

Title: How do protected areas affect fishers? An assessment of fishers' spatial behaviour around protected areas.

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2. Abstract

The ways that fishers allocate their fishing effort in space can affect the ecological impact and the economic performance of fisheries. This spatial behaviour can be influenced by a number of physical, ecological, social, economic, technical, institutional and cognitive factors. Many fisheries development and management interventions aim to alter the spatial distribution of fishing effort but are based on untested assumptions about fishers' spatial behaviour and their willingness and ability to change it. Thus understanding the spatial distribution of fishing effort is increasingly recognised as an important consideration for fisheries management. Despite this, the spatial behaviour of fishers is poorly understood, especially in the western Indian Ocean and similar regions. This study uses a mixed-methods approach to understand the diverse factors influencing artisanal fishers' spatial behaviour in Seychelles and Kenya, specifically to investigate evidence for perceived or realised 'spillover' benefits to fishers of MPAs.

A semi-structured interview survey will collect data on current fishing behaviour, factors affecting fishers' decisions, costs of fisheries operations and recent changes in behaviour or factors. This will be followed by a program of participatory effort mapping and catch monitoring that will yield detailed data on spatial behaviour, and spatial patterns in fisheries adjacent, and not adjacent to MPAs. This will be integrated with existing geo-referenced data in GIS to test whether theoretical models of spatial behaviour can be used to predict the distribution of fishing effort and draw out key implications for the design of MPAs and other spatial management measures, and the impacts of global trends in fuel price and technology. Such information is critical to understanding how spatial management strategies and global drivers impact the well-being and sustainability of fishing communities and have practical applications in the design of marine resource management throughout the Western Indian Ocean region.

Research will be conducted in partnership with local fishers, giving them the opportunity to contribute their substantial knowledge as well as engage with debates over the efficacy and cost of MPA establishment. GIS training will also be provided for project researchers. Findings will be published in international and regional journals as well as being fed back to participating communities and relevant policy communities in each country.

3. Background

Spatial distribution of fishing effort

A range of factors influence fishers when deciding where to fish. These include: knowledge about habitat and fish movement, weather, technology such as boats, de facto or de jure fisheries regulations, cultural beliefs and norms, ability to sell the catch, and fuel costs. This leads to considerable heterogeneity in fisher behaviour and a complex pattern of how fishing effort is distributed throughout fishing grounds.

Many fisheries development and management interventions aim to alter fishers' spatial behaviour. Success of interventions such as protected areas and attempts to encourage fishing effort to move offshore often rest on largely untested assumptions about fishers'

spatial distribution of fishing effort and their willingness or ability to change it. For example, most marine-reserve models assume fishing that effort is evenly distributed and that effort displaced by reserves simply disappears or is reallocated in the larger economy (Wilens et al. 2002). Such establishment of MPAs without considering fishers' behaviour can lead to negative ecological impacts due to the displacement of fishers onto adjacent areas (Dinmore et al. 2003).

A range of studies underpin the importance of understanding both spatial and behavioural aspects of fisheries for management (Hilborn et al., 2005; Salas and Gaertner, 2004; Wilens et al., 2002). For example, lack of appreciation of fishers' spatial behaviour can lead to misinterpretation of trends in catch-per-unit-effort (Walters, 2003) or ignorance of key economic features of fisheries - fuel costs incurred by travelling to fishing grounds can be a major proportion of the costs of fishing operations (FAO 2007a). Despite the ecological and economic importance of spatial fishing effort distribution, few relevant studies have been conducted in tropical developing countries (Aswani 1998; Bene & Tewfik 2001; Daw 2008a; Abernethy et al 2007), and none have done so in the context of how marine protected areas may influence of spatial harvesting patterns. Understanding how fishers' spatial behaviour is affected by various factors can help managers to understand economic and knock-on ecological effects of MPA designation, fuel price changes and subsidies; high-value markets for particular species; and policies aiming to encourage effort to move offshore.

The complexity of the spatial distribution of fishing effort

Fishers' spatial behaviour can be affected by a wide range of factors. For example, patterns of resource distribution and habitats affect effort distribution in as far as fishers are able to perceive them (Pet-Soede et al., 2001). Fishers may maximise such knowledge by preferring familiar grounds where they can accumulate local detailed local knowledge (Begossi, 2001). Technical considerations may determine potential fishing areas (e.g. Bene and Tewfik, 2001), while technical innovations may allow more accurate navigation or monitoring of trends in catch data (Eales and Wilens, 1986). Social factors affecting effort distribution may include the activities of other fishers leading to interference competition (Gillis and Frank, 2001) and the existence of rules and institutions. Rules may be formal, like the establishment of MPAs or informal territorial arrangements established, enforced and monitored by fishers themselves (de Castro and Begossi, 1995). Previous research by the Seychelles Fisheries Authority (SFA), for example, has suggested the existence of informal institutions around fishing of spawning aggregations. Individual characteristics of fishers may affect their spatial behaviour, including age, technical skill and the extent to which they are profit maximisers, or risk averse. Such individual variation are important to understand as they lead to heterogeneous patterns within a fishery.

The distance fishers travel to fishing grounds can be affected by weather, individual risk aversion and vessel type; and determines the potential resource spaces for different fishers (Pet-Soede et al., 2001). Energy and travel-time costs increase linearly with distance travelled and are determined by fuel expenses and the opportunity cost of time, which depends on other potential activities, for example fishing at nearer sites or

engaging in non-fishing activities. This suggests that evenly distributed resources will be exploited more intensively closer to landing sites (Caddy and Carocci, 1999). More distant sites would therefore be expected to have more pristine stocks so that the choice of how far to travel involves a trade-off between the costs of travel and expected benefits of higher yields.

In order to understand these patterns and predict the effect of proposed management strategies one must understand the social, microeconomic and natural environment in which fishers make these decisions (Aswani, 1998). Despite the potential of theoretical models, such as the ideal free distribution, to simulate fishing behaviour (Abernethy et al 2007), Wilen (2004) highlights a lack of economic models complex enough to realistically predict fishers' spatial behaviour, and suggests the need for diverse research methods as proposed in this project.

Rationale for research within the Western Indian Ocean

This topic is particularly timely for investigation in the Western Indian Ocean due to four trends that could profoundly affect fishers' spatial behaviour, with impacts on the ecology of fished ecosystems and the livelihoods of artisanal fishers.

First, there continues to be growing interest in establishing marine protected areas. Wilen et al. (2002) note that most marine reserve plans assume that fishing effort displaced by management disappears. In reality, human effort may be displaced into adjacent areas, particularly when poverty, livelihoods and education limit the options to exit the fishery (Cinner et al 2008). Displaced fishing effort may have disproportionate ecological impact on adjacent areas (Dinsmore et al 2003) and so the net impacts of MPAs are unpredictable if there is a poor understanding of fishers' decision-making behaviour.

When marine protected areas are established, fishers invariably lose access to fishing grounds and may be forced to incur more travel costs. In theory, the economic cost of MPA establishment may ultimately be compensated by increased volume or value of catch as a result of spillover, when adult fish migrate from 'no take' areas to fished areas and become available to fishers (Gell and Roberts 2003) or by the export of eggs or larvae. Studies of spillover in marine protected areas in the Philippines have shown that fishers fishing near the boundaries of MPAs caught more and larger fish (Russ et al. 2004) and recent data from Kenya suggests that the abundance of large siganids and lutjanids in well-established marine parks leads to increased revenues for adjacent fisheries (T.R. McClanahan, pers comm.). Although spillover and larval export are often used as justifications for why fishers should be supportive of MPAs, the evidence is still equivocal and such benefits rely on the existence of particular conditions (Hillborn et al 2005). In addition, the benefits of spillover may be restricted to very short distances from the MPA and positive effects of spillover and larval export may be overwhelmed by increased pressure on fished areas due to displaced effort. Understanding how fishing grounds adjacent to protected areas are used is therefore necessary for understanding the benefits and costs of MPAs to resource users and of critical concern to natural resource managers and development agencies when trying to maximise the sustainability dividends of MPAs.

