Submit by Monday 3 December 2012

DARWIN INITIATIVE APPLICATION FOR GRANT FOR ROUND 19: STAGE 2

Please read the Guidance Notes before completing this form. Where no word limits are given, the size of the box is a guide to the amount of information required.

Information to be extracted to the database is highlighted blue.

ELIGIBILITY

1. Name and address of organisation (NB: Notification of results will be by post and email to the Project Leader)

Name:	Address:
University of East Anglia	School of Environmental Sciences, University Plain, Norwich, Norfolk NR47TJ, UK

2. Stage 1 reference and Project title

Application Ref. 2085 **Managing the landscape-scale sustainability of Amazonian freshwater fisheries**

3. Project dates, duration and total Darwin Initiative Grant requested, matched funding

Proposed start date:		Duration of project:		End date:	
Darwin request	2013/14 £	2014/15 £	2015/16 £	2016/17 £	Total £253,508
Proposed (confirmed and unconfirmed) matched funding as percentage of total Project cost: Conservatively estimated at **~76%** including staff salaries and all confirmed and unconfirmed funding.					

4. Define the outcome of the project. This should be a repetition of Question 24, Outcome Statement.

(max 100 words)

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.

5. Country(ies)

Which eligible host country(ies) will your project be working in. You may copy and paste this table if you need to provide details of more than four countries.

Country 1: **BRAZIL**	Country 2:
Country 3:	Country 4:

6. Biodiversity Conventions

Which of the three conventions supported by the Darwin Initiative will your project be supporting? Note: projects supporting more than one convention will not achieve a higher scoring

Convention On Biological Diversity (CBD)	Yes
Convention on Migratory Species (CMS)	Yes
Convention on International Trade in Endangered Species (CITES)	No

6b. Biodiversity Conventions

Please detail how your project will contribute to the objectives of the convention(s) your project is targeting. You may wish to refer to Articles or Programmes of Work here.
Note: No additional significance will be ascribed for projects that report contributions to more than one convention

The project will provide 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. 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 <u>all five</u> strategic goals (A – E) 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.

Is any liaison proposed with the CBD/CITES/CMS focal point in the host country?
☐ **Yes X No**   **if yes, please give details:**

7. Principals in project. Please identify and provide a one page CV for each of these named individuals. You may copy and paste this table if you need to provide details of more personnel or more than one project partner.

Details	Project Leader	PP 1 - Main	PP 2
Surname	Peres	Andrade	Michalski
Forename (s)	Carlos	Paulo	Fernanda
Post held	Professor	Professor	Professor
Institution (if different to above)	University of East Anglia	Universidade Federal of Amazonas	Universidade Federal do Amapá
Department	School of Environmental Sciences	Dept. of Agronomy, Vertebrate Wildlife Laboratory	Post-Graduate Program in Tropical Biodiversity & Conservation
Telephone			
Email			

8. Has your organisation received funding under the Darwin Initiative before? If so, please provide details of the most recent (up to 6 examples).

Reference No	Project Leader	Title
162/12/014	Carlos Peres	Biodiversity and functional value of Amazonian primary, secondary and plantation forests in Brazil
16-001	Carlos Peres	Community-based sustainable management of forest resources in Amazonian extractive reserves

9a. IF YOU ANSWERED 'NO' TO QUESTION 8 please complete Question 9,

What year was your organisation established/ incorporated/ registered?	1963
What is the legal status of your organisation?	NGO No Government No University Yes Other (explain)
Type of organisation (e.g. University, NGO, private sector, Government Department etc)	University
Have you unsuccessfully applied to the Darwin Initiative before? If yes please provide the application reference number(s)	1) One <u>unsuccessful</u> proposal, with Dr Douglas Yu, (Application **Ref No: 1506**) 2) Two <u>successful</u> projects: **162/12/014** (2003-2005) and **16-001** (2007-2010)
How is your organisation currently funded?	As a UK university, it is supported by a combination of public and private funds.
Have you provided appropriate audited/independently examined accounts?	Yes

9b. Provide detail of 3 contracts previously held by your institution that demonstrate your credibility as a research organisation and provide track record relevant to the project proposed. These contacts should have been held in the last 5 years and be of a similar size to the grant requested in your Darwin application.

Contract 1 Title	NE/C002504/1 - Precise atmospheric O2 measurements in the UK and their application to land and ocean carbon cycle studies
Contract Value	
Contract Duration	01/11/05 – 31/10/10
Role of institution in project	Primary execution
Brief summary of the aims, objectives and outcomes of the contract.	Development of a new methodology for both measuring O_2 concentrations in the atmosphere, and applying it to global scale biogeochemical cycles
Reference contact details (Name, e-mail, address, phone number).	Dr Andrew Manning (ENV)

Contract 2 Title	NE/E001696/1 - Global data synthesis of air fluxes of gases & aerosols for policy-directed modelling & assessment of climate change & pollution
Contract Value	
Contract Duration	15/11/06 – 14/05/10
Role of institution in project	Primary execution
Brief summary of the aims, objectives and outcomes of the contract.	Global data compilation and synthesis of atmospheric gases and aerosols, with particular relevance to global policy on aerosol pollution.
Reference contact details (Name, e-mail, address, phone number)	Professor Peter Liss (ENV)

Contract 3 Title	NE/F005474/1 - Detecting and classifying bifurcations in the climate system
Contract Value	
Contract Duration	15/05/08 – 15/04/11
Role of institution in project	Primary execution
Brief summary of the aims, objectives and outcomes of the contract.	Exploration of tipping points in planetary scale climate systems, showing nonlinearities in positive and negative feed-backs leading to rapid climate change.
Reference contact details (Name, e-mail, address, phone number).	Professor Tim Lenton (ENV)

9c. Describe briefly the aims, activities and achievements of your organisation. (Large institutions please note that this should describe your unit or department)

Aims (50 words)
The School of Environmental Sciences (ENV) is one of the longest established, largest and most fully developed Schools of Environmental Sciences in Europe. Our holistic approach to teaching and research, integrating biological, physical, chemical, social and geotechnical sciences into the study of natural and human environments creates real strength.

Activities (50 words)
Research is undertaken under a set of guiding themes, in interdisciplinary centres and by groupings of like-minded researchers. Our research activities take place in world recognised research centres such as Tyndall and CSERGE, in research laboratories such as ESFDL, LGMAC, and in ZICER, as well as within the School generally.

Achievements (50 words)
In the 2008 Research Assessment Exercise the School received the highest possible research ranking (5*). The 2012 National Student Survey, gave ENV a 96% satisfaction rate, joint 5th in the UK. Teaching was a particular highlight of the survey, and ENV came in joint 2nd with a rating of 97% satisfaction.

10. Please list all the partners involved (including the Lead Institution) and explain their roles and responsibilities in the project. Describe the extent of their involvement at all stages, including project development. This section should illustrate the capacity of partners to be involved in the project. Please provide written evidence of partnerships.
Please copy/delete boxes for more or fewer partnerships.

Lead institution and website:	Details (including roles and responsibilities and capacity to engage with the project): (max 200 words)
University of East Anglia, UEA www.uea.ac.uk	The PL will be responsible for the overall project science and field logistics oversight, including daily communication with all Partners and Collaborators, remote or in situ coordination of joint project activities in the field, and two field campaigns along the Rio Juruá of 1 month each per project year. The PL will also meet with all Partners and Collaborators twice each year; help teach the technical extension workshops to local stakeholders; co-supervise MSc students; help coordinate the onset of household surveys; conduct part of the limnological and stock assessment field campaigns; facilitate project extension linkages via the Brazilian Ministry of Fisheries Affairs in Brasília, and co-design the exit strategy with CEUC/SDS and FAS. In addition, UEA via Prof Peres and other ecologists will host Brazilian students connected with the project under the *Science Without Borders* programme for research internships periods of 6-12 months.
	The Centre for Environment, Fisheries & Aquaculture Science (CEFAS, Lowestoft, UK), which is directly connected to UEA, will also be able to offer capacity building opportunities for Brazilian scientists and postgraduate students associated with the Project.

