lake management and zoning spreads spontaneously across the Juruá far beyond the boundaries of our study area.

**Indicator 4. Time-series from at least 26 lakes beginning to show population recovery trends by the end of Project Year 3.**

We have been able to reconstruct data on arapaima counts since 2005. In the final year of the project we will have 10 years of solid arapaima stock size data from at least 60 lakes, thereby enabling us to show arapaima population recovery. We are currently in the process of analyzing preliminary data on these counts with a view of publishing an initial paper on this topic. We expect to vastly exceed our initial targets in relation to this indicator.

**Output 4: Design and establish a management plan for "problem" apex predators including *Pteronura* and *Melanosuchus***

**Indicator 1. Development and preparation of educational booklet with the goal of reducing conflicts between subsistence/commercial fishermen and *Pteronura and Melanosuchus***

This indicator is dependent on previous results. We plan to carry this out during Years 2 and 3 of the project.

**Indicator 2. Dissemination of a "problem-species" illustrated educational booklet to all Juruá communities.**

This indicator is dependent on previous results. We plan to carry this out during Years 2 and 3 of the project.

**Indicator 3. Population estimates combined intensive field surveys and information from interviews at 40 communities on the spatial distribution of occupancy records of *Pteronura and Melanosuchus.***

The data are being collected by two previously trained local monitors. This information will be used to achieve indicators 1, 2 and 4. During the next dry season a specific staff member will collect data about giant otter population recovery and conflict with fisherman using both direct surveys and local interviews.

***Indicator 4.* Illustrated talks at seven venues bringing together representatives of ~40 local communities of RESEX Medio Juruá and RDS Uacari.**

This indicator is dependent on previous results. We plan to carry this out during Years 2 and 3 of the project.

**Output 5: Empirical and theoretical test of management protocols and expansion into other river basins of Brazilian Amazonia and other Amazonian countries**

This output will be done during the last year of the project

## 3.3 Progress towards the project Purpose/Outcome

During the first project year we have already implemented data collection regarding most faunal groups and resource populations. We have also conducted technical training in different approaches and strengthened our relationships with partners. A fact to be considered is the high level of social and political organization of the communities who live in this region. This socio-political characteristic can be an important role in achieving positive project outcomes.

Our presence throughout the region is really welcome and the communities are genuinely interested in our project. By the end of Year 1 we think that the overall assessment is very positive and we are well placed and have the necessary conditions to accomplish our realistic purposes satisfactorily. The project activities will eventually move into a seamlessly clear exit strategy and many of the ideas and concepts instigated so far will transcend the lifetime of this project. We are also forging better ties with the local political administration which will facilitate some outreach activities as part of this project.

### 3.4 Goal/ Impact: achievement of positive impact on biodiversity and poverty alleviation

This is a ground-breaking sustainable development project that we intend to demonstrate at the highest level. Virtually all conservation/development programs in the tropics fail to achieve either the goals of biodiversity conservation or the socioeconomic interests of local communities. This Darwin Project, however, can be ultimately seen as either a success or failure if the project promotes ***both*** stock recovery of historically overexploited biological resources ***and*** improved livelihood conditions for the local population (including quantifiable changes in local revenues). At vthe risk of sounding like a horrible cliché, this project has every chance of eventually (Year 3) demonstrating a rare win-win success story in terms of natural resource management in a tropical environment.

## 4. Project support to the Conventions (CBD, CMS and/or CITES)

The project provides a strong contribution to several CBD articles, including the Sustainable Use and Conservation of Biological Diversity, implementation of Protected Areas, Biodiversity Monitoring, Use of Local Traditional Knowledge, Research and Training, and Technical and Scientific Cooperation under the thematic areas of Ecosystems Approaches, Sustainable Use of Biodiversity, Protected Areas, and Forest Biodiversity, as all aquatic resource populations addressed here are sustained by increasingly degraded seasonally-flooded forests. As such the project also supports RAMSAR, the Convention on Wetlands of International Importance. The project will also provide a subsidiary body on scientific, technical and technological extension that can be applied not just to the Juruá region, but in the other eight lowland Amazonian countries.