Second, policies designed to relocate artisanal fishing effort further offshore to relieve pressure on inshore resources are currently favoured by fisheries managers and international donor projects in Kenya and Tanzania (Wamukota et al. 2008) and have been favoured in the past in Seychelles. These are likely to be unsuccessful without a realistic understanding of fishers' incentives and decision making. For example, in Seychelles such policies were negated by misguided implementation and a lack of management plans, which left a powerful fleet of inboard vessels competing with the small boat fisheries for demersal resources (Wakeford, 2000).

Third, the current severe increases on the price of fuel and food may have a significant impact on the behaviour of fishers. For example, higher fuel prices may result in motorised fisheries concentrating effort on near-shore resources.

Fourth, rapidly increasing sophistication and access to technology, even in developing countries, is changing the nature of fisheries (FAO 2007b). Communications technology, including mobile phones allows unprecedented rapid dissemination about fishing sites and fish movements as well as marketing opportunities. Meanwhile, navigation technology including GPS, echosounders and chart plotters is permeating developing country fisheries, potentially radically altering the information environment in which fishers make spatial decisions.

This proposal will investigate how various factors affect the spatial behaviour, and profitability of artisanal fishers. We will also look for empirical evidence of spillover by detailed monitoring of spatial behaviour and catch rates in relation to MPAs. Answers to these questions are critical to understanding how spatial management strategies and global drivers impact the well-being and sustainability of fishing communities. They will have practical applications in the design of marine resource management strategies throughout the Western Indian Ocean region.

4. Goals and Objectives

The aim of this project is to generate a greater understanding of spatial fishing behaviour in the WIO region, which can be used to improve fisheries management and stakeholder participation. In particular we aim to shed light on three policy relevant questions:

1. How do protected areas impact the ways that surrounding fishing grounds areas used and what implications does this have on the livelihood of artisanal fishers?
2. How do major changes in variables related to spatial fishing behaviour, such as fuel costs, influence artisanal fisheries systems and fishers' livelihoods?
3. How can a better understanding of spatial fishing behaviour inform fisheries development policies that equip fishers and encourage them to exploit more distant fishing grounds?

These will be informed by four linked research questions defined in Table 1.

Table 1. Research questions and their components and methods to be used to answer each (letters correspond to descriptions in Methods section: **A**-existing effort mapping, **B**-

existing ecological data, *C*-existing georeferenced data on habitat etc, *D*-Semi-structured interviews and retrospective interviews, *E*-Participatory effort and catch monitoring, *F*-Additional contextual information).

Key Question	Question Components	Method
1. What are the costs and benefits of fishing at different sites?	1a. What are the variable costs of distance?	D, F
	1b. How do the costs and benefits of fishing operations balance?	D, F
2. How do fishers choose fishing sites?	2a. What factors affect decision making about spatial behaviour?	D
	2b. What power do various models of spatial behaviour have to predict the observed distribution of effort?	A, B, C, D, E, F
3. How and why do fishers adjust their spatial behaviour in response to MPA establishment?	3a. Are spatial effort distribution patterns (e.g. dispersion coefficient) different between sites adjacent to and far from MPAs?	A, D, E
	3b. How do fishers perceive, and respond to fisher density?	D
	3c. How do fishers report adjusting to MPA establishment in the past and in the future to hypothetical establishment? What reasons do they give for this?	D
4. Is there evidence for spillover from existing WIO MPAs?	4a. Are catches larger or more profitable with proximity to MPAs?	D, E
	4b. Do catches from adjacent to MPAs reflect MPA size and the status of fish populations within MPAs?	B, D, E
	4c. Do fishers perceive a spillover effect from MPAs?	D

5. Methodologies

Research approach

This research plan is designed to tap into the considerable experience and expertise of fishers about their own behaviour, constraints and socioeconomic context, and appreciate the interests and rights of research subjects to be involved in research about their livelihoods. The research therefore aims at a ‘participatory’ rather than purely ‘extractive’ engagement with fishers’ knowledge (Daw 2008b) and will build on existing partnerships between SFA, CRCP and local fishers. Although overall research questions are laid out here, we aim to incorporate fishers’ interests, theories and advice during the design of fieldwork, and will feedback results to allow them to contribute their own interpretations.

We also recognise the need to use multiple methods and knowledge sources for interdisciplinary research. We will triangulate a variety of data and analyses for each research question (Table 1). Throughout the study we will aim, where possible, for a dynamic understanding by asking questions about changes in the past and hypothetical responses to future conditions and by comparing our data with valid data previous years.

Study sites

The study will focus on small scale artisanal trap and hand-line fisheries in Kenya and Seychelles. Seychelles and Kenya are ideal sites for this investigation due to the presence of diverse artisanal fisheries, institutional research capacity, and a history of research which can put the data from this project in context. The two countries represent opposite

ends of the regional spectrum of wealth and development. Seychellois fishers have powered fibreglass boats and greater access to technology, while most of Kenyan fishers engaging in similar fisheries have no engines. Use of engines will be an important factor determining potential distance of fishing grounds and susceptibility to fuel price shocks.

Sites have been selected to include those in the vicinity of large and small MPAs and in areas with no MPAs. Kenyan sites include Bamburi Beach (Mombasa Marine Park), Kuruwitu (small community-managed MPA) and Gazi (not adjacent to any MPA). Seychelles sites include the east coast of Mahe (St Anne Marine park), the west coast of Mahe (only one small park) and Praslin (small closed areas of Cousin and Cousine in south coast and larger Curieuse park on north coast).

Use of existing data

We will initially assess, and where appropriate, geo-reference and analyse existing data on spatial effort distribution (**A**). A previous MASMA-funded projects on coral bleaching, fish and socioeconomics in the WIO generated preliminary data on fishing locations from socioeconomic interviews with fishers in both countries. In Seychelles, an MSc project (Christophe 2006) and a PhD thesis (Daw 2008b) involved collection of information on fishing sites, although these contain little information on temporal changes or factors affecting behaviour. These earlier studies will provide preliminary indications of spatial behaviour, help with planning our more detailed surveys, and allow for comparison of spatial behaviour over the previous 4 years.

We will build on previous collaboration with Dr Tim McClanahan and Nick Graham to facilitate analysis of our results in the context of their detailed ecological data from the target MPAs within Kenya and Seychelles respectively (**B**). Such collaborations during previous MASMA projects have resulted in novel interdisciplinary research and publications incorporating a wide range of connected datasets. Existing geo-referenced data on bathymetry, habitats, coastlines landing sites and other relevant information from SFA, CRCP and online resources will be assessed for their potential to provide contextual analysis of the interview and monitoring data. (**C**)

Data collection

A literature review will be conducted on the research relevant to spatial behaviour of fishers. An inaugural meeting will be held in Seychelles in early 2009 to identify key variables from literature, initial discussions and participant observation of fishing operations with key informant fishers. Two rounds of fieldwork will then be planned.

Semi-structured interviews with fishers (**D**), involving closed and open-ended questions on the following topics and key trends in recent years.

- Individual characteristics (age, socioeconomics, gear, boat, technology, experience, linkage to markets)
- Spatial effort distribution
- Strategies for choosing fishing sites
- Ranking of factors affecting site choice
- Indications of risk adversity and profit maximising tendencies

- Networks of knowledge and following behaviour
- Costs of inputs and fuel consumption
- Understandings of MPA impacts, effort levels
- Responses to hypothetical changes in costs, markets and available fishing area.

All interviews will be conducted on a one-to-one basis because of the collection of sensitive fishing strategy and financial information.

A subset of 15-20 individual fishers in each country will be recruited for a participatory monitoring exercise to investigate actual fishing behaviour and catches for three two-month periods each and one final month (*E*). This will provide data over an entire year to give an indication of seasonal trends and one month's data for inter-annual comparison. Spatial behaviour will be monitored using GPS, and detailed catch recording by logbook will be supplemented by regular contact with SFA and CRCP field assistants who will collate information in a linked database and GIS system. Retrospective interviews will be conducted with participants to allow fishers to explain how they made decisions during monitored fishing trips. Depending on initial observations and discussions with participants, catch monitoring may include some directed fishing effort in pre-defined strata to ensure catch data is collected from a range of distances from MPAs.

Additional contextual information from each site will be monitored including fish and input prices, markets and weather to account for their effects on monitored trips (*F*).