Partner Name and website where available: Universidade Federal do Amazonas (UFAM) **www.ufam.edu.br**	Details
	Andrade will be in charge of the freshwater turtle ecology and management component of the project, and will maintain full-time physical presence in Manaus or Carauari, and serve as a liaison vice-coordinator of the Project in the PL's absence. He has a team of four experienced technicians (with full-time salaries covered by UFAM) with whom he is prepared to travel to the study landscape twice each year for 3 years (covering both the dry- and the wet-seasons) to: coordinate discussions with local communities over protected beach zoning; oversee the adult female captures, biometrics, and satellite geo-tagging of turtles; coordinate activities during the busy egg-laying season including nest counts at all beaches, hatchling eclosion counts, quarantining, and microchip tagging of hatchlings; and teach the 5-day turtle ecology & management workshop. **Andrade** and the PL will also co-supervise a UFAM MSc student who will conduct part of the satellite monitoring of adult movements both in situ and remotely via MoveBank www.**movebank**.org. This PP will also assist in the wider policy integration of the project which at its most ambitious scale will include GIS-based conservation zoning plans for all major white-water riparian corridors of the Brazilian Amazon where turtle populations are limited by the scarcity of protected fluvial beaches.

Have you included a Letter of Support from this institution?	Yes

Partner Name and website where available: **Universidade Federal do Amapá** **www.unifap.br**	**Details** **Michalski** will further help anchor the project into Brazilian academia and policy by providing full-time presence in Macapá, Manaus or Carauarí, assisting with project bureaucracy, and supervising MSc students at UNIFAP. She will be responsible for the "problem-species" component of the project including giant otter and black caiman field surveys, discussions with local communities on the thorny issue of population culls resulting from natural predation threats, helping prepare the *Apex Predator Booklet*, and co-teaching the technical extension workshops. She is a member of the National Centre of Predators http://www.icmbio.gov.br/portal/biodiversidade/centros-de-pesquisa/predadores.html and the ProCarnívoros Association www.procarnivoros.org.br , both of which oversee human-wildlife conflicts in relation to large apex predators. **Michalski** is a hard-core Brazilian vertebrate biologist and further strengthens the wildlife biology vein of the project.
Have you included a Letter of Support from this institution?	**Yes**

Lead institution and website: **Fundação Amazonas Sustentável (FAS)** **fas-amazonas.org**	**Details (including roles and responsibilities and capacity to engage with the project): (max 200 words)** **Fundação Amazonas Sustentável (FAS)** has deployed one of the largest Payments for Ecosystem Services programmes anywhere in the tropics. Since 2007, they have enrolled >8,200 families belonging to 541 local communities of rural Amazonians settled within 15 State of Amazonas Sustainable-Use Forest Reserves (accounting for >10 million hectares) in a successful deforestation avoidance programme. Following extensive discussions with Dr Virgílio Viana of **FAS**, we have decided to join forces to expand this programme to biological resource populations that are overexploited by semi-subsistence communities. A joint project with **FAS** provides a critical economy of scale in deploying joint field activities, a unique integration of objectives in managing both forest and aquatic landscapes, and vastly increases our chances of future applications of project results to the other 14 reserves where they work. We also gain full-time access to their facilities in Manaus and Carauari. **FAS** has agreed to deploy joint technical workshops with project members and share the burden of organizing those workshops. Our project philosophy will also influence their remit in not only considering the degree of forest cover in those reserves, but the integrity of biological communities of forests, rivers and lakes, particularly in terms of the viability of harvest-sensitive vertebrate populations.

11. Have you provided CVs for the senior team including the Project Leader	Yes

TECHNICAL EXCELLENCE

12. Problem the project is trying to address

Please describe the problem your project is trying to address. For example, what biodiversity and development challenges will the project address? Why are they relevant, for whom? How did you identify these problems?

Lowland Amazonia supports the largest freshwater fishery and the most species-rich fish fauna on Earth. Aquatic vertebrates (fish and reptiles) 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. Basic life-history data and stock-recruitment relationships necessary to implement effective quantitative fisheries management are still lacking. This 3-yr project will be conducted along a 492-km section of the Central Juruá region of western Brazilian Amazonia and aims to develop a spatially-explicit set of guidelines to inform landscape-scale fisheries management protocols that can be applied to any major watershed across all lowland Amazonian countries. In particular, we will use a network of 83 large oxbow lakes and 97 sandy beaches along the second-largest white-water tributary of the Amazon to (1) consolidate 'fishing agreements' to zone the spatial structure of commercial fishing; (2) understand the relationship between spawning biomass and fish recruitment and how this stock-recruitment relationship depends on limnological variables such as lake size and productivity; (3) understand the demographic importance of 'no-take' areas (i.e. strictly protected lakes and beaches) in maintaining a sustainable fishery and the spatial dynamics of commercial fishing boats; (4) resolve 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.

13. Methodology

Describe the methods and approach you will use to achieve your intended outcomes and impact. Provide information on how you will undertake the work (materials and methods) and how you will manage the work (roles and responsibilities, project management tools etc).

(Max 500 words – repeat from Stage 1 -- changes are highlighted in **blue**)

The work programme will be broken down into eight empirical and theoretical components, briefly described as following:

Fishing Agreements and Spatial Zoning of Fishing Activity. '*Acordos-de-Pesca*' (fishing agreements) offers a promising approach to resolve long-held fishing disputes between local communities and commercial fishing boats in the central Rio Juruá region. We will work with the Fishermen Cooperatives of Carauarí and Eirunepé, the two largest regional urban centers, and use these agreements to consolidate three classes of access to oxbow-lakes for commercial fishing boats ('strictly-protected'; 'subsistence-only'; and 'open' lakes). This will form the basis of a large-scale spatial zoning experiment to be investigated by this project.

Freshwater turtle ecology & management program. An incipient *Podocnemis* turtle management programme implemented in the Médio Juruá region (including dry-season protection of egg-laying beaches; and quarantining of turtle hatchlings) will be consolidated as part of this Project.

Oxbow-lake productivity. At each of 83 oxbow-lakes (size range = 3 – 250 ha) along a 500-km section of the Central Juruá river, the following limnological variables will be measured (using both in situ sampling and a remote-sensing approach) both in the dry and wet seasons: oxbow-lake size and connectivity; aquatic plant (macrophyte) cover; water transparency; temperature; sediment load; conductivity; chlorophyll concentration; dissolved oxygen; dissolved inorganic carbon (DIC); and plankton abundance.

Large-scale sampling of household-level CPUE. Data on Catch-Per-Unit-Effort [Fish offtake (Kg) per unit time (hours) spent fishing] will be recorded for 420 households distributed across 35 local communities using a semi-structured questionnaire deployed during weekly interviews for 24 consecutive months. Six subsistence fishing techniques are used throughout

the Juruá, so type of fishing gear will be one of the main covariates in subsequent GLMM modelling.