The project will strengthen all five strategic goals of the Strategic Plan for Biodiversity (2011-2020) as agreed within the Aichi Biodiversity Targets framework. In particular, the project will provide a decisive contribution to Target 11 of Strategic Goal A in relation to the effective implementation of *Sustainable-Use Protected Areas* in tropical forest regions. The project will also aid the implementation of the Biodiversity Convention within Brazil via our collaboration with ICMBio and CEUC/SDS, the protected areas branch of the Brazilian Ministry of Environment (MMA) and the State of Amazonas, respectively. This will maximise integration between this project and other initiatives, including MMA's ARPA protected areas programme for the Brazilian Amazon.

Finally, large turtles can migrate thousands of kilometres and the *Podocnemis* GPS tracking component of the turtle ecology subproject will elucidate where male and female turtles go during the nonbreeding season. This fits well with research priorities from the Strategic Plan of the Convention on Migratory Species of Wild Animals (CMS).

## 5. Project support to poverty alleviation

There are some promising areas in which the objectives of biodiversity conservation and human welfare can be integrated via this project. The arapaima management protocol is a strong window of opportunity to harmonize the goals of sustainable resource management and poverty alleviation. In particular, protected lakes can become something analogous to a bank account. In these lakes we found an average of around US$9,000 available in fish catches, considering all the management rules, and this value can grow every year as the protection process is consolidated and resource populations increase. This is significant because these local communities rarely have any cash-earning opportunities, so that a seasonal windfall of >US$10,000 is crucial in improving local welfare.

To secure these fishing revenues every year, the communities have to improve the management structure of the lakes, but this is being done as part of the project advisory activities. They are improving the cryo-preservation structure of ice-chilled (rather than salted) fish and a new fleet of small fishing boats will be available next year. Moreover, the lakes can also function as a social insurance option, because when anyone becomes ill for example, a

portion of the arapaima stock could be captured and sold, thereby covering the costs of emergency travel and medical care. Finally, communities that actively engage in lake management can easily double or treble their income is sustainably harvested fish, as 20% of the estimated adult stock size can be legally captured and sold (although we will be ascertaining if this quota approaches an optimum sustainable yield). Consequently, an annual windfall can be earned following stock assessments and offtakes of the population surplus at the end of the dry season.

## 6. Monitoring, evaluation and lessons

We have credible evidence to believe that floodplain management could contribute to the conservation and improvement of local livelihoods. In the Mamiraua reserve, located the floodplains of the Middle Solimões region, local income from Arapaima management in 2013 was very substantial (http://www.mamiraua.org.br/pt-br/comunicacao/noticias/2014/4/10/em-2013-renda-com-manejo-de-pirarucu-ultrapassa-dois-milhoes-de-reais/). Last year aggregate income across our study local communities from fish sales alone was more than R$ 220,000 and this money was equally shared among all families working in the management program. With the improvement of management conditions and a growing *Arapaima* population, for example, we could see in a short time, very strong benefits and financial incentives from management.

## 7. Actions taken in response to previous reviews (if applicable)

Not applicable – this project is only 10 months old.

## 8. Other comments on progress not covered elsewhere

We are happy with the way the project has progressed so far. Inevitably some project areas were moderately downsized whilst others have been greatly expanded, and new activities and outputs were introduced as adjustments to new opportunities that had not been foreseen at the time we wrote the proposal. The Juruá continues to be a difficult region in which to work, and to this day we cannot find a single cash-point machine in Carauari which forces us to carry a risky amount of cash to pay local wages and cover other project expenses.

## 9. Sustainability

Due to the large geographic expanse and insufficient amount of human resources, it is not possible to contemplate conservation in the Amazon without the inclusion of rural peoples as key component of this process. Community based management (CBM) can be a powerful tool to promote conservation. The Brazilian government has attempted to implement some initiatives using a CBM framework, but these approaches are at best patchy and poorly monitored. Our staff has a strong and friendly relationship with different spheres of the Brazilian government. With a good proposal in hand we would be able to convince local and state governments to implement our guidelines in several areas.

