Island Coastal Academy Network (I-CAN), Western Indian Ocean- Internationally-accredited capacity-building for sustainable coastal biodiversity conservation

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Community Centred Conservation (C3)
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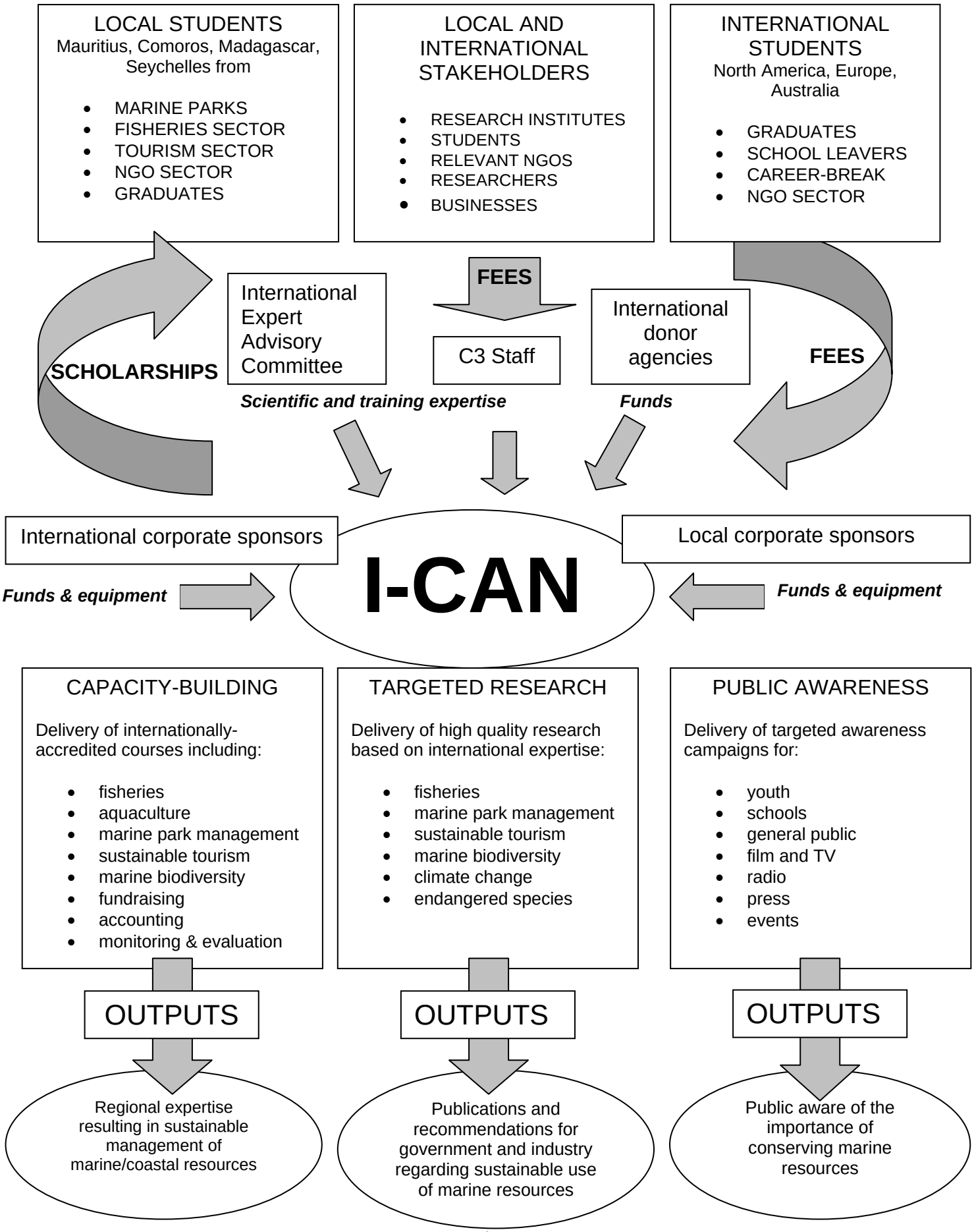
The Western Indian Ocean, showing the primary beneficiary countries: Mauritius, Madagascar, Comoros and Seychelles

Executive Summary

The concept of the Island Coastal Academy Network (I-CAN) is a unique, innovative and entrepreneurial plan to engage private, public and non-governmental sectors in a holistic project that will assure the sustainable development of marine resources throughout the Western Indian Ocean. It has long been recognized that this region harbours incredible and little-explored marine biodiversity with enormous actual (and potential) value in terms of food production, medicinal uses, coastal protection and recreational value. However, a lack of technical expertise is limiting the effectiveness of current conservation initiatives. The Network, with nodes in Mauritius, Madagascar and the Comoros, will be the first of its kind and will build local capacity through internationally-recognized vocational BTEC qualifications in Coastal Biodiversity Management, Sustainable tourism and Community Based Organization management. Training of local BTEC trainers and a unique plan for financial sustainability will ensure that this project leaves a regional legacy for years to come.

Project summary flow chart



Summary of progress

The project funds were received in January 2009, and scoping visits and project set-up visits followed shortly afterwards. Serious political turmoil in Madagascar postponed work in the country until June 2009 when international travel warnings were lifted. Offices have been established in each country and formal contracts signed with local partners in Madagascar and Comoros, who have provided additional teaching facilities and office space in-kind, which are currently being equipped with IT, teaching and library facilities. Corporate sponsorship has been secured from Air Madagascar, and other potential sponsors are regularly being approached and consulted. Partners in each country have been formally consulted about the course design and the accreditation process with Edexcel is now well underway. All local partners are very keen to implement the BTEC courses as soon as accreditation has been approved and the first courses are expected to start in 2010.

Current progress with respect to original objectives and outputs

Objective 1: To develop internationally-accredited tailor-made BTEC courses in (1) Coastal Biodiversity Management, (2) Sustainable tourism and (3) Community Based Organization management

- ***Output 1.1: Relevant course manuals and lecture