Analysis

A GIS expert will be hired during the analysis phase of the project to assist with advanced spatial analysis and modelling. GIS Network analysis, distance-cost methods and mobile GIS will be employed to collect and manipulate data. Aggregated effort distribution maps for each site from both existing, interview and monitoring data will be produced. Spatial networks of fishing grounds and fisher movements will be analysed in relation to identified factors influencing fishing ground selection. This will also characterise how the 'resource space' of fishers varies with technical and socioeconomic characteristics. These maps will be integrated with contextual data on to test whether any models of spatial behaviour, such as the ideal free distribution, friction of distance, multi-criteria evaluation, or simple resource space models, offer predictive power for fishers' behaviour (Abernethy et al 2007, Caddy and Carocci 1999). The implications of distance and changes in the economic drivers will be assessed by creating balance sheets for fisheries operations, incorporating estimates of the value of catches and inputs (fuel, time, equipment, bait etc.) (Daw 2008a).

Spillover will be investigated by statistical comparison between locations at different distances from MPA boundaries and landing sites in terms of catch and profit per unit effort, and fishing effort intensity. Confounding variables of season, country, boat, fish price, gear type and fisher experience will be tested for significance. Three null hypotheses will be tested with statistical analysis:

Kenya, organizing workshops, write-up and reporting, and providing information back to communities and managers. Mr Maina will be responsible for project design and overseeing GIS management and analysis of spatial data. Mr Robinson (SFA) will be responsible for managing fieldwork in Seychelles and ensuring policy relevance of research. Research assistants will assist with surveys in both Kenya and Seychelles. Analysis, reporting and writing up of peer-reviewed papers will be the lead responsibility of Dr Daw and Dr Cinner, but with the direct involvement of the other researchers. Project administration will be managed by Coral Reef Conservation Program (CRCP), who have extensive experience in managing previous MASMA projects.

6. Approvals

In Seychelles the work will fall under the mandate of SFA for conducting fisheries research (SFA Establishment Act, 1984). The work in Kenya is part of a long-term project that has developed collaborative programs with Kenya Marine and Fisheries Research Institute, Kenya Wildlife Service and Kenya's Ministry of Fisheries. Research clearance is approved by the Kenya Office of Research Clearance in the Ministry of Science and Technology (Research Permit No. MOEST 13/001/15C 104).

7. Gender Considerations

The work will not have any explicit gender focus. Men dominate artisanal fisheries in the proposed study sites and will therefore be the focus of the study. However, results on livelihoods, and time spent travelling to fishing sites have implications for the well being of wives and families of fishers and fishers' family relationships and responsibilities may be factors in their decision-making. These household considerations, will be addressed in the semi-structured interview component of the project. Additionally the activities of women fish traders may affect and be affected by changes studied through this proposal.

8. Risk analysis

The project relies on the collaboration of a sufficient quantity of fishers with the research and willingness to share information on fishing sites and financial balance giving the project an inherent risk. Aquiring participation of communities can be challenging, particularly in areas where they have bad experiences with past programs, government, or universities, and considerable sensitivity to and awareness of these problems must be considered in the preparation of meetings and interviews. Our project will be focused largely on areas where strong collaborative relationships with team members already exist. Participation will also be facilitated by the focus on fishing strategies, profitability and the effect of MPAs, which are of direct interest to fishers. We also will aim to maintain relationships by presenting preliminary findings to communities, seeking their own interpretations of our data and including representatives in future meetings where the full presentations are made. In the past, we have returned to the communities in Kenya and presented results to fishers and community leaders in formal and informal settings.

Political instability in Kenya is a minor concern, but Dr. Cinner and Mr. Wamukota launched the CBO project in Kenya during the recent political crisis, with no problems occurring in remote field sites such as Kiruwitu.

9. Impact Assessment

Mapping of fishing grounds has serious potential ethical considerations (Maurstad 2003), which will be addressed by ensuring informed consent for participants, absolute confidentiality about individual fishing grounds and profit, and anonymity of responses. To avoid the identification of individual fishing sites or fishers' personal information, research outputs will present aggregated data (Daw 2008a), but individual fishers will be given detailed analysis and maps of their own behaviour. Data will be fed back to participants before publication so that their comments and interpretation will be taken into account. Fishers participating in the detailed monitoring will be compensated for their time and effort.

Participation in this research will offer benefits to fishers of improved understanding and capacity to engage with scientists and management debates. However there is a possibility that fishing power may be enhanced by improved spatial understanding, or technical capability as a result of participating in this study. Paying compensation for participation in the detailed monitoring is ethically and practically necessary due to the considerable time and commitment required. There is a possibility that such an incentive may disrupt fishing behaviour or even subsidise unsustainable fishing. This will be minimised by limiting the assessment period to only half of one year and limiting incentives to 10-20% of typical daily catch value. All research will be approved by the University of East Anglia Faculty of Social Science Research Ethics committee before commencement and will adhere to guidelines in the respective countries of research.

10. In-Country Collaboration

In Kenya, we will collaborate with Beach Management Units in Bamburi and Kuruwitu building on a long-term working relationship between CRCP and these organisations. In Seychelles we will partner with SCMRT-MPA who are responsible for management of Seychelles national MPAs. This project will also strengthen the GEF/UNDP 'Mainstreaming Biodiversity Programme' which is developing fisher associations in support of area-based co-management of the trap fishery by collaborating with the developing fisher associations.

11. Results and Dissemination of Research Findings

Project outputs will be at the international, national, and local scale. Peer-reviewed research publications in international journals will include at least the following four publications or similar, depending on results:

1. Analysis of factors influencing fishers spatial behaviour (Target journal: *Fisheries Research*)
2. Implications of interview data for MPA and spatial management (*WIOMSA journal, Marine Policy*)
3. Evidence of MPA spillover from monitoring (*Environmental Conservation*)
4. Models which explain and predict spatial behaviour of fishers and implications for MPA planning & spatial management (*Canadian Journal of Fisheries and Aquaculture*)

At the local level we expect the following outputs from the project:

- A GIS training workshop to provide the necessary skills for our data collectors. This could be open to a limited number of attendees from the region with additional support.
- Employment and continued capacity building of regional social scientists and field assistants including hands-on training in experimental design, field methods, analysis, GIS, use of databases and writing of peer review publications.
- Building and maintaining collaborative research partnerships with specific fishers and fishing groups, improving their capacity to become engaged with spatial management planning and collaborative management
- Better understanding of the spatial distribution of artisanal fishing effort to inform policies such as attempts to re-locate fishing offshore
- Empirically grounded evidence on which to make decisions about MPAs which consider the social-ecological system over larger scales

A seminar in each country for policy-makers including fisheries management agencies such as SFA and Kenya Ministry of Fisheries, coastal management authorities, and local marine scientists will allow presentation and discussion of the results to facilitate uptake in policy circles. This will also be an opportunity for junior scientists to practise disseminating their research.

This project will also be the basis for a further application to WIOMSA towards the end of the project for an analysis workshop. This will bring together researchers from the region who have an interest in, and/or data on, spatial behaviour of fishers and spatial distribution of resources to conduct integration and meta-analysis of such datasets to draw out wider generalisations and firm policy recommendations for the region.

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13. Available Resources

The work will be done through support from support of MASMA-WIOMSA and Seychelles Fisheries Authority (SFA). WIOMSA will support most of the field and travel expenses and the participation of Drs Daw and Cinner, SFA will provide Mr Robinson's time, and fieldworker time, vehicles and computer facilities as in-kind support. UEA and CoECCRS will provide institutional hosting, office space and IT facilities of Drs Daw and Cinner. The new Conservation Planning and GIS programme at CoECCRS will provide guidance and resources on GIS and spatial analyses. Research will be based from CRCP in Mombasa and SFA in Victoria. Both have library facilities, field equipment, vehicle access, and computer facilities and are located near study sites. CRCP will facilitate overall project administration.

14. Curriculum Vitae

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An interdisciplinary researcher using fisheries as a model of integrated social-ecological systems. I combine multiple methods and training in ecology, fisheries science, socioeconomics and politics to understand linkages between ecological and social components of coastal system at multiple scales. I aim to inform sustainable and equitable governance of coastal and natural resources, particularly in the developing world.