We are using a mixed approach between environmental predictors and traditional ecological knowledge, so it is completely feasible and economically realistic to replicate projet lessons in other areas. In addition to completing our research and outreach program over the next two years, one of the principal actions will be to distribute the Handbook of Freshwater Fisheries Management Techniques for all government departments, and present the guidelines in all important Brazilian conservation meetings. Above all, however, we expect that there will be spontaneous initiatives to follow through with similar guidelines as the success story of fishery management spreads well beyond our study area. In fact there is a huge demand from local tribal and non-tribal communities right across the Amazon to sustainably manage natural resources. Yet there is a dearth of research targeting many resource populations, and few technical extension programs to support local communities and spread the lessons. It is our hope that this project goes some ways to bridge this gap, particularly along the major meandering tributaries of the Amazon.

## 10. Darwin Identity

As the project effectively began less than 1 year ago, this early days and so far the use of the Darwin Initiative logo has only been used sparingly. However, we intend to do just that as the project matures and results begin to see the light of day and are disseminated in written documents and oral presentations.

## 11. Project Expenditure

**Table 1 project expenditure during the reporting period (1 April 2013 – 31 March 2014)**

| Project spend since last annual report | 2013/14 Grant (£) | 2013/14 Total actual Darwin Costs (£) | Variance % | Comments (please explain significant variances) |
|---|---|---|---|---|
| Staff costs (see below) | | | | |
| Consultancy costs | | | | |
| Overhead Costs | | | | |
| Travel and subsistence | | | | |
| Operating Costs | | | | |
| Capital items (see below) | | | | |
| Others (see below) | | | | |
| **TOTAL** | **92,172** | **92,172** | | |

**Justification**

The initial travel and subsistence costs of this project had been severely underestimated mainly because of (1) the high costs of local flights, the fact that local fuel prices in Carauarí are the most expensive in Brazil, (2) our promised logistical support in kind from HRT Oil & Gas (see original proposal) largely failed to come through because this mixed-capital oil and gas venture is effectively going bankrupt following two helicopter crashes (both with human fatalities) and failure to find oil in the oil & gas field of the Juruá-Tefé region; (3) the high local costs of boat rental to maintain multiple simultaneous project activities, and (4) the large number of field assistants receiving local wages that are currently working with us. Conversely, we have spent significantly less of our capital equipment budget allocation. Most of the costs of this project takes place in some of the most remote regions of Western Brazilian Amazonia and are strictly operational. These involve fuel and food in working with over 40 field assistants and full-time local staff within a vast region that is approximately 500 x 40 km in area. In addition, the turtle GPS tracking component has been delayed for a number of reasons to Year 2 of the project so we so far we have not yet had the additional costs of purchasing capital equipment such as expensive GPS transmitters and data acquisition and repatriation costs. This will be done in years 2 and 3 of the project. We have also purchased two smaller outboard motors (15HP and 25HP) but decided to leave the 40HP to be purchased during Year 2 of the project; this is a request made by our local partners and it is likely that they will retain access to these motors after the end of the project. Some of the budget line discrepancies are also due to (a) the addition of different project Outputs that had not been anticipated at proposal stage; and (2) differences in the way University of East Anglia finances records expenditure across different budget lines. Overall, we anticipate staying within our expenditure limit for each project year, but we make a plea to exercise a certain amount of flexibility in allocating expenditure across different budget line.

## 12. OPTIONAL: Outstanding achievements of your project during the reporting period (300-400 words maximum). This section may be used for publicity purposes

I agree for the Darwin Secretariat to publish the content of this section (please leave this line in to indicate your agreement to use any material you provide here)

This Darwin project explicitly consider the spatial zoning of a major freshwater fishery in the Western Brazilian Amazon, and seeks to advance conflict resolution between local subsistence and commercial interests. Early results suggest that population recovery of otherwise historically depressed harvest-sensitive stocks, such as *Arapaima* and *Colossoma* fish, can be remarkably rapid. The project has so far gained rapid acceptance with local communities who can now clearly see the social and financial benefits of enforcing no-take areas and join us in what has effectively become a large scale bioeconomic experiment involving spatial zoning and no-take areas. This is still early days, however, and this project can be ultimately judged as either a triumph or failure if the project verifiably promotes *both* stock recovery of historically overexploited biological resources *and* improved livelihood conditions for the local population (including quantifiable changes in local revenues). This project has every chance of eventually demonstrating a rare 'win-win' success story in terms of natural resource management in a tropical environment, and there is no particular reason why this case-study cannot be replicated across many other regions of lowland Amazonia.