Annual counts of pirarucu (*Arapaima gigas*) stocks. The heavily overfished *Arapaima* is one of the largest freshwater fishes on Earth. *Arapaima* has evolved air-breathing behaviour to survive extremely low dissolved Oxygen concentrations of oxbox lakes in lowland Amazonia. Because these lung-fish come up for air every ~15min, they can be counted by trained Project assistants. *Arapaima* populations will therefore be censused each year at 83 oxbow-lakes coinciding with the period of lowest lake water-level. A stock-recruitment model will then be used to design sustainable offtake quotas for this commercially valuable species.

Meetings with Fishery Cooperative and GPS-monitoring of commercial fishing boats. Based on Method (1) above, Garmin 60Csx GPS receivers will be fitted to most of the ~150 fishing boats stationed in Carauarí and Eirunepé, to quantify the spatial structure of commercial fishing activity.

Monitoring of fish-landing offtake at two urban centers. Quantitative estimates of fish and turtle landings at the urban markets of Carauarí and Eirunepé will be obtained using weekly surveys during Project Years 1 and 2 (≈ 104 weeks).

Role of 'problem-species' in human-wildlife conflicts. Two endangered species in the Juruá -- Giant Otter (*Pteronura brasiliensis*) and Black Caiman (*Melanosulchus niger*) – are perceived as major competitors and routinely killed by fishermen. This component of the project will be developed using population censuses; local interviews; and quantitative estimates of fish resource use and spatial overlap between otters/caimans and fishermen.

Spatial modelling of oxbow-lake fish productivity. This theoretical component will build on 24 months of empirical data from 83 oxbow-lakes in the Central Juruá region to estimate key parameters in oxbow-based source-sink dynamics of aquatic resources for the entire Rio Juruá watershed.

14. Outcome

Detail what the expected outcomes of this work will be. The outcome should identify what will change and who will benefit. The outcome should refer to how the project will contribute to reducing poverty while contributing to sustainable development and management of biodiversity and its products. A summary statement of this outcome should be provided in question 4 and 24.

This project will:

(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.

(2) Understand the competitive basis for local conflicts 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.

(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.

(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 are frequently killed by fishermen to protect fish stocks.

(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.

(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*.

15a. Is this a new initiative or a development of existing work (funded through any source)?   Please give details (Max 200 words):

Although this is thematically an entirely new initiative, it builds upon an earlier 3-year Darwin-funded project (Ref. No. 16-001) in the same region of Brazilian Amazonia (a 492-km section of the median Juruá river). Our earlier project (2007-2010) was not designed to consider the conservation and management of local fisheries and other aquatic resources, but as we have learnt, these are in fact the most valuable natural resources in this region and throughout the floodplain forests of all major tributaries of the Amazon. Furthermore, our previous project built the solid socio-political foundations on which this project can now be efficiently erected, including an excellent working relationship with 35 local communities (including the availability of 45 trustworthy field assistants); strong alliances with the University of Amazonas and local government and nongovernment agencies; a relationship of trust with state-agencies based in Manaus; access to an office in Carauarí and two field stations along the Rio Juruá, which will facilitate logistical deployment of the project. In sum, the project itself is entirely new but the territory and political landscape in which it will be deployed are well known to us, and we now know exactly what it takes to make this project work.

15b. Are you aware of any other individuals/organisations/ projects carrying out or applying for funding for similar work? ☐ **Yes X No**

If yes, please give details explaining similarities and differences, and explaining how your work will be additional to this work and what attempts have been/will be made to co-operate with and learn lessons from such work for mutual benefits:

15c. Are you applying for funding relating to the proposed project from other sources? ☐ **Yes X No**

If yes, please give brief details including when you expect to hear the result. Please ensure you include the figures requested in the spreadsheet as Unconfirmed funding**.**

16. Value for money

Please describe why you consider your application to be good value for money including justification of why the measures you will adopt will secure value for money?

(Max 250 words)

Raising per capita daily extractive yields from aquatic sources of animal protein by only 50% (a conservative estimate that we can easily achieve over 3+ years), would represent financial savings to local livelihoods of US$1,149,750 in purchases of substitution meat (chilled bovine beef), considering only the 4,500 people of the Médio Juruá region. This alone dwarfs the budget of this project. Applying project lessons to a much larger scale (e.g. to include the ~2.2 million rural people of Amazonas) would further grow the value-for-money justification of the project. There are a number of overlapping government agencies in Amazonian countries charged with implementing sustainable natural resource management. Unfortunately, the most obvious resource exploitation management problems are overlooked and management restrictions, if any, are difficult to enforce, resulting in negligible levels of compliance, particularly by the rural private enterprise sector, often serving powerful financial interests. This project is fully endorsed by state agencies and aims to implement with local stakeholders — the legal occupants of two large sustainable-use Amazonian forest reserves — a comprehensive landscape-scale community-based fisheries management protocol that can be used as an Amazon-wide model. Levels of financial and human resources that can be leveraged by government agencies in several Amazonian countries are hundreds of times greater than the cost of this project. This is effectively a demonstration project showing how CPRM (common-pool resource management) protocols that manipulate the spatial structure of harvesting

activities over vast landscapes can be implemented. The project is therefore designed to catalyse much larger financial investments to emulate our working management model elsewhere in Brazilian, Peruvian, Bolivian and Colombian Amazonia. We expect that, if successful, this model will attract many millions of USD from official sources, dwarfing the total budget of this project.

17. Ethics

Outline your approach to meeting the Darwin Initiative's key principles for research ethics as outlined in the guidance notes.

(Max 300 words)

This project will meet all national and state legislative and ethical obligations of a research & technical extension programme of this kind both in Brazil and the UK. This will require: (1) a SISBIO research license from IBAMA as applied to any scientific enterprise in Brazil; (2) the explicit prior informed consent of the Deliberating Councils of the two target forest reserves (RDS Uacari and RESEX Medio Juruá) and the leadership of all local communities; (3) proper authorization from CEUC-SDS to conduct research & extension at RDS Uacari; (4) proper authorization from ICMBio to conduct research & extension at RESEX Medio Jurua; (5) adequate veterinary training in handling live animals including *Arapaima* fish and *Podocnemis* turtles; and (6) as required by Brazilian laws guarding against inappropriate scientific conduct and biopiracy, the appropriate scientific research permits to collect any plant and animal voucher specimens, which will be deposited in official herbaria and zoological collections. All interview-based sampling protocols will pay explicit attention to the well-being of local interviewees. We are very familiar with the ethics of social science protocols and interviewers will put themselves "in the shoes" of local informants in all partner communities. Questionnaires will be reviewed by a Committee with a membership outside the School of Environmental Sciences at UEA, as mirrored by ESRC demands for all their funded social research. We have 4 years of experience in the study region dealing with all stakeholders involved, including village leaders, local extractors, the management councils of the two target reserves, and all relevant government agencies, which will ensure appropriate sensitivity to all stages of negotiations, often involving competing interests. The rights and privacy of all people involved in any research project activities will be respected; and we will guard against any risks & hazards in upholding the safety of both project members and local assistants.

PATHWAY TO IMPACT

18. Legacy

Please describe what you expect will change as a result of this project with regards to biodiversity conservation/sustainable use and poverty alleviation. For example, what will be the long term benefits (particularly for biodiversity and poor people) of the project in the host country or region and have you identified any potential problems to achieving these benefits?