Education:

- 9/03-9/07 PhD on fishers' knowledge, Depts Marine Sciences Politics, Newcastle University
9/06-12/06 **Visiting Researcher**, Beijer Institute for Ecological Economics, Stockholm.
9/02-9/03 **MSc. Tropical Coastal Management (Distinction)**, Newcastle University
9/94-6/97 **BSc. (Hons.) Marine Biology (Upper 2nd class)**, Newcastle University

Skills

- Social science & ecological research Extensive experience in collection and analysis of quantitative (household survey, questionnaire) as well as qualitative data (e.g. focus groups, in depth-interview)
On-board fisheries research and data collection, underwater visual surveys
- Data management and analysis Extensive experience designing and managing large databases. Advanced Statistical Data analysis (GLM, GAM, hierarchical modelling, multivariate techniques) in R. MapInfo GIS software, NVivo qualitative data analysis software.
- Teaching/ Training Experienced training underwater ecological surveys, database management; field courses in social science and fisheries data collection; and lectures, seminars and thesis supervision at university undergraduate and postgraduate level.
- Coordination & leadership Experienced in coordinating and leading international teams in fieldwork and in remote collaboration. Trained in facilitating stakeholder dialogue workshops.
- Languages English (mother tongue); fair Spanish, basic Malay, Seychellois Kreol & French

Selected Recent Consultancy and Research Experience:

- Period Title, Employer/Funder - Responsibilities and Achievement (Total Funds, role)**
- 3-5/08 **Invited expert and author.** *FAO* - Preparation of paper and participation in two expert meetings for 'High-Level Conference on World Food Security and the Challenges of Climate Change and Bioenergy'. (\$10,000, principal investigator)
- 3-7/08 **Researcher & Project Manager.** *Natural and Environmental Research Council (NERC) & Department for International Development (DFID), UK* - Marine and coastal ecosystem services and poverty alleviation (ESPA) Situation assessment (£250,000, co-investigator)
- 2-5/08 **Database consultant.** *JCU/WIOMSA, MASMA Community-based organisations study* - Designed and create database to manage quantitative and quantitative data from a large scale international research project (\$5000, sole consultant)
- 10/07 **Data management trainer.** *WCS, WIOMSA* - Training of WIO-region staff to in socioeconomic databases Access (\$9,010, Trainer)
- 1/07 **Social scientist observer.** *European Union, Scientific Advice for Fisheries Management at Multiple Scales project*- Participant observation of fisheries management discussions in Regional Advisory Council and International Council for the Exploration of the Seas meetings.

- 5/05-7/08 **Socioeconomic Researcher.** WCS/WIOMSA, MASMA project on impacts of bleaching - Designed international study in 5 WIO nations. Responsible for database Seychelles data collection, analysis and writing papers. (collaborator)
- 1-2/04 **Consultant Researcher.** *Society for the Conservation of Reef Fish Aggregations* - Stakeholder interviews to compile a database on status and utilisation of >100 previously undescribed spawning aggregations in Sabah, Malaysia in collaboration with local government and NGO staff (~\$7000, PI)
- 4-8/03 **Spatial and economic analysis of lobster fisheries.** *Reefmap/NERC and others*— Interview mapping of spatial distribution of artisanal fishing effort in Nicaraguan Caribbean. Provision of field course and supervision for local students, (£13,000, co-investigator).
- 7-9/02 **Fisheries Consultant.** *WWF Malaysia* —Assessment of the live reef fish trade and fishery in Northern Sabah, Malaysia. Leader of small team, Interviews, focus groups and participatory observations to document gears, species, communities, trends and perceptions and provide recommendations (PI)
- 2-4/02 **Senior EU Fisheries Observer.** *MacAlister Elliot & Partners/EU* – Onboard monitoring of Spanish trawler and supervision of observers on ~20 EU fishing vessels in NW Atlantic.
- 7/00-9/01 **Chief Scientist, Borneo Project.** *Greenforce UK* - Leading research, training, local collaboration, reporting and dissemination on permanent marine research expedition in Malaysian Borneo. Designed methods, training and data-management system.
- 1-5/00 **Fisheries Scientist.** *Marine Resources Assessment Group* - SW Atlantic Responsible for data management, sampling and catch processing on international stock assessment cruise. Observation and analysis of experimental commercial longline fishery.
- 5/99-1/00 **Fisheries Consultant.** MRAG Ltd/ Foreign and Commonwealth Office EU, DfID London – Administration, licensing, and patrol logistics for the British Indian Ocean Territories Fisheries. Research, proposal preparation, observer briefing and project administration.
- 2-4/99 **Fisheries Observer.** *MRAG Ltd/EU* - Monitoring of Portuguese trawler in NW Atlantic.
- 10/96-11/98 **Expedition Leader,** *Reefs of Massawa Expedition 1997, Various funding sources* - Expedition with the Eritrean Ministry of Fisheries. Field research on coral reef community structure, eutrophication and management of the Aquariumfish industry. (£8,200 budget)
- 3-5/98 **Science Officer.** *Coral Cay Conservation Ltd* - Co-ordinated science programme & training teams in species ID and survey methodology on expedition in Negros, Philippines.

Selected peer reviewed publications (13 in total)

- Cinner, J., T. M. Daw and T. R. McClanahan (In Press) Socioeconomic factors that affect artisanal fishers' readiness to exit a declining fishery. *Conservation biology*.
- McClanahan, T. R., J. Cinner, J. Maina, N. A. J. Graham, T. M. Daw, S. M. Stead, A. Wamukota, K. Brown, M. Ateweberhan, V. Venus and N. V. C. Polunin (In Press) Conservation action in a changing climate. *Conservation letters*. **1**: 53-59
- Daw, T. M. (2008) Spatial distribution of effort by artisanal fishers: Exploring economic factors affecting the lobster fisheries of the Corn Islands, Nicaragua. *Fisheries Research* **90**(1-3): 17-25.
- Graham, N. A. J., S. K. Wilson, S. Jennings, N. V. C. Polunin, J. Robinson, J. P. Bijoux and T. M. Daw (2007) Lag effects in the impacts of mass coral bleaching on coral reef fish, fisheries and ecosystems. *Conservation biology* **21**(5): 1291-1300.
- Stead, S., T. Daw and T. Gray (2007) Uses of Fishers' Knowledge in Fisheries Management. *Anthropology in Action* **13**: 77-86.
- Daw, T. and T. Gray (2005) Fisheries science and sustainability in international policy: a study of failure in the European Union's Common Fisheries Policy. *Marine Policy* **29**(3): 189-197.
- Daw, T.M., Rogers, V.C.C., Mapson, P. & J.E. Kynoch (2001) Structure and management issues of the emerging ornamental fish trade In Eritrea. *Aquarium Sciences and Conservation*. **3**:53-64.

JAN ROBINSON

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C/o Seychelles Fishing Authority, P.O. Box 449, Fishing Port, Mahé, Seychelles

Tel: +248 670338, Fax: +248 224508, Email: jrobinson@sfa.sc

EXPERIENCE

2001-present

Seychelles Fishing Authority: Manager, Fisheries Research Department

- Managed a large staff of statisticians, biologists and fisheries technicians engaged in the monitoring and assessment of artisanal and industrial fisheries.
- Developed and managed fisheries stock assessment projects, applied fisheries and ecological research programmes, often in collaboration with overseas partners.
- Awarded a competitive Marine Science for Management (MASMA) grant of the WIOMSA for research on the importance of reef fish spawning aggregations for the management of artisanal fisheries.
- Assisted IUCN-EARO in the development of a regional spawning aggregation programme.
- Recently appointed Regional Coordinator of the Pelagic Fisheries Component of the South West Indian Ocean Fisheries Project (SWIOFP), a large marine ecosystem (LME) project.
- Seychelles scientific advisor to the PDF B phase of SWIOFP and coordinated the development of national SWIOFP projects in collaboration with local partners and fishers.
- Recently acted as a fisheries consultant to the FAO, IUCN, INFOSA, the Marine Resources Assessment Group (MRAG) of the United Kingdom, and the GEF-UNDP Agulhas-Somali LME Programme
- Development/implementation of national fisheries projects for the Second National Communication to UN Framework Convention on Climate Change (UNFCCC).