## Annex 1: Report of progress and achievements against Logical Framework for Financial Year 2013-2014

| Project summary | Measurable Indicators | Progress and Achievements April 2013 - March 2014 | Actions required/planned for next period |
|---|---|---|---|
| *Goal/Impact*<br><br>Understand the spatial dynamics of productivity and exploitation of aquatic vertebrates — including fish and reptiles — along the Rio Juruá, a major tributary of the Amazon river, and create a spatially-explicit set of management guidelines to protect the landscape-scale sustainability of inland fisheries that can be feasibly enforced by local resource users. This will be based on community-based "fishing agreements" over an access-rights zoning system defining a spatio-temporal harvesting mosaic of commercial and subsistence fisheries including no-take areas (i.e. subsistence-only and strictly protected oxbow lakes). This will lead to measurable protein-acquisition benefits to small-scale artisanal fishermen resulting from population recovery of harvest-sensitive stocks. | | (report on any contribution towards positive impact on biodiversity or positive changes in the conditions of human communities associated with biodiversity e.g. steps towards sustainable use or equitable sharing of costs or benefits) | [redacted] |
| *Purpose/Outcome* (insert original project purpose/outcome statement)<br><br>(1) Understand the landscape-scale context and spatial dynamics of the (over)exploitation of local fisheries and the biophysical basis of fish/turtle resource productivity across one of the most productive white-water tributaries of the Amazon river, the ~3,000-km long Juruá River.<br><br>(2) Understand the competitive basis for local conflicts | Annual counts of adult pirarucu (*Arapaima gigas*) fish in 83 oxbow lakes under varying categories of protection status, as per 'fishing agreements' between local communities and commercial fishermen.<br><br>A range of research and management activities centred on breeding sites where ovipositing female turtles (*Podocnemis expansa* and *Podocnemis unifilis)* converge. A total of ~65 protected and unprotected sandy beaches along the Rio Juruá will be monitored. | The counts for Year 1 are done. All of our focal lakes will be counted every year, during the tenure of the project and we will make sure we find the resources to conti nue this work for at least a few more years after the project terminates.<br><br>We are going to start these activities during the next dry season. For the moment we mapped all protected and many unprotected beaches. We also had the first meetings with decision-makers and local communities; and the turtle component of the project looks strong and promising. | We will keep the arapaima count and consolidate the fishing agreements between local communities and commercial fishermen.<br><br>- Survey fluvial sandy beaches to verify the ecological effects of beach protection.<br>- Sampling in the lakes, to verify the effects of community management on the abundance of two large-bodied species of freshwater turtles<br>- GPS telemetry of freshwater turtles (females and juveniles)<br>- Capture-mark-recapture of |

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| between commercial (large-scale) fishing boats using long gillnets (>200m) and small-scale, subsistence fishermen using artisanal fishing gear (line-and-hook; cast-nets; spears; bow-and-arrow), which often result in outbreaks of rural violence and occasionally deaths along the Rio Juruá.<br><br>(3) Measure the importance of no-take areas (oxbow lakes and sand beaches) via strictly-enforced 'fishing agreements' setting aside two categories of protected lakes and beaches, in both managing the spatial structure of aquatic protein harvest, and allowing stock recovery of key harvest-sensitive fish species, such as pirarucu (*Arapaima gigas*) and tambaqui (*Colossoma macropomum*), and freshwater turtles.<br><br>(4) Understand the resource overlap basis for local human-wildlife conflicts in aquatic ecosystems, including large apex predators (e.g. giant river otters, *Pteronura brasiliensis* and black caimans, *Melanosulchus niger*) which | Limnological measurements conducted at 83 oxbow lakes along a ~492-km section of the Juruá River.<br><br>CPUE data from offtakes of all aquatic sources of animal protein recorded on a weekly basis over 24 months at ~420 households from 35 local communities along a ~492-km section of the Juruá River<br><br>GPS monitoring of the movements of a fleet of commercial fishing boats over at least a 1-year period, following authorization from the Fishermen Cooperative of Carauarí and Eirunepé; and Monitoring of fish landings from fishing boats at the local markets of these urban centers.<br><br>Spatial modelling of oxbow-lake fish productivity under varying degrees of protection from commercial fishing and connectivity to the main river channel. | Done.<br><br>We have implemented the data survey.<br><br>This is a complex goal, because we have found that to fit a GPS receiver onto a fishing boat requires high levels of fisherman cooperation and trust. So we are planning to do this in the second year of the project, once our relationship with a wide set of boats is consolidated.<br><br>Future action.<br><br>Future action. | freshwater turtles<br>- Household and community scale surveys of freshwater turtle offtake throughout the annual calendar |