(Max 300 words)

Inland fisheries comprise the most important source of animal protein for the 23 million rural and urban people of Amazonia, a region containing the most species-rich ichthyofauna on Earth (>5,500 freshwater fish species). The Juruá river is the most important source of commercially-valuable fish landings (particularly Characiforms) to the largest urban market (Manaus ≈ 2 million people). However, widespread long-gill-net and dynamite overfishing in all major tributaries and abutting oxbow lakes has lead to the collapse of many fish stocks, reducing the supply of fish protein to both local subsistence communities and commercial fisheries. Governmental policies to prevent stock depletion, including minimum-size rules, banning of predatory fishing-gear, and no-take seasons, are widely violated, rarely enforced and have had little success. This has incentivized the production of alternative (terrestrial) animal protein, including bovine cattle and small livestock, which necessarily depend on cattle pasture expansion which, in turn, accounts for 80% of all Amazonian deforestation. This project therefore addresses what is arguably the most critical issue at the interface between

food security, biodiversity conservation, natural resource management, and land-use change. Community-based management of local fisheries through use-restricted spatio-temporal mosaics is arguably the most powerful solution to this resource management problem, but this is yet to be tested empirically. The project aims to implement with local actors (and endorsed by state agencies) a water-tight landscape scale community-based system of use-restriction accords that can be used as a basin-wide model of inland fisheries management. As a byproduct, the project will have direct implications to one of the most intractable management challenges in Amazonia: the conservation of the heavily settled Amazonian floodplain forests, which sustain the trophic resources on which fish and turtle populations depend. Financial investments in emulating a successful model elsewhere in Amazonia will likely attract many millions of USD from official sources, dwarfing the total budget of this project.

19. Pathway to poverty alleviation

Please describe how your project will benefit poor people living in low-income countries. Projects are required to show how positive impact on poverty alleviation will be generated from your project in low-income countries. All projects funded under the Darwin Initiative in Round 19 must be compliant with the Overseas Development Assistance criteria as set out by the OECD. The outcomes of your research must at the very least provide insight into issues of importance in achieving poverty alleviation.

(Max 300 words)

This demonstration project is at the nexus of local food security, alternative revenue generation for low-income rural communities, wildlife conservation, and implementation of natural resource management in legally-occupied protected areas. Rural Amazonians live primarily along major navigable rivers and their nutrient-rich floodplains, and consume 369-800 grams of fish per day all year-round. Aquatic vertebrate protein remains the most important component of human nutrition, yet many large-bodied and migratory fish and turtle species are declining in numbers and biomass yield despite higher capture capacity and effort, increasingly forcing local communities into a market-integrated economy where cash must be generated to purchase alternative protein, including bovine beef. Animal protein provision is arguably the most important ecosystem service of Amazonian rivers and floodplain forests for local riparian communities, yet this service is being eroded due to overfishing and deforestation along floodplains. This project seeks to understand the wildlife conservation and socioeconomic benefits of stock protection to local communities in terms of increasing fishing yields, thereby elucidating the advantages of protected areas to local residents.

Most Amazonian communities live in a virtually cash-free economy where extractive goods from natural ecosystems and subsistence crops largely meet local needs. Moreover, income inequality in Brazil is one of the highest anywhere, with few welfare programmes reaching remote parts of the country. Yet Brazil is technically not defined as a "low-middle income" OECD country and as such the host country focus of the pre-proposal was questioned by the expert panel. However, the entire lowland Amazon is a homogeneously low-income region sharing very similar resource management challenges and limited capacity. The results of this start-up demonstration project can therefore be applied to any of the nine Amazonian countries, including Peru, Bolivia, and Colombia, several of which are OECD low-income countries. We will therefore ensure that project results (and our *Freshwater Fisheries Handbook*) are made available in Spanish and distributed to the relevant agencies of all Amazonian countries, including INDERENA and MINAM (Peru), ANLA and Ministerio de Medio Ambiente (Colombia), and Ministerio de Medio Ambiente y Agua (Bolivia).

20. Exit strategy

State whether or not the project will reach a stable and sustainable end point. If the project is not discrete, but is part of a progressive approach, give details of the exit strategy and show how relevant activities will be continued to secure the benefits from the project. Where individuals receive advanced training, for example, what will happen should that individual leave?

(Max 200 words)

The project will be conducted under the jurisdiction of ICMBio/MMA and CEUC/SDS, respectively the federal and state-level governmental organizations responsible for the implementation of sustainable use protected areas in Brazilian Amazonia. The project is designed to instigate the sustainable management of freshwater resources within multiple-use protected areas and beyond. As such project approaches are expected to merge seamlessly with *ProBUC*, the Biodiversity Monitoring Program of CEUC/SDS, which has long-term funding. Any significant project protocols tested and lessons learnt can be subsequently deployed by *ProBUC* once the project is discontinued. The project is also expected to train individuals that will likely end up working for these organizations, thereby ensuring transferability of project results. GPS-based sampling procedures in which the movements of any fleet of commercial fishing boats can be monitored are also expected to be rolled out to other river basins, thereby ensuring enforceable compliance of spatial restrictions on fishing activities. Lessons learnt from the *Podocnemis* turtle component of the project can also be transferred to *Projeto Pé de Pincha*, which has a long-term financial structure. In sum, this is not a one-off set of activities but represent a seminal interdisciplinary investment upon which similar freshwater biodiversity monitoring and negotiated restrictions can be implemented in the long-term, well beyond the project lifetime.

HIGHLY DESIRABLE

21. Raising awareness of the potential worth of biodiversity

If your project contains an element of communications, knowledge sharing and/or dissemination please provide a description of your intended audience, how you intend to engage them, what the expected products/materials there will be and what you expect to achieve as a result. For example, are you expecting to directly influence policy in your host country or is your project a community advocacy project to support better management of biodiversity?

(Max 300 words)

Our intended audience include government agencies and the public at large. The focal megafauna addressed by project include at least eight charismatic large-bodied species of fish, turtles, caimans and giant otter, providing ample ammunition for short 10-min videos that can be aired during talks and uploaded to YouTube (this is indirectly costed in this project). These large vertebrate species are frequently eaten by, and therefore well known to, all rural and most urban Amazonians. Few conservation stories are more captivating than a group of small children safely releasing thousands of post-quarantine turtle hatchlings raised on protected sand beaches, as expected from one of the project outputs. The results of the project should speak for themselves if the 'win-win' scenario that we expect to achieve [i.e. a clear population recovery trajectory for vulnerable harvest-sensitive species _and_ higher local protein intake [as a function of elevated CPUEs] is indeed materialized.

The illustrated *Handbook of Freshwater Fisheries Management Techniques*, and the *Turtle Ecology &* Management and the "*Problem-Species*" booklets that we intend to produce during the last 12 months of the project is another dissemination tool, because this can be repeatedly printed at low cost and distributed across hundreds of local communities outside the study region who also face very similar management problems. Although most of the publications resulting from this project are expected to consist of 'dry' technical documents in peer-reviewed journals of limited readerships, we will endeavour to produce a few popular articles in Portuguese and Spanish that can reach much wider audiences. We will also work with *Rede Globo* and *Bandeirante*, two large Brazilian television networks to produce at least one special documentary on the *Life of the Juruá Floodplains*. Finally, we expect to give dozens of talks to different local, national and international audiences during workshops, symposia, and international congresses, thereby also targeting more specialized audiences.

22. Importance of subject focus for this project

If your project is working on an area of biodiversity or biodiversity-development linkages that has had limited attention (both in the Darwin Initiative portfolio and in conservation in general) please give details.