1998-2001

Royal Geographical Society Shoals of Capricorn Programme: Science Coordinator Seychelles

- Established and operated a field research facility (laboratories, accommodation, offices, dive store, vessels) in the St. Anne Marine National Park, to facilitate a multidisciplinary research programmes focused on the Mascarene Ridge and Islands.
- Developed and implemented a monitoring programme to study impacts of the East Coast Mahe Phase III Reclamation Project in collaboration with the Marine Parks Authority.
- Local coordinator for the DETR Darwin Zooplankton Monitoring Programme, including logistical planning and participation in research cruises.
- Developed and presented core modules on coral reef ecology and monitoring for the Seychelles Maritime Training Centre.

1996-1998

Plymouth Marine Laboratory (CCMS): Part-time Research Assistant

- Investigated ecological multivariate software package PRIMER for applicability in taxonomy, population biology and applied ecotoxicology.
- Described new species in the pollution indicator complex *Pontonema* (Nematoda) and worked on the ecology and morphometrics of a suspected new genus of nematodes.

EDUCATION

1995-1996

M.Sc. Applied Marine Science, University of Plymouth, UK (*Distinction*)

Thesis: Morphological variability in the pollution-indicator complex *Pontonema* (Nematoda).

Advisor: Prof. Richard Warwick

Subjects: Fisheries, pollution ecology, ecotoxicology, EIA, ICZM

1990-1993

B.Sc. Marine Biology, University of Wales, Swansea, UK (*2:2 with Honours*)

Thesis: A comparison of visual and olfactory stimuli in inducing shoaling behaviour in juvenile common goby, *Pomatoschistus microps*.

Subjects: Fisheries, benthic ecology, marine genetics and reproduction, oceanography, statistics

SKILLS

Languages: English (mother tongue); Creole (basic), French (basic)

IT: Proficient use of a variety of statistical and stock assessment software; trained in ArcGIS..

Other: PADI Rescue Diver, RYA Powerboat qualification (II), Advanced expeditionary medic (RGS).

MEMBERSHIP, AFFILIATIONS AND RESPONSIBILITIES

- Chair of the Indian Ocean Tuna Commission (IOTC) Working Party on Billfish (2008-)
- Seychelles scientific representative to the South West Indian Ocean Fisheries Commission
- Western Indian Ocean Marine Science Association (WIOMSA)
- Scientific Committee of the Seychelles Islands Foundation, which manages the Aldabra Atoll Special Reserve (UNESCO World Heritage Site).

RELEVANT PUBLICATIONS AND MANUSCRIPTS

Robinson, J., Isidore, M., Marguerite, M.A., Öhman, M.C. & Payet, R.J. (2004) Spatial and temporal distribution of reef fish spawning aggregations in the Seychelles – An interview-based survey of artisanal fishers. *Western Indian Ocean Journal of Marine Science* 3: 63-69

Robinson, J., Aumeeruddy, R., Jörgensen, T.L. & Öhman, M.C (2008). Dynamics of camouflage (*Epinephelus polyphekadion*) and brown marbled grouper (*E. fuscoguttatus*) spawning aggregations at a remote atoll, Seychelles. *Bulletin of Marine Science*.

Robinson, J., Samoily, M., & Kimani, P. (2007) Reef fish spawning aggregations in the Western Indian Ocean: Current knowledge and implications for management. In: *Coral Reef Degradation in the Indian Ocean. Status Report 2007*. CORDIO, Kalmar.

Robinson, J., Aumeeruddy, R., Isidore, M., Payet, R., Marguerite, M., Laval, M., Domingue, G., Lucas, V. (2006) Country review: Seychelles. In: De Young, C. (ed.) *Review of the state of world marine capture fisheries management: Indian Ocean*. FAO Fisheries Technical Paper. No. 488. Rome, FAO. 2006. pp 425-435

Robinson, J., and 6 authors (2001). The status of the coral reefs of Aride Island Nature Reserve and Ile Coco Marine National Park, Seychelles. Royal Geographical Society *Shoals of Capricorn Programme*, Shoals Report R027. London, UK. 21pp.

Robinson, J., and 7 authors (2001). The impacts of sedimentation on coral reefs 2 ½ years after the onset of the East Coast Phase III Dredging and Land Reclamation Project, Seychelles: Final Report. Royal Geographical Society *Shoals of Capricorn Programme*, Shoals Report, London, UK.

Graham, N.A.J., Wilson, S.K., Jennings, S., Polunin, N.V.C., Bijoux, J.P. & **Robinson, J.** (2006) Dynamic fragility of oceanic coral reef ecosystems. *Proceedings of the National Academy of Sciences* 103 (22): 8425-8429

Graham, N.A.J., Wilson, S.K., Jennings, S., Polunin, N.V.C., **Robinson, J.**, Bijoux, J. & Daw, T. (in press) Lag effects in the impacts of mass coral bleaching on coral reef fish, fisheries and ecosystems. *Conservation Biology* 21(5): 1291-1300.

Grandcourt, E., Hecht, T., Booth, A. & **Robinson, J.** (2008) A retrospective stock assessment of the Emperor red snapper, *Lutjanus sebae* (Cuvier, 1816), on the Seychelles Bank (1977-2006). *ICES Journal of Marine Science*.

Seychelles National Plan of Action for the Conservation and Management of Sharks (2007). Seychelles Fishing Authority, Victoria, Seychelles. 59 p. (co-author)

Aumeeruddy, R. & **Robinson, J.** (2006) Closure of the live reef food fish fishery in Seychelles. *Secretariat of the Pacific Community Live Reef Fish Information Bulletin* 16:3-9

Azemia, R., **Robinson, J.** (2005) Seychelles Artisanal Fisheries Statistics for 2004. Seychelles Fishing Authority Technical Report (SFA/R&D/059). Government of Seychelles, Victoria. 87p (plus statistical reports for the years 2002 and 2003)

Andrew Wekesa Wamukota

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Date of Birth: October 20th, 1973
Citizenship: Kenyan
Marital status: Married
Languages: English and Swahili- Fluent in both written and spoken

Education

2007: Master of Philosophy in Environmental studies, specializing in Environmental Economics, Moi University
1997: Bachelor of Arts (Major: Economics and Sociology), University of Nairobi, Second Class Upper Division

Professional Experience

1. Wildlife Conservation Society/ Coral Reef Conservation Society, Research Associate.
2. Kenya Sea turtle Conservation Committee, Programs Coordinator.

I have over seven years progressive experience in research and program administration/coordination. During this time I have undertaken research either singularly or jointly with other scientists in addition to completing research at a Masters level (Master of Philosophy) in fish market connectivity in two districts in Kenya.

My other research activities have focused on socioeconomic and ecological drivers of resource management. Of particular importance are human dimensions in the management of terrestrial and marine resources mainly semi-arid lands, coral reefs and sea turtles. I have collaborated with scientists from governmental and non governmental research institutions nationally and regionally.

Research and Program Coordination

2007: Research associate, Wildlife Conservation Society-Coral Reef Conservation Project.

August 2007: Principal Investigator, Wildlife Conservation Society-Coral Reef Conservation project.

Project: Effectiveness of Community based organizations in managing coastal resources in the Western Indian Ocean.

October 2006 – December 2006: Socio-economist, Wildlife Conservation Society- on secondment from KESCOM. The project was undertaken in Zanzibar, Tanga and Dar es Salaam in Tanzania to monitor socioeconomic factors following the coral reef bleaching.

January 2006- present: Programs Coordinator, lead Socioeconomist, education and awareness sub committee chairperson (KESCOM). My responsibilities included enlisting the participation of community involvement in the conservation and management of sea turtles along the Kenyan coast.

June – September 2005: Socioeconomist, Wildlife Conservation Society- on secondment from KESCOM

In the Socioeconomic monitoring of coral reef post bleaching effect in North Coast, Kenya,.

April 2003- December 2005: Assistant Programs Coordinator, Socioeconomic specialist, education and awareness sub committee chairperson (KESCOM).

July 2000 – February 2001: Socio-economist, Semi Arid Rural Development Program (SARDEP) Keiyo and Marakwet Districts.