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| are frequently killed by fishermen to protect fish stocks.<br><br>(5) Create a set of spatially-explicit guidelines that can be feasibly enforced to manage the sustainable exploitation of freshwater protein resources across major watersheds of lowland Amazonia.<br><br>(6) Extend the results of this project to (i) other parts of the Juruá watershed; (ii) other major rivers of Brazilian Amazonia; and (iii) other lowland Amazonian countries, using lessons learnt from the project and project results translated into a substantive illustrated *Handbook of Freshwater Fisheries Management Techniques*. | | | |
| Output 1. Local empowerment and consolidation of an oxbow lake management system across the entire study landscape | 1 Background research leading to the development of a spatially explicit management protocol of community-based freshwater fisheries management<br><br>2 Data from limnological sampling of 83 spatially-explicit oxbow lakes during both the wet and the dry seasons.<br><br>3 Technical training Workshop deployed to both artisanal and | 1-We began the data collection, and the preliminary analysis.<br><br>2- We have sampled 64 lakes during both dry and wet seasons. We will repeat the sampling to verify the supra-annual variation in limnological variables.<br><br>3- We have begun the technical training. But we are planning to undertake an intensive training workshop during the next dry season. | |

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| | commercial fishermen of the central Rio Juruá region; Technical training Workshop with key stakeholders including the Fishermen Cooperatives, municipal county administrators of fishing licenses, managers of sustainable-use protected areas, and representatives of SDS/CEUC and ICMBio)<br><br>4 Deliberations of negotiated settlement between commercial and artisanal fishermen thereby subsidizing a legal agreement ratified by the Fishermen Cooperatives of Carauarí and Eirunepé<br><br>5 Preparation of the *Handbook of Community-Based Freshwater Fisheries Management Techniques.*<br><br>*6* Dissemination of the *Handbook* to all institutions involved in resource management, particularly concerning fisheries. | 4- This is one of the biggest challenges of our project. We started the negotiations, but this involves time and patience. Our goal is to finish the project with a real and measurable agreement between professional and artisanal fishermen, which we are referring to as 'Fishing Accords'.<br><br>5- Future action.<br><br>6- Future action. |
| Activity 1.1 Seasonal limnological sampling of 83 oxbow lakes with one dry-season and one wet-season campaign. | | We have sampled 64 lakes during both seasons of the year. We will repeat the sampling to further understand the supra-annual variation. |
| Activity 1.2 Household-level surveys of all types of aquatic resources extracted across ~420 households distributed across 35 local communities. | | We start the surveys and this will continue for another 24 months (or slightly fewer). |
| Activity 1.2 Investigate the relationship between household CPUE and oxbow lake primary productivity under different categories of lake protection. | | Future action. |
| Activity 1.4 Investigate the relationship between household CPUE e explanatory variables both at the patch and landscape scale. | | Future action. |
| Activity 1.5 Examine the functionality and ecosystem level consequences of lake protection status according to the 'fishing accords' promoted by the | | Future action. |

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| project. | | |
| Activity 1.6 Downloading and porcessing of GPS tracking data and composite maps of commercial fishing boat forays and density of fishing activity both within and outside the focal reserves. | | Future action. |
| Activity 1.7 Design, preparation, printing and distribution of a *Handbook of Freshwater Fisheries Management Techniques.* | | Future action. |
| Output 2. Local empowerment and deployment of a freshwater turtle ecology and management programme. | Training Workshop on turtle management to local stakeholders, namely the residents of RDS Uacari and RESEX Medio Juruá. | This activity is planned for the next dry season. |
| | Discussions with Reserve Management Council on spatial zoning of all dry-season sandy beaches. | This activity is planned for the next dry season. |
| | Number of fluvial sand beaches protected along a 492-km section of the Rio Juruá. | All the protected beaches have been mapped. We are also mapping beaches of similar characteristics that remain unprotected. |
| | Counts and electronic tagging of live turtle hatchlings dug from nests, quarantined, and released. | Future action. |
| | Large-scale movements of adult *Podocnemis* turtles over a 24-month period. | Future action. |
| Activity 2.1. Local agreements setting-aside a set of protected egg-laying sand beaches along a 492-km section of the Rio Juruá. | | This activity is planned for the next dry season. |
| Activity 2.2 A 5-day training course (for 30 local assistants and village leaders) on the conservation & management of freshwater turtles. | | This activity is planned for the next dry season. |