(Max 250 words)

The conservation of freshwater species and management of freshwater resources are arguably the two most neglected frontiers in Conservation Biology, particularly in the humid tropics. Conservation planning of terrestrial biotas has been reasonably well addressed in recent decades and there has been a renewed focus on marine biotas and marine protected areas. We believe this project will therefore help redress the balance in relation to tropical freshwater biodiversity and freshwater resources in the largest river basin on Earth. In addition, the still incipient issue of no-take areas is growing in stature in the conservation ecology literature, but this concept has never been extended to highly mobile freshwater resource populations that may operate under source-sink population dynamics, within which protected source populations could be critical in maintaining overexploited stocks elsewhere, as most of the wider landscape is expected to incur demographic deficits due to overharvesting. Both the empirical fieldwork and theoretical modelling components of this project will examine the concept of no-take oxbow lakes and fluvial beaches (which will be strictly protected on a seasonal basis) as a conservation tool to boost the landscape-scale sustainability of the most vulnerable resource populations. Finally, the spatial dynamics of intra-tropical migratory species remain poorly known specially in Amazonia. 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.

23. Leverage

a) Secured

Provide details of all funding successfully levered (and identified in the Budget) towards the costs of the project, including any income from other public bodies, private sponsorship, donations, trusts, fees or trading activity.

Confirmed:

- Fundação Amazonas Sustentável (FAS) will contribute £164,842 in household-scale local stipends at the same local communities targeted by this project (R$60/month per household x 261 households over 3+ project years);

- Another large in-kind contribution involves the full-time use of two large field stations managed by CEUC/SDS (with office/internet facilities) that will remain entirely available to the Project over 3+ years. Rental costs of these facilities would be conservatively equivalent to £7,200 over a 3-year period considering a mean usage of 6 project members for 24 months.

- One international airfare to the PL per year for 3 consecutive years (granted by the Brazilian Ministry of Education – CAPES) = £3,300.

- ARGOS Satellite transmitter (5 transmitters) and satellite tracking service fee covered by UFAM. This amounts to £10,780.

- Full-time salaries of four wildlife technicians employed by UFAM (and seconded to the Vertebrate Wildlife Lab of UFAM). This is equivalent to £180,000 over a 3-yr period.

b) Unsecured

Provide details of any matched funding where an application has been submitted, or that you intend applying for during the course of the project. This could include matched funding from the private sector, charitable organisations or other public sector schemes.

Date applied for	Donor organisation	Amount	Comments
3 November 2012	HRT Oil & Gas (oil company)	£21,033	48 (12 per yr x 4 yrs) free return flights in small aircrafts for project members from Manaus to Carauari. Commercial flights over this 900-km route are monopolized by a small airline, and are therefore very expensive (R$1500 each). This request will almost certainly go through.
5 November 2012	ICMBio (Brazilian Ministry of Environment)	£29,212	Printing costs of 10,000 hardcopies (at R$10 each) of the illustrated *Handbook of Freshwater Fisheries Management Techniques*;
8 November 2012	Samir Arora (professional filmmaker and video-editor)	£7,500	Samir Arora (http://vimeo.com/scarora) is a freelance director and video editor who has agreed to produce a 10-min project video to be posted on YouTube. His career includes projects in 16mm, 35mm, and all flavours of digital video. He teaches digital videography at Duke University, North Carolina, USA.

PROJECT MONITORING AND EVALUATION

MEASURING IMPACT

24. LOGICAL FRAMEWORK

Darwin projects will be required to report against their progress towards their expected outputs and outcomes if funded. This section sets out the expected outputs and outcomes of your project, how you expect to measure progress against these and how we can verify this. Further detail is provided in Annex x of the guidance notes which you are encouraged to refer to. The information provided here will be transposed into a logframe should your project be successful in gaining funding from the Darwin Initiative. The use of the logframe is sometimes described in terms of the Logical Framework Approach, which is about applying clear, logical thought when seeking to tackle the complex and ever-changing challenges of poverty and need. In other words, it is about sensible planning.

Impact

The Impact is not intended to be achieved solely by the project. This is a higher-level situation that the project will contribute towards achieving. All Darwin projects are expected to contribute to poverty alleviation and sustainable use of biodiversity and its products.

> (Max 100 words)
>
> The project is expected to enhance the implementation of sustainable-use tropical forest reserves, which account for 63.1 million hectares of new protected areas created in Brazilian Amazonia since 1991. We expect the project will achieve the ideal 'win-win' scenario in which both higher biomass yields per unit effort for local rural populations and clear population recovery for highly vulnerable harvest-sensitive species can be demonstrated. The project is expected to pioneer the design and field-test of a spatial model of natural resource management that can be enforced by local communities and applied by government agencies to most freshwater resources in Amazonian inland fisheries.

Outcome

There can only be one Outcome for the project. The Outcome should identify what will change, and who will benefit. The Outcome should refer to how the project will contribute to reducing poverty and contribute to the sustainable use/conservation of biodiversity and its products. This should be a summary statement derived from the answer given to question 14.

(Max 100 words)

Understand the spatial dynamics of productivity and exploitation of aquatic vertebrates — including fish, turtles and caimans — 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.

Measuring outcomes - indicators

Provide detail of what you will measure to assess your progress towards achieving this outcome. You should also be able to state what the change you expect to achieve as a result of this project i.e. the difference between the existing state and the expected end state. You may require multiple indicators to measure the outcome – if you have more than 3 indicators please just insert a row(s).

Indicator 1	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.
Indicator 2	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.
Indicator 3	Limnological measurements conducted at 83 oxbow lakes along a ~492-km section of the Juruá River.
Indicator 4	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
Indicator 5	(a) 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 (b) Monitoring of fish landings from fishing boats at the local markets of these urban centers.
Indicator 6	Spatial modelling of oxbow-lake fish productivity under varying degrees of protection from commercial fishing and connectivity to the main river channel.

Verifying outcomes

Identify the source material the Darwin Initiative (and you) can use to verify the indicators provided. These are generally recorded details such as publications, surveys, project notes, reports, tapes, videos etc.

Indicator 1	Data sheets and Excel spreadsheets; photos/videos of Arapaima counts; photos/videos of Arapaima workshop; time series of Arapaima counts; analytical material on stock-recruitment model.

Indicator 2	Data sheets and Excel spreadsheets; photos/videos of hatchling eclosion in protected beaches; data on hatchling releases; *MoveBank* data on GPS-tracked adult turtle movements; data on mark-recapture program using transponder chips; photos/videos of Podocnemis turtle workshop.
Indicator 3	Data sheets and Excel spreadsheets; measurements of 11 limnological variables and patch metrics of 83 oxbow lakes; GIS maps of macrophyte cover on lakes
Indicator 4	Data sheets and Excel spreadsheets from ~420 households monitored at 35 communities; large meta datafile containing offtake data from some 43,680 household interviews.
Indicator 5	Composite maps of commercial fishing activities and movements of the entire fleet of 'freeze' boats. Fish landing data from urban markets.
Indicator 6	Model simulations and predictive modelling results based on real-world data, but assuming different scenarios of oxbow lake protection from commercial fishing; and GIS mapping of all oxbow lakes, sandy beaches, and flood-pulse duration of the floodplain forests. Stock-recruitment model simulations under different protection scenarios. A source-sink dynamics model for at least one of the eight aquatic vertebrate species addressed in this study.

Outcome risks and important assumptions

You will need to define the important assumptions, which are critical to the realisation of the *outcome and impact* of the project. It is important at this stage to ensure that these assumptions can be monitored since if these assumptions change, it may prevent you from achieving your expected outcome. If there are more than 3 assumptions please insert a row(s).