Publications

- **Wamukota W.A** (in review) The Marine Fish marketing in Malindi and Kilifi Districts-Kenya. WIO Journal
- **Wamukota W.A** (in review) Perceptions about trends and threats to sea turtles in Kenya. in J. Hoorweg and N. A. Muthiga, editors. *Coastal Ecology*. African Studies Centre, Leiden, Netherlands.
- Cinner, J., T. R. McClanahan, C. Abunge, and **A. Wamukota** (in review). Human dimensions of conserving Kenya's coral reefs. in J. Hoorweg and N. A. Muthiga, editors. *Coastal Ecology*. African Studies Centre, Leiden, Netherlands.
- McClanahan T.R, J.E. Cinner, J. Maina, N.A.J. Graham, T.M. Daw, S.M. Stead, **A. Wamukota**, K. Brown, M. Ateweberhan, V. Venus, & N.V.C. Polunin (2008). Conservation action in a changing climate. *Conservation Letters*
- **Wamukota W.A** (2007). Proceedings of the Exposure and Exchange Workshop on Sustainable Marine Life Management, Giriama Beach Hotel, July 30th–August 4th 2007.
- **Wamukota, W.A.** (2007) Elevating Sea Turtle Conservation through awareness in Kenya. KESCOM Technical Report Series, 2007, Mombasa, Kenya
- **Evanson Chege Kamau, Wamukota Andrew** and Nyawira Muthiga (2006) Integrating Multiple Demands on Coastal Zones with Emphasis on Aquatic Ecosystems and Fisheries. A Specific Targeted Research Project (STREP). Found online at <http://www.incofish.org/WorkpackagesWP10>
- **Wamukota W.A** (2005) Using a rights based approach to conserve Natural Resources: The Case of Sea Turtles. In Wakwabubi E and Matendo L (eds) *Institutionalizing Rights in Development Through Citizen Participation*. Case Studies from Kenya, Uganda and Zimbabwe. Participatory Methodologies Forum of Kenya (PMAFORK). Nairobi.
- **Wamukota W.A** (2005). Proceedings of the Exposure and Exchange Workshop on Marine Life Management, Plaza Beach Hotel, April 10th–15th 2005.
- Nzuki S. **Wamukota W.A.** Mueni E (2004). Enhancing Community Participation in the Conservation and Management of Sea Turtles in Kenya. KESCOM Technical Report Series, 2004, Mombasa, Kenya.
- **Wamukota W.A.** (2001). Cost and Benefits of Natural Resource Management. “A tale of two micro-catchments” In *Strengthening Capacities Empowering Local Communities*, SARDEP 1999-2000 Mid Term Progress Report- Kajiado, Keiyo and Marakwet, Laikipia

Referees:

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JOSHUA ELI CINNER

ARC Centre of Excellence for Coral Reef Studies James Cook University Townsville QLD 4811 Australia joshua.cinner@jcu.edu.au

Education

PhD, 2006	James Cook University
MA Marine Affairs, 2000	University of Rhode Island
BA Environmental Conservation & Geography 1995	University of Colorado

Scholarships & Fellowships

-
- ◆ Australian Research Council “Australian Postdoctoral Fellowship” (2008-2010)
 - ◆ Australian Academy of Science visiting scholar- Sweden 2008
 - ◆ James Cook University International Postgraduate Research Scholarship (2002-2005)

Research and Management Positions

Senior Research Fellow - ARC Australian Postdoctoral Fellowship	2006- 2010
James Cook University, Townsville, Australia	Supervisor: Dr. Terry Hughes
Postdoctoral Research Fellow	2005
Coral Reef Conservation Project, Mombasa, Kenya	Supervisor: Dr. Tim McClanahan
Environmental Social Scientist	2001-2003
Wildlife Conservation Society, New York	Supervisor: Dr. Tim McClanahan

Grants & Awards

-
- ◆ US\$23,919 from the National Geographic Society's Committee for Research and Exploration in support of project "How can communities sustainably manage coral reefs?" (Principal Investigator) (2008)
 - ◆ US\$16,500 from the WIOMSA to write a book on “Adapting to a Changing Environment: Global Warming Consequences and Proposed Actions for the Western Indian Ocean” (2008)
 - ◆ US\$29,500 from the WIOMSA to lead 2nd working group on “Social and ecological responses to reef ecosystem change in the Western Indian Ocean.” (Principal Investigator) (2008)
 - ◆ US\$10,000 from the Australian Academy of Science for scientific visit to Europe (Principal Investigator) (2008)
 - ◆ US\$205,000 from the Australian Research Council for “How can communities sustainably manage coral reefs?” (Principal Investigator) (2007-10)
 - ◆ US\$30,000 from the WIOMSA to lead working group on “Social and ecological responses to reef ecosystem change in the Western Indian Ocean” (Principal Investigator) (2007)
 - ◆ US\$150,000 the WIOMSA “The effectiveness of community based organizations for managing coastal resources in the Western Indian Ocean.” (Principal Investigator) (2007-8)
 - ◆ US\$150,000 from the WIOMSA “Preparing for climate change through the assessment of biodiversity and management preferences across a scale of environmental variation in the Western Indian Ocean.” (Co- Investigator) (2007-10)
 - ◆ US\$560,000 internal “Research Advancement Program” grant from James Cook University (Co-Investigator)
 - ◆ US\$150,000 from WIOMSA “The effects of coral bleaching on coral reef fish, fisheries, ecosystem services, and associated socioeconomics in the Western Indian Ocean” (Co-Investigator) (2005-7)
 - ◆ US\$25,000 from NOAA for socioeconomic training in Caribbean (2005)
 - ◆ US\$ 2,000 from the North American Free Trade Agreement for socioeconomic study in Mexico (1999)
 - ◆ US\$ 2,500 from Peace Corps for environmental education projects in Jamaica (1997)

Select Publications

Cinner, J., M.M.P.B. Fuentes, H. Randriamahazo. Exploring social resilience in Madagascar’s marine protected areas. **Ecology & Society**: accepted with minor revisions

- Cinner, J., T.M. Daw, T.R. McClanahan. Socioeconomic factors that affect artisanal fishers' readiness to exit a declining fishery. **Conservation Biology**: in press
- Hicks, C., TR McClanahan, J.Cinner, and J Mills. Trade offs in ecological goods and services associated with different coral reef management strategies. **Ecology & Society**. Minor revisions
- McClanahan T.R, J.Cinner, J Maina, N.A.J. Graham, T.M. Daw, S.M. Stead, A. Wamukota, K. Brown, M. Ateweberhan, V. Venus, & N.V.C. Polunin. Identifying Reefs of Hope and Hopeful Actions: Contextualizing Environmental, Ecological, and Social Parameters to Effectively Respond to Climate Change. **Conservation Biology**: revisions submitted
- McClanahan, T. and J. Cinner. (2008). A framework for adaptive gear based fisheries management in Papua New Guinea. **Aquatic Conservation: Marine and Coastal Ecosystems**: 18: 493-507
- McClanahan T.R, J. Cinner, et al.. (2008) Conservation action in a changing climate. **Conservation Letters**: 1:53-59
- Pratchett, M, P. Munday, S. Wilson, N. Graham, J. Cinner, D. Bellwood, G. Jones, N. Polunin, T. McClanahan. (2008) Effects of climate-induced coral bleaching on coral-reef fishers: ecological and economic consequences. Invited review in **Oceanography and Marine Biology: an Annual Review**: 46: 251-296
- Cinner, J. (2007) Designing marine reserves to reflect local socioeconomic conditions: Lessons from long-enduring customary management systems. Invited paper in **Coral Reefs** 26:1035–1045
- Cinner, J. (2007) The role of taboos in conserving coastal resources in Madagascar. Invited paper in **Traditional Marine Resource Management and Knowledge Information Bulletin**. 22: 15-23
- Cinner, J. and S. Aswani (2007). Integrating customary management into marine conservation. **Biological Conservation**: 140: 201-216
- Cinner, J., S. Sutton, T. Bond. (2007) Socioeconomic thresholds that affect use of customary fisheries management tools. *Conservation Biology* 21: 1603-1611 *Highlighted in Australasian Science (March 2008: 14)*
- Cinner, J., M. Marnane, T. McClanahan, G. Almany. (2006). Periodic closures as adaptive coral reef management in the Indo-Pacific. **Ecology & Society** 11(1): 31.
- Cinner, J. and T. McClanahan (2006). Socioeconomic factors leading to overfishing in an artisanal coral reef fishery. **Environmental Conservation** 33: 73-80.
- McClanahan, T., M. Marnane, J. Cinner, W. Kiene. (2006). A comparison of marine protected areas and alternative approaches to coral reef conservation. **Current Biology** 16: 1408-1413
- Cinner, J. (2005) Socioeconomic factors influencing customary marine tenure in the Indo-Pacific. **Ecol. & Soc.** 10:
- Cinner, J., M. Marnane, T. McClanahan. (2005). Conservation and community benefits from traditional coral reef management at Ahus Island, Papua New Guinea. Invited paper in **Conservation Biology** 19: 1714-1723.
- Cinner, J., M. Marnane, T. Clark, T. McClanahan, J. Ben, R. Yamuna. (2005). Trade, Tenure, and Tradition: Influence of sociocultural factors on resource use in Melanesia. **Conservation Biology** 19: 1469-1477
- Cinner, J. and R. Pollnac. (2004). Poverty, Perceptions and Planning: Why socioeconomics matter in the management of Mexican reefs. **Ocean & Coastal Management** 47: 479-493