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| Activity 2.3 Monitoring of numerical abundance and reproductive output of *Podocnemis expansa* and *P. unifilis* females during the breeding season. along a subset of study beaches. This will include a minimum of 5,100 nests over a 3-yr period. | | This monitoring has begun and coincides with the peak dry season, and many project activities reach a peak. |
| Activity 2.4 Monitoring the hatchling activity of some 300,000 hatchlings over a 3-year period; Record biometric data on ~5% of these hatchlings; organize and conduct quarantine period of turtle hatchlings; successful release of post-quarantine hatchlings. | | This monitoring has begun and coincides with the peak dry season, and many project activities reach a peak. |
| Activity 2.5 GPS and VHF-transmitter tagging of 10 adult female turtles (5 *P. expansa* and 5 *P. unifilis*), which will be monitored for 24 months. This satellite tracking component will ensure that we understand turtle migrations and the role of oxbow lakes during the non-breeding season. | | Future action. |
| Activity 2.6 Electronic tagging of 5,000 post-quarantine hatchlings [using transponders microchips] prior to releasing from fluvial beaches | | Future action. |
| Activity 2.7 Design and production of an illustrated booklet on *Freshwater Turtle Ecology & Management*. | | Future action. |
| Output 3. Local empowerment and consolidation of *Arapaima* stock assessment and management programme | Initial presentation of subproject and raining Workshop to local artisanal fishermen from 35 local communities on Arapaima census techniques | We presented the project objectives for all leaders and all local and state-level institutions. |
| | Training Workshop extension to key stakeholders outside the two protected areas (Fishermen Cooperatives, municipal county administrators of fishing licenses, managers of sustainable-use protected areas, and representatives of SDS/CEUC and ICMBio) | We started the technical training. But we are planning an intensive training workshop for this next dry season. |
| | Total number of protected oxbow lakes negotiated with commercial | |

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| | fishermen cooperative under mutually-agreed “fishing accords”. These will be invigilated during the dry-season, and will adhere to a sustainable offtake quota following a stock-recruitment assessment<br><br>Time-series from at least 26 lakes beginning to show population recovery trends by the end of Project Year 3. | We consolidated work on lakes that were the focus of many local communities and improved the protection of 6 additional lakes which provide food and cash for three communities. We are going try to boost the protection of more lakes, particularly in areas outside of the reserves which have long been neglected.<br><br>This is being conducted in more than 40 lakes |
| Activity 3.1Reserve council and community meetings to ensure that this component of the project is understood. These meetings will include the selection of the key oxbow lakes. | | Done |
| Activity 3.2 Annual counts of adult pirarucu fish (*Arapaima gigas*) in at least 23 oxbow lakes | | A total of 80 lakes have been counted. These lake will be counted every year, during and after the project completion. |
| Activity 3.3 Mapping of lakes with varying probability of *Arapaima* occurrence | | Done |
| Activity 3.4 Training of 60 artisanal fishermen in *Arapaima* census techniques, to be included in annual counts | | We started the technical training. But we are planning an intensive training session this dry season. |
| Activity 3.5 A target number of 26 large oxbow lakes to be included into stock assessments of *Arapaima* by Year 3 of the Project. These lakes will be managed thereafter following tightening of commercial access restrictions. | | We included 6 lakes in the first year, in addition to a set of lakes that were the focus of local communities. |
| Output 4. Design and establishment of a management plan for “problem” apex predators including *Pteronura* and *Melanosuchus* | Development and preparation of educational booklet with the goal of reducing conflicts between subsistence/commercial fishermen and *Pteronura and Melanosuchus*<br><br>Dissemination of a “problem- | Future action.<br><br>Future action. |