Assumption 1	Census techniques from dugout canoes, which have already been developed and tested for this air-breathing fish, can be implemented at a large number of oxbow lakes for this air-breathing fish. This is safe assumption.
Assumption 2	Egg-laying female turtles can be counted at night during the breeding seasons, and that the nests can be marked for later retrieval (and quarantining) of turtle hatchlings at all protected beaches to reduce post-hatchling mortality. Adult females of both *P expansa* and *P unifilis* can be captured and GPS-tagged during egg-laying events. This is safe assumption. At least some adult males can be GPS-tagged – this is an unsafe assumption because males are far more difficult to capture.
Assumption 3	Measurements of 11 patch metrics and limnological variables can be gathered at all 83 oxbow lakes during the dry-season, and repeated once during the wet season. This is safe assumption.
Assumption 4	Daily wages of R$40 are available to pay a total of 35 reliable local field assistants or "*monitores*" (one per community) to work for the project for at least 5 days per month; each field assistant will sample a group of 12 households once each week. This is safe assumption.
Assumption 5	(a) Commercial fishermen will both comply with the spatial monitoring scheme, following conditional directives from the Fishermen Cooperative, and will allow monitoring of boat movements. This would require that GPS receivers, which can operate for at least 72 hours on one set of batteries, are neither turned-off nor removed from the boats even when boats are unstaffed by project personnel. This is a sensitive assumption, so will require both creative negotiation with fishermen leaders and a verification

	mechanism of continuous functionality of GPS receivers to ensure that we are indeed recording honest movement data on fishing boats. This procedure has not been attempted before in Amazonia but is doable.
	(b) We are able to hire appropriate field assistants or recruit UFAM MSc students to monitor fish landing data at two urban markets.
Assumption 6	(a) Background empirical data are collected to parameterize model simulations; (b) Cloud-free high-resolution *Rapid-Eye* satellite images can be purchased to cover the entire study area and ALOS PALSAR high-resolution radar images can be obtained from JAXA (Japanese Aerospace Agency) to map the dynamics of the flood pulse. The modelling work is certain; however, the robustness of model outputs reply heavily on data quality and quantity.

Outputs

Outputs are the specific, direct deliverables of the project. These will provide the conditions necessary to achieve the Outcome. The logic of the chain from Output to Outcome therefore needs to be clear. If you have more than 3 outputs insert a row(s). It is advised to have less than 6 outputs since this level of detail can be provided at the activity level.

Output 1	Design, local empowerment, consolidation and expansion of the landscape scale spatial management system concerning a large network of oxbow lakes
Output 2	Design, local empowerment, consolidation and expansion of the spatial management system addressing freshwater turtles and ovipositing sites on fluvial sandy beaches
Output 3	Design, local empowerment, and expansion of the management system addressing *Arapaima* fisheries in both oxbow lakes and the river channel
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*)
Output 5	Empirical and theoretical test of established management protocols and expansion into other river basins of Brazilian Amazonia and other Amazonian countries

Measuring outputs

Provide detail of what you will measure to assess your progress towards achieving these outputs. You should also be able to state what the change you expect to achieve as a result of this project i.e. the difference between the existing state and the expected end state. You may require multiple indicators to measure each output – if you have more than 3 indicators please just insert a row(s).

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

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)
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
Indicator 5	Preparation of the *Handbook of Community-Based Freshwater Fisheries Management Techniques*
Indicator 6	Dissemination of the *Handbook* to all institutions involved in resource management, particularly concerning fisheries

Output 2: Local empowerment and deployment of a freshwater turtle ecology and management programme	
Indicator 1	Training Workshop on turtle management to local stakeholders, namely the residents of RDS Uacari and RESEX Medio Jurua
Indicator 2	Discussions with Reserve Management Council on spatial zoning of all dry-season sandy beaches
Indicator 3	Number of fluvial sand beaches protected along a 492-km section of the Rio Juruá
Indicator 4	Counts and electronic tagging of live turtle hatchlings dug from nests, quarantined, and released.
Indicator 5	Large-scale movements of adult *Podocnemis* turtles over a 24-month period.

Output 3: Local empowerment and consolidation of *Arapaima* stock assessment and management programme	
Indicator 1	Initial presentation of subproject and raining Workshop to local artisanal fishermen from 35 local communities on Arapaima census techniques
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)
Indicator 3	Total number of protected oxbow lakes negotiated with commercial 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
Indicator 4	Time-series from at least 26 lakes beginning to show population recovery trends by the end of Project Year 3.

Output 4: Design and establishment of 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*

Indicator 2	Dissemination of a "problem-species" illustrated educational booklet to all Jurua communities.
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.*
Indicator 4	Illustrated talks at seven venues bringing together representatives of ~40 local communities of RESEX Medio Jurua and RDS Uacari.

Output 5: Empirical and theoretical test of management protocols and expansion into other river basins of Brazilian Amazonia and other Amazonian countries	
Indicator 1	Analytical approaches to data integration including productivity-based stock-recruitment models; 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.
Indicator 2	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.
Indicator 3	Final Workshop held in Manaus to a target audience of natural resource management agencies, particularly government and nongovernment organizations responsible for fisheries management
Indicator 4	Presentations of project results at the Latin American Wildlife Management Congress, Association for Tropical Biology & Conservation meeting, and Society for Conservation Biology.

Verifying outputs

Identify the source material the Darwin Initiative (and you) can use to verify the indicators provided. These are generally recorded details such as publications, surveys, project notes, reports, tapes, videos etc.

Indicator 1	Completed datasheets of household CPEU surveys; *Arapaima* counts; limnological surveys of oxbow lakes; turtle nest and hatchling counts; counts of giant otters; counts of black caimans;
Indicator 2	Minutes of negotiation meetings with the Fishermen Cooperative of Carauari & Eirunepé
Indicator 3	Composite maps of commercial fishing boat activity within and outside target reserves within a 500-km section of the Rio Juruá.
Indicator 4	GIS analysis of oxbow lake patch metrics and aquatic plant (macrophyte) cover based on *Rapid-Eye* imagery.
Indicator 5	Stock-recruitment models for key commercially-valuable fish species, including *Arapaima* and *Colossoma*.
Indicator 6	Development of quantitative techniques to inform the spatial management and mapping of exploited vertebrate populations

Output risks and important assumptions

You will need to define the important assumptions, which are critical to the realisation of the achievement of your outputs. It is important at this stage to ensure that these assumptions can be monitored since if these assumptions change, it may prevent you from achieving your expected outcome. If there are more than 3 assumptions please insert a row(s).

Assumption 1	All 83 oxbow lakes can be mapped using both low- (*Landsat*) and high-resolution (*Rapid-Eye*) land cover data; and physically accessed during both the dry and the wet season. Field measurement of lake limnology can be deployed without any problems.
Assumption 2	Local discussions on turtle subproject go well following deliberation by the Management Councils of both RDS Uacari and RESEX Medio-Jurua.
Assumption 3	Local communities within the immediate proximity of 23 key oxbow lakes both agree to the Arapaima Conservation & Management Plan, and participate in field activities such as the critical invigilation of lakes ensuring protection from commercial fishing boats.
Assumption 4	Population surveys and interviews concerning all "problem" apex-predators can be implemented smoothly.
Assumption 5	Background field data that will feed all modelling approaches are of sufficiently high quality; and that the spatial extent of the sites investigated is meaningful.

Activities

Define the tasks to be undertaken by the research team to produce the outputs. Activities should be designed in a way that their completion should be sufficient and indicators should not be necessary. Any risks and assumptions should also be taken into account during project design.