Referees

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Senior Conservation Scientist
Wildlife Conservation Society
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James Cook University
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Richard Pollnac
Prof. Anthropology & Marine Affairs
University of Rhode Island
Tel: (401) 874-4140 or 874-6201
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Joseph Maina Mbui

PERSONAL DETAILS

DATE OF BIRTH	14-February-1975
NATIONALITY	Kenyan Citizen
PERMANENT ADDRESS	Kibaki Flats #12, P.O. Box 10222 code: 80101 Bamburi via Mombasa, Kenya. Telephone: +254-723-883021 Email: mainajm@gmail.com

RESEARCH INTERESTS

<p>My research interests include remote sensing, scaling and spatial analysis; change detection and spatial/ecological modelling; coastal and marine ecosystems response to climate change; biogeography; developing new decision support tools; and natural resource management. Projects I am currently involved in focus on identifying coral reef systems that are likely to survive climate change related stress; investigating adaptive capacity of coastal communities to changing environment; ecosystem services; and coastal altimetry</p>

ACADEMIC QUALIFICATION

Higher education	
2005 - Mar 2007	MSc. Geo-information Science and Earth Observation for Environmental Modelling and Management – Consortium of Lund Univ. ,Univ. Of Southampton, Univ. Of Warsaw and the International Institute for Geo-information Science and Earth Observation (ITC), The Netherlands (www.gem-msc.org).
1996 - 2001	BSc. (Honours) Natural Resource Management, Egerton University, Kenya

EMPLOYMENT RECORD

Period	Organization	Title and duties
2001 – 2005	Wildlife Conservation Society - Coral Reef Conservation Project	Research Assistant: <ul style="list-style-type: none"> Ecological, socioeconomics, & biophysical data collection, management and manipulation; and dissemination of results to local communities and relevant government agencies
2007-2008	Consulting, various	Consultant: <ul style="list-style-type: none"> Climate change and adaptation Environmental modeling and management Land and ocean applications of GIS, remote sensing and modeling tools Coastal and marine systems conservation science and natural resource management
August 2008-Jul-2009	Wildlife Conservation Society, Coral reefs program	Research Associate <ul style="list-style-type: none"> Spatial analyst - coral reefs program

RECENT CONSULTING

Nov 2008: East Africa Wildlife Society: impact of climate change, vulnerability assessments and adaptation/mitigation measures on wetlands, marine and coastal resources in East Africa. *Contact person: Dr. Jared Bosire, jbosire@kmfri.co.ke*

Aug 2008: Overseas Development Group/School of Development Studies University of East Anglia, UK: project-ecosystem services for poverty alleviation: marine and coastal situation analysis, task-mapping ecosystem services
Contact person: Prof. Katrina Brown, k.brown@uea.ac.uk

Mar-June 2008: National GIS consultant, The Nile Basin Initiative of the Food and Agriculture Organization of The United Nations, Nairobi
Contact person: Mr. Bart Hilhorst, faonile@africaonline.co.ug

Mar-Apr 2008: UNDP Biofuel Project - Baseline survey of energy use patterns and associated socio-economics in Southern Kenya
Contact person: Mr. Fritjof Boerstler, fritjof.boerstler@undp.org

Feb-June 2008: Lagoon Resources sector consultant for the Regional Programme for the Sustainable Management of the Coastal Zone of the Countries of the Indian Ocean (ReCoMaP-IOC)
Contact person: Mr. Hassanali Tayffa, hassanali.tayffa@coi-ioc.org

Nov07 to Feb08: Consulting for WWF/CI, Madagascar - climate change vulnerability assessments project
Contact person: Dr. Emily Pidgeon, e.pidgeon@conservation.org

May07 to Sept 07: Wildlife Conservation Society's coral reef conservation project, Mombasa- Modeling benthic-fisheries interaction to investigate impacts of fishing intensity, catch selection and climate change on reef structure and processes
Contact person: Dr. Tim McClanahan, tmccclanahan@wcs.org

Sept07-Oct2007: Lecturing: International Institute for Geo-information Science and Earth Observation (ITC), The Netherlands- Short course on applications of GIS and Remote Sensing in Integrated Coastal Zone Management and disaster risk reduction, Dakar, Senegal
Contact person: Prof. Tsehaie Woldai, woldai@itc.nl

SOFTWARE APPLICATION SKILLS

Intermediate to advanced level skills in the following applications:

Remote sensing, environmental modelling and geo-information science	<i>MATLAB, ArcGIS, ArcIMS, ERDAS, ILWIS, ENVI, UNESCO Bilko, IDRISI, MaxEnt, PCraster</i>
Systems analysis and dynamic modelling	<i>STELLA, iTHINK (IEE systems), MAPSYS</i>
Statistical applications	<i>R, Canoco, Statistica, SAS JMP, SPSS, Minitab</i>
Programming	<i>Python, Java script, Jython</i>
Database	<i>Access, Filemaker</i>
MS office	<i>Word, Excel, Powerpoint</i>
Other	<i>LaTex (text processing), Unidata's IDV for remote data access</i>

OTHER QUALIFICATIONS AND SKILLS

Corals, algae and reef fish genus to species level identification

Open water diver (PADI), June 2001

Fluency in Spoken and written English, Swahili and currently taking French classes

PEER REVIEWED PUBLICATIONS

Maina, J., McClanahan, T. R., Venus, V., (2008) Meso-scale modelling of coral's susceptibility to environmental stress using remotely sensed data: Reply to comments by [Dunne \(2008\)](#) *Ecological modeling* <http://dx.doi.org/10.1016/j.ecolmodel.2008.06.032>

Maina, J., Venus, V., McClanahan, T. R., Ateweberhan, M. (2008) Modelling ecological susceptibility of coral reefs to environmental stress using remote sensing data and GIS models. *Ecological modeling* 212:180–199

T.R. McClanahan, J.E. Cinner, **J. Maina**, N.A.J. Graham, T.M. Daw, S.M. Stead, A. Wamukota, K. Brown, M. Ateweberhan V. Venus, & N.V.C. Polunin (2008) Conservation action in a changing climate *Conservation Letters* 1:53-59

McClanahan, T. R., M. Ateweberhan, C. Muhando, **J. Maina**, and S. M. Mohammed (2007) Effects of climate and seawater temperature variation on coral bleaching and mortality. *Ecological Monographs* **77**:503-525.

McClanahan, T.R., Graham, N.A.J., **Maina, J.**, Chabanet, P., Bruggemann, J.H., Polunin, N.V.C. (2007) Influence of instantaneous variation on estimates of coral reef fish populations and communities. *Marine Ecological Progress Series* 340: 221–234

McClanahan, T.R., Verheij, E., **Maina, J.** (2006). Comparing the Management Effectiveness of a Marine Park And A Multiple Use Collaborative Management Area In East Africa. *Aquatic Conservation: Marine and Freshwater Ecosystems* 16: 147–165

McClanahan, T. R., Baker, A., Ateweberhan, M., **Maina, J.**, Moothien-Pillay, R., (2005) Refining coral bleaching experiments and models through reiterative field studies. *Marine Ecology Progress Series*. 305: 301–303

McClanahan, T.R., **Maina, J.**, Moothien-Pillay, R., Baker, A. (2005). The Effects of Geography, Temperature History, Taxa, And Water Flow On Patterns Of Coral Bleaching Intensity In Mauritius (20⁰s) In 2004. *Marine Ecology Progress Series*. 298: 131–142

McClanahan, T.R., **Maina, J.**, Davies, J. (2005). Attitudes Of Resource Users And Managers Towards Fisheries Management Options In Kenyan Coral Reefs. *Fisheries Management and Ecology*. 11: 1-8

McClanahan, T.R., **Maina, J.**, Starger, C.J., Herron-Perez, P. & Dusek, E. (2005). Detriments To Post-Bleaching Recovery Of Corals. *Coral reefs*. 24: 230-246

McClanahan, T.R., Davies, J., **Maina, J.** (2005). Factors influencing resource users and managers' perceptions towards marine protected area management in Kenya. *Environmental Conservation*. 32 (1): 1–8

McClanahan, T.R., Shawn M. McLaughlin, Joanne E. Davy, William H. Wilson, Esther C. Peters, Kathy L. Price & **Maina, J.** (2004). Observation of a New Source of Coral Mortality along the Kenyan Coast. *Hydrobiologia*. 530/531: 469-479

McClanahan, T.R. & **Maina, J.** (2003). Response Of Coral Assemblages To The Interaction Between Natural Temperature Variation And Rare Warm-Water Events. *Ecosystems*. 6: 551-563.

McClanahan, T.R., **Maina, J.** & Pet-Soede, L. (2002). Effects Of The 1998 Coral Mortality Event On Kenyan Coral Reefs And Fisheries. *Ambio* 31: 543-550.

EVALUATION OF SCIENTIFIC PAPERS

Evaluation of 1-2 papers in 2007-2008 for *Ecological Modelling; Environmental Monitoring and Assessment; & Information Systems* journals

MEMBERSHIPS AND PROFESSIONAL ASSOCIATIONS

- UNeDRA: University Network for Disaster Risk Reduction in Africa
- African Association of Remote sensing of the environment
- International Society for Ecological Modelling – European chapter
- The Fisheries Society of the British Isles – UK
- Western Indian Ocean Marine Science Association

DÉBORA DE FREITAS

ARC Centre of Excellence for Coral Reef Studies James Cook University Townsville QLD 4811 Australia debora.defreitas@jcu.edu.au

Education

PhD Environmental Sciences, 2009 (concluding)	James Cook University, Australia
MSc Oceanography, 2003	Federal University of Rio Grande, Brazil
MSs-Complementary Studies in Marine Policy, 2003	University of Delaware, USA
BSc Oceanography, 2000	Federal University of Rio Grande, Brazil

Scholarships & Fellowships

- ◆ Postdoctoral Research Fellowship - Australia (2008-2011)
- ◆ James Cook University International Postgraduate Research Scholarship- Australia (2006-2008)
- ◆ National Coordination for the Improvement of Graduate People- Brazil (2001-2003)
- ◆ Consortium Program in Superior Education established between CAPES- Brazil and the Fund for the Improvement of Postsecondary Education FIPSE- USA (2003)
- ◆ National Council for Technologic and Scientific Development- Brazil (2000)
- ◆ Research Support Foundation of Rio Grande do Sul State- Brazil (1995-1999)

Research and GIS related Positions

Postdoctoral Research Fellow-ARC Australian Postdoctoral Fellowship	Supervisor. Prof Bob Pressey (2008-2011)
James Cook University- Townsville	Supervisor: Dr. David King (2006-2009)
Member of the International Scientific Committee of the CoastGIS (GIS and computer mapping for coastal zone management)	(2007 to present)
GIS Officer CSIRO Sustainable Ecosystems - CSIRO- Townsville	Supervisor: Dr Alexander Smaijgl (2006-2008)
GIS Officer and Researcher Collaborator - Coastal Management Laboratory, Brazil	Supervisor: Paulo Tagliani (2000-2005)
Tutor Introduction to GIS, James Cook University- Townsville	(2006-2007)
Supervisor Environmental Management Department – Rio Grande City Council, Brazil	(2003-2005)

Grants & Awards

- ◆ AU\$146000 from the James Cook University Research Scholarship Program (2006-2008)
- ◆ AU\$ 3300 Travel Award from the GIS for the Coastal Zone: Spatial Data, Modelling and Management to attend CoastGIS conferences in Wollongong (Australia) and Santander (Spain). (2006-2007)
- ◆ AU\$8000 the Consortium Program in Superior Education established between CAPES (Brazil) and the FIPSE (USA) (2003)
- ◆ AU\$8700 Financial Support and Scholarship from the National Coordination for the Improvement of Graduate People (CAPES) (2001-2003)
- ◆ AU\$ 2000 Travel Grant from the De La Republica University and American States Organization to attend the International Course in Satellite Observation of Coastal Environments, Uruguay (2002)

- ◆ AU\$ 2000 Travel Grant from Concepción University (Postgraduate Oceanography Program) and UNESCO to attend the International Course in Advanced Topics in Coastal Zone Management, Chile (2001)
- ◆ AU\$ 2000 Brazilian Long Term Ecological Research (PELD), Brazil. (2000)
- ◆ AU\$ 2500 Travel Grant from the Coastal Zone Canada 2000 Conference to attend the Coastal Zone Canada 2000 Conference. (2000)

Training GIS and Coastal Management

- ◆ (2008) Ecosystem-Based Management Tools Network: Coastal-Marine Ecosystem-Based Management Tools Training for South Pacific Practitioners. Townsville, Australia.
- ◆ (2003) Complementary studies in Marine Policy. University of Delaware (Center for the Study of Marine Policy), United States.
- ◆ (2002) Introduction to Remote Sensing and GIS Applications in Coastal Environments Course. São Paulo, Brazil.
- ◆ (2001) Geographic Information Systems (GIS) in Ecology: Fundamental and Applications. Porto Alegre, Brazil.
- ◆ (2001) Environmental Planning Uses of Coastal Plain employing Geographic Information Systems (GIS). Rio Grande, Brazil.
- ◆ (2000) International Course in Advanced Topics in Coastal Zone Management, Concepción University, Chile.

Select Publications

Peer-Reviewed

- De Freitas, D.M., Kininmonth, S., Woodley, S. (2009). Linking Science and Management in the Adoption of Sensor Network Technology in the Great Barrier Reef Coast, Australia. **Computers, Environment and Urban Systems**: in press.
- De Freitas, D.M., Tagliani, P.R. (2008). The use of GIS for the integration of Traditional and Scientific Knowledge in supporting Artisanal Fisheries Management in southern Brazil. **Journal of Environmental Management**, 1:10: in press.
- De Freitas, D.M., Tagliani, P.R. (2007). Spatial planning of shrimp farming in the Patos Lagoon Estuary (southern Brazil): an integrated coastal management approach. **Journal of Coastal Research**, 47: 136–140.
- Tagliani, P.R., De Freitas, D.M., Domingues, M. (2007). Conflicting Uses in Mangueira Bay: A Prospective Analysis. **Journal of Coastal Research**, 47: 141-144.
- De Freitas, D.M., Muelbert, J.H. (2004). Ichthyoplankton Distribution and Abundance off Southeastern and Southern Brazil between 11/15 and 12/05/1995. **Brazilian Archives of Biology and Technology**, 47(4): 601-612.

Non-Peer-Reviewed

- De Freitas, D.M., Sutton, S. (2008). Spatial Implications of Rezoning of Australia's Great Barrier Reef for Recreation Fishers. 5th World Recreational Fishing Conference November 10-13, Florida, USA. (Abstract Accepted).
- De Freitas, D.M. (2008) The use of Spatial Information and GIS in Community Engagement and Management Processes of Natural Resources in the Burdekin Dry Tropics Coast. Coast to Coast 2008, 18-22 August, Darwin, Australia.
- De Freitas, D.M., Sutton, S., Moloney, J. (2007). Spatial and Non-Spatial Dimensions of Geographic Information-Based Tools in Supporting Participation in the Great Barrier Reef Coast (Northern Australia). 8th International Symposium on GIS and Computer Mapping for Coastal Zone Management. 8-10 October, Santander, Spain.
- De Freitas, D.M. (2006). The Utilization of GIS Tools to Support Artisanal Fisheries Management in the Southern Coast of Brazil. GIS for the Coastal Zone: Spatial Data, Modelling and Management. 13-17 July, Wollongong, Australia.

Referees

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