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| | species" illustrated educational booklet to all Juruá communities.<br><br>Population estimates combined intensive field surveys and information from interviews at 40 communities on the spatial distribution of occupancy records of *Pteronura and Melanosuchus.*<br><br>Illustrated talks at seven venues bringing together representatives of ~40 local communities of RESEX Medio Juruá and RDS Uacari. | We began interviews and surveys of population parameters.<br><br>Future action. |
| Activity 4.1 Investigate the spatial distribution and habitat selection of both Giant Otters and Black Caimans in relation to the spatial distribution of (human) fishing activity | | We started the Black Caiman surveys and will soon begin the Giant Otter surveys this next dry season. |
| Activity 4.2 Investigate levels of otter, caiman and human mortality and the intensity of conflicts between fishermen and large aquatic apex predators. Four resident fishermen were killed by large Black Caimans in the last 3 yrs so this is a raw issue. | | We started the systematic interviews with fishermen and with the local Secretary of Health. |
| Activity 4.3 Interviews at 40 communities to obtain species occupancy and incidence density data for a 500-km section of the Rio Juruá | | We started these interviews |
| Activity 4.4 Mapping of all water bodies including oxbow lakes, overlaid with the occurrence probability of *Pteronura* and *Melanusuchus* | | We have mapped the occupancy of Black Caymans across most of our study area. The Giant Otter study will begin next dry season. |
| Activity 4.5 Conduct a spatio-temporal and resource overlap analysis between otters/caimans and fishermen | | Future action. |
| Activity 4.6 Design and production of an illustrated educational booklet to enhance the prospects of large predator conflict resolution across all local communities | | Future action. |
| Output 5: Empirical and theoretical test of management protocols and expansion into other river basins of | Analytical approaches to data integration including productivity-based stock-recruitment models; | Future action. |

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| Brazilian Amazonia and other Amazonian countries | spatial modeling showing the importance of no-take areas under a source-sink population framework; an analysis of the socioeconomic benefits of no-take areas accrued to local communities. | |
| | Distribution of the *Fisheries Handbook* to all relevant institutions and government agencies involved in the management of freshwater fisheries in Brazilian, Bolivian, Colombian and Peruvian Amazonia. | Future action. |
| | Final Workshop held in Manaus to a target audience of natural resource management agencies, particularly government and nongovernment organizations responsible for fisheries management | Future action. |
| | Presentations of project results at the Latin American Wildlife Management Congress, Association for Tropical Biology & Conservation meeting, and Society for Conservation Biology. | Future action. |
| Activity 5.1 Stock-recruitment model to inform sustainable *Arapaima* offtakes from seasonally discrete water-bodies such as oxbow lakes | | This is being done but is yet to be completed |
| Activity 5.2 Elaboration of an *Arapaima* source-sink population model with and without no-take areas under varying degrees of primary productivity | | Future action. |
| Activity 5.3 A State of Amazonas wide *Podocnemis expansa* turtle conservation gap analysis involving all major river basins providing adequate nesting sites. | | Future action. |

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| Activity 5.4 A cost-benefit analysis of implementation of no-take areas quantifying the opportunity costs to local communities, socioeconomic challenges to implementation, levels of compliance, and tangible benefits to local communities (e.g. increases in fish biomass yields or per capita intake of fish protein). | Future action. |
| Activity 5.5 Identification of all likely sites across Brazilian Amazonia where our zonation-based fisheries management protocol can be replicated. | Future action. |