Output 1: Local empowerment and consolidation of an oxbow lake management system across the entire study landscape	
Activity 1.1	Seasonal limnological sampling of 83 oxbow lakes with one dry-season and one wet-season campaign
Activity 1.2	Household-level surveys of all types of aquatic resources extracted across ~420 households distributed across 35 local communities
Activity 1.3	Investigate the relationship between household CPUE and oxbow lake primary productivity under different categories of lake protection
Activity 1.4	Investigate the relationship between household CPUE e explanatory variables both at the patch and landscape scale
Activity 1.5	Examine the functionality and ecosystem level consequences of lake protection status according to the 'fishing accords' promoted by the 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.
Activity 1.7	Design, preparation, printing and distribution of a *Handbook of Freshwater Fisheries Management Techniques*

	Output 2: Local empowerment and deployment of freshwater turtle ecology and management programme
Activity 2.1	Local agreements setting-aside a set of protected egg-laying sand beaches along a 492-km section of the Rio Jurua.
Activity 2.2	A 5-day training course (for 30 local assistants and village leaders) on the conservation & management of freshwater turtles.
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.
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.
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.
Activity 2.6	Electronic tagging of 5,000 post-quarantine hatchlings [using transponders microchips] prior to releasing from fluvial beaches
Activity 2.7	Design and production of an illustrated booklet on *Freshwater Turtle Ecology & Management*.

	Output 3: Local empowerment and consolidation of *Arapaima* stock assessment and management programme
Activity 3.1	Reserve 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.
Activity 3.2	Annual counts of adult pirarucu fish (*Arapaima gigas*) in at least 23 oxbow lakes
Activity 3.3	Mapping of lakes with varying probability of *Arapaima* occurrence
Activity 3.4	Training of 60 artisanal fishermen in *Arapaima* census techniques, to be included in annual counts
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.

	Output 4: Design and establishment of a management plan for "problem" apex predators including *Pteronura* and *Melanosuchus*
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
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.
Activity 4.3	Interviews at 40 communities to obtain species occupancy and incidence

	density data for a 500-km section of the Rio Juruá.
Activity 4.4	Mapping of all water bodies including oxbow lakes, overlaid with the occurrence probability of *Pteronura* and *Melanusuchus*
Activity 4.5	Conduct a spatio-temporal and resource overlap analysis between otters/caimans and fishermen
Activity 4.6	Design and production of an illustrated educational booklet to enhance the prospects of large predator conflict resolution across all local communities.

Output 5: Empirical and theoretical test of management protocols and expansion into other river basins of Brazilian Amazonia and other Amazonian countries	
Activity 5.1	Stock-recruitment model to inform sustainable *Arapaima* offtakes from seasonally discrete water-bodies such as oxbow lakes
Activity 5.2	Elaboration of an *Arapaima* source-sink population model with and without no-take areas under varying degrees of primary productivity
Activity 5.3	A State of Amazonas wide *Podocnemis expansa* turtle conservation gap analysis involving all major river basins providing adequate nesting sites.
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).
Activity 5.5	Identification of all likely sites across Brazilian Amazonia where our zonation-based fisheries management protocol can be replicated.

25. Provide a project implementation timetable that shows the key milestones in project activities. Complete the following table as appropriate to describe the intended workplan for your project.

	Activity	No of Months	Year 1				Year 2				Year 3			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Output 1	**Local empowerment and consolidation of oxbow lake management system across the entire study landscape**													
1.1	Seasonal limnological sampling of 83 oxbow lakes with one dry-season and one wet-season campaign	8			x	x		x	x					
1.2	Household-level surveys of all types of aquatic resources extracted across ~420 households distributed across 35 local communities	32	x	x	x	x	x	x	x	x	x	x	x	
1.3	Investigate the relationship between household CPUE and oxbow lake primary productivity under different categories of lake protection	3				x				x				x
1.4	Investigate the relationship between household CPUE e explanatory variables both at the patch and landscape scale	3				x				x				x
1.5	Examine the functionality and ecosystem level consequences of lake protection status according to the 'fishing accords' promoted by the project.	3											x	x
1.6	Downloading and processing of GPS tracking data and composite maps of commercial fishing boat forays and density of fishing activity both within and outside the focal reserves.	24 + 3	x	x	x	x	x	x	x	x		x	x	
1.7	Design, preparation, printing and distribution of a *Handbook of Freshwater Fisheries Management Techniques*	4											x	x
Output 2	**Local empowerment and deployment of freshwater turtle ecology and management programme**													
2.1	Local agreements setting-aside a set of protected egg-laying sand beaches along a 492-km section of the Rio Jurua.	4	x	x										
2.2	A 5-day training course (for 30 local assistants and village leaders) on the conservation & management of freshwater turtles.	1				x								
2.3	Monitoring of numerical abundance and reproductive output	8			x	x			x	x				

	Activity	No of Months	Year 1				Year 2				Year 3			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
	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.													
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.	8			x	x			x	x				
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.	26	x	x	x	x	x	x	x	x	x			
2.6	Electronic tagging of >5,000 post-quarantine hatchlings [using transponders microchips] prior to releasing from fluvial beaches	10			x	x			x	x				
2.7	Design and production of an illustrated booklet on *Freshwater Turtle Ecology & Management*.	3										x	x	
Output 3	**Local empowerment and consolidation of *Arapaima* stock assessment and management programme**													
3.1	Reserve 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.	3	x	x										
3.2	Annual counts of adult pirarucu fish (*Arapaima gigas*) in at least 23 oxbow lakes	6		x				x			x			
3.3	Mapping of lakes with varying probability of *Arapaima* occurrence	3										x		
3.4	Training of 60 artisanal fishermen in *Arapaima* census techniques, to be included in annual counts	3		x				x			x			
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.	6			x	x			x	x			x	x

	Activity	No of Months	Year 1				Year 2				Year 3			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Output 4	**Design and establishment of a management plan for "problem" apex predators including *Pteronura* and *Melanosuchus***													
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	12		x	x			x	x			x	x	
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.	9		x	x			x	x			x	x	
4.3	Interviews at 40 communities to obtain species occupancy and incidence density data for a 500-km section of the Rio Juruá.	4		x	x									
4.4	Mapping of all water bodies including oxbow lakes, overlaid with the occurrence probability of *Pteronura* and *Melanusuchus*	3		x	x	x								
4.5	Conduct a spatio-temporal and resource overlap analysis between otters/caimans and fishermen	3											x	x
4.6	Design and production of an illustrated educational booklet to enhance the prospects of large predator conflict resolution across all local communities.	3											x	
Output 5	**Stock-recruitment model to inform sustainable *Arapaima* offtakes from seasonally discrete water-bodies such as oxbow lakes**													
5.1	Stock-recruitment model to inform sustainable *Arapaima* offtakes from seasonally discrete water-bodies such as oxbow lakes	3					x				x			
5.2	Elaboration of an *Arapaima* source-sink population model with and without no-take areas under varying degrees of primary productivity	3											x	
5.3	A State of Amazonas wide *Podocnemis expansa* turtle conservation gap analysis involving all major river basins	4										x	x	

	Activity	No of Months	Year 1				Year 2				Year 3			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
	providing adequate nesting sites.													
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).	5										x	x	x
5.5	Identification of all likely sites across Brazilian Amazonia where our zonation-based fisheries management protocol can be replicated.	2											x	x

26. Project based monitoring and evaluation

Describe, referring to the Indicators above, how the progress of the project will be monitored and evaluated, making reference to who is responsible for the projects monitoring and evaluation. Darwin Initiative projects are expected to be adaptive and you should detail how the monitoring and evaluation will feed into the delivery of the project including its management. Monitoring and evaluation is expected to be built into the project and not an 'add' on. It is as important to measure for negative impacts as it is for positive impact.

(Max 500 words)

The project leader (PL) and project partners (PPs) will be aware of all project activities and be updated on a regular basis by the project field coordinator (FC) even when the PL is absent from the study region. We will maintain a command-and-control hierarchy of project activities in which terminal points of data collection will feed project performance information through a chain of field workers to our project base in Carauarí, and ultimately to the PL and PPs. The FC himself will be responsible for the quality-control of data acquisition, and a number of administrative tasks (including paying local field assistants; purchasing fuel and food supplies; and maintaining an office in Carauari) that will be shared with the PPs and collaborating institutions. We will deploy an appropriate economy-of-scale with the collaborating institutions (FAS, ICMBio and CEUC/SDS) to ensure that local communities and our field assistants are visited on a monthly basis, thereby fine-tuning the communication chain on all project matters. This is critical because many remote communities are cut-off from internet and mobile phone coverage, hence requiring personal contact to ensure appropriate data-quality control, and speedy resolution of logistical matters that may constrain continuity of project activities. The project has been broken down into six components, each of which coordinated by a partner and/or collaborator.

PERES is the PL and will be involved in all key stakeholder negotiations (such as the Fishermen Cooperatives) and participate in the workshops leading to 'fishing agreements'. He will also be ultimately responsible for much of the data analysis, data quality control, and will maintain an oversight over all project activities. ANDRADE is the most experienced aquatic turtle biologist in the Brazilian Amazon and will be responsible for all matters related to the turtle ecology and management component of the project; MICHALSKI is an accomplish carnivore wildlife biologist and will be responsible for the 'problem species' (giant otter and black caiman) component of the project, and for co-supervising MSc students who become involved in several project activities; SILVA is a freshwater ecologist and will be responsible for the limnological fieldwork and estimates of primary productivity in oxbow lakes, and for ensuring smooth houlsehold offtake data collection and processing; LEVI is a member of the US Center for Stock Assessment Research, a fisheries research lab funded by the National Marine Fisheries Service. He will be responsible for the spatial modelling component of the project, following a detailed analytical strategy to be agreed with the PL. All project components will interact thematically if not logistically, but coordinators may not always be in the field simultaneously. We therefore expect that all collaborators and partner institutions will share joint responsibility for smooth project continuity and reporting, particularly activities that will require long-term monitoring.

Given our exit strategy, our management framework will continue to be monitored well after the end date of the project. For example, we expect to be able to continue monitoring *Arapaima* population sizes within protected lakes; the number of female turtles nesting on protected beaches on an annual basis for many years after the project is discontinued.

FUNDING AND BUDGET

Please complete the separate Excel spreadsheet which provides the Budget for this application. Some of the questions earlier and below refer to the information in this spreadsheet.

NB: Please state all costs by financial year (1 April to 31 March) and in GBP. **Budgets submitted in other currencies will not be accepted.** Use current prices – and include anticipated inflation, as appropriate, up to 3% per annum. The Darwin Initiative cannot agree any increase in grants once awarded.

27. Value for Money

Please explain how you worked out your budget and how you will provide value for money through managing a cost effective and efficient project. You should also discuss any significant assumptions you have made when working out your budget.

(max 300 words)

This project is <u>hugely</u> subsidized in a number of ways by several Brazilian institutions, so that the Darwin contribution would account for only a small fraction of the real costs of the project. Nearly £XXXX in salaries covering the core project staff members come from Brazilian and US organizations, a strong conservation NGO, and two governmental environmental agencies, and this excludes MSc studentships funded by the Ministry of Education. We will have free-of-charge access to two very suitable field-stations during the entire project (one at RESEX Medio Jurua and another at RDS Uacari), and two large halls where technical workshops hosting 100+ people can be held. Nearly £XXXX in turtle GPS tracking equipment is available from UFAM. We have also accumulated many equipment items and supplies, which will be handed down to this project. These include an aluminium boat + outboard; five canoes; limnological equipment; camping gear; medical supplies, etc, hence the exclusion of these items from the budget. An additional economy of scale in terms of project logistics will be available from joint activities with SDS and FAS, which will maximise the rate at which all of the focal communities are visited. We estimate this will save £XXXX in fuel and additional boat hire over the 3 years of the project. We will also be able to share the expenses of technical workshops with SDS and FAS, representing substantial additional savings. Moreover, Fundação Amazonas Sustentável (FAS) will provide a total of £XXXX per year during the 3-yr duration of the project (see Letter) in local stipends to 261 households across the study area as part of the Bolsa Floresta Biodiversidade programme. This is expected to vastly enhance the level of local good-will to both engage with Project objectives and compensate for any opportunity costs that may result from spatial zoning on natural resource use.

FCO NOTIFICATIONS

Please check the box if you think that there are sensitivities that the Foreign and Commonwealth Office will need to be aware of should they want to publicise the project's success in the Darwin competition in the host country. ☐

Please indicate whether you have contacted the local UK embassy or High Commission directly to discuss security issues (see Guidance Notes) and attach details of any advice you have received from them.

Yes (no written advice) ☐   **Yes, advice attached** ☐   **No   X**

CERTIFICATION 2013/14

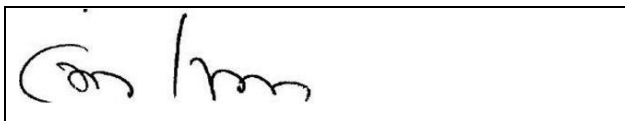On behalf of the trustees of the   University of East Anglia

I apply for a grant of £**253,508** in respect of **all expenditure** to be incurred during the lifetime of this project based on the activities and dates specified in the above application.

I certify that, to the best of our knowledge and belief, the statements made by us in this application are true and the information provided is correct. I am aware that this application form will form the basis of the project schedule should this application be successful. (*This form should be signed by an individual authorised by the lead institution to submit applications and sign contracts on their behalf.*)

I enclose CVs for project principals and letters of support. Our most recent audited/independently verified accounts and annual report are also enclosed/can be found at *(delete as appropriate)***:**

Name (block capitals)	Carlos A. Peres
Position in the organisation	Professor of Tropical Conservation Ecology

Signed		Date:	3 December 2012

Stage 2 Application - Checklist for submission

	Check
Have you provided **actual start and end dates** for your project?	x
Have you provided your **budget based on UK government financial years** i.e. 1 April – 31 March and in GBP?	x
Have you checked that your **budget is complete**, correctly adds up and that you have included the correct final total on the top page of the application?	x
Has your application been **signed by a suitably authorised individual**? (clear electronic or scanned signatures are acceptable in the email)	**x**
Have you included a **1 page CV for all the Principals** identified at Question 7?	x
Have you included a **letter of support from the <u>main</u> partner(s) organisations** identified at Question 10?	x
Have you **checked with the FCO** in the project country/ies and have you included any evidence of this?	x
Have you included a **copy of the last 2 years annual report and accounts** for the lead organisation? An electronic link to a website is acceptable.	x
Have you **read the Guidance Notes**?	x
Have you **checked the Darwin website** immediately prior to submission to ensure there are no late updates?	**x**

Once you have answered the questions above, please submit the application, not later than midnight GMT on Monday 3 December 2012 to Darwin-Applications@ltsi.co.uk using the application number (from your Stage 1 feedback letter) and the first few words of the project title **as the subject of your email**. If you are e-mailing supporting documentation separately please include in the subject line an indication of the number of e-mails you are sending (eg whether the e-mail is 1 of 2, 2 of 3 etc). You are not required to send a hard copy.