## Annex 2 Project's full current logframe

## Annex 3 Standard Measures

### Table 1 Project Standard Output Measures

| Code No. | Description | Year 1 Total | Year 2 Total | Year 3 Total | Year 4 Total | Total to date | Number planned for reporting period | Total planned during the project |
|---|---|---|---|---|---|---|---|---|
| Output 1 | **Local empowerment and consolidation of oxbow lake management system across the entire study landscape** | 1 | 1 | 4 | 1 | 1 | 1 | 7 |
| Output 2 | **Local empowerment and deployment of freshwater turtle ecology and management programme** | 1 | 1 | 4 | 1 | 1 | 1 | 7 |
| Output 3 | **Local empowerment and consolidation of *Arapaima* stock assessment and management programme** | 2 | 1 | 1 | 1 | 2 | 2 | 5 |
| Output 4 | **Design and establishment of a management plan for "problem" apex predators including *Pteronura* and *Melanosuchus*** | 1 | 2 | 2 | 1 | 1 | 1 | 6 |
| Output 5 | **Stock-recruitment model to inform sustainable *Arapaima* offtakes from seasonally discrete water-bodies such as oxbow lakes** | 0 | 1 | 2 | 2 | 0 | 0 | 5 |
| **NEW PROJECT OUTPUTS** | | | | | | | | |
| **Output 6 (New)** | **Local training in biodiversity monitoring and waterbird conservation** | 1 | 1 | 0 | 0 | 1 | 1 | 2 |
| **Output 7 (New)** | **Seasonal movements of terrestrial** | 1 | 1 | 0 | 0 | 1 | 1 | 2 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **vertebrates between floodplain (varzea) forest and upland (terra firme) forest** | | | | | | | |
| **Output 8 (New)** | **Terrestrial wildlife depletion envelopes near local communities** | 1 | 1 | 1 | 0 | 1 | 1 | 3 |
| **Output 9 (New)** | **Protected areas, community management and food security** | 0 | 1 | 1 | 0 | 0 | 0 | 2 |

**Table 2 Publications**

| Type | Detail | Publishers | Available from | Cost £ |
|---|---|---|---|---|
| journal | Palmerin, F., C.A. Peres, F.C.W Rosas. 2014. Giant otter population responses to habitat expansion and degradation induced by a mega hydroelectric dam. | Biological Conservation (Elsevier). | http://dx.doi.org/10.1016/j.biocon.2014.03.015 | 0 |
| journal | Lapola, D., L.A. Martinelli, C.A. Peres, et al. 2014. Pervasive transitions in the Brazilian land-use system. | Nature Climate Change, (Nature) | http://www.nature.com/nclimate/journal/v4/n1/full/nclimate2056.html | 0 |
| journal | Mitchard, E.T.A. + 90 coauthors including C.A.Peres. 2013. Strongly divergent estimates of Amazon forest carbon density from ground plots and satellites. | Global Ecology and Biogeography | DOI: 10.1111/geb.12168 | 0 |
| journal | Nichols, E, Uriarte, M., Peres, C. A., Louzada, J., Braga, R. F., Schiffler, G. & Spector, S. H. 2013. Human-Induced Trophic Cascades along the Fecal Detritus Pathway. | *PLoS ONE* | http://www.plosone.org/article/ | 0 |
| journal | Laufer, J., F. Michalski, and C.A. Peres. 2013. Assessing sampling biases in logging impact studies in tropical forests. | Tropical Conservation Science | http://www.tropicalconservationscience.org/ | 0 |

## Annex 4 Onwards – supplementary material (optional but encouraged as evidence of project achievement)

This may include outputs of the project, but need not necessarily include all project documentation. For example, the abstract of a conference would be adequate, as would be a summary of a thesis rather than the full document. If we feel that reviewing the full document would be useful, we will contact you again to ask for it to be submitted.

It is important, however, that you include enough evidence of project achievement to allow reassurance that the project is continuing to work towards its objectives. Evidence can be provided in many formats (photos, copies of presentations/press releases/press cuttings, publications, minutes of meetings, reports, questionnaires, reports etc) and you should ensure you include some of these materials to support the annual report text.

## Checklist for submission

| | Check |
|---|---|
| **Is the report less than 10MB?** If so, please email to Darwin-Projects@ltsi.co.uk putting the project number in the Subject line. | y |
| **Is your report more than 10MB?** If so, please discuss with Darwin-Projects@ltsi.co.uk about the best way to deliver the report, putting the project number in the Subject line. | n |
| **Have you included means of verification?** You need not submit every project document, but the main outputs and a selection of the others would strengthen the report. | y |
| **Do you have hard copies of material you want to submit with the report?** If so, please make this clear in the covering email and ensure all material is marked with the project number. | n |
| Have you involved your partners in preparation of the report and named the main contributors | y |
| Have you completed the Project Expenditure table fully? | y |
| Do not include claim forms or other communications with this report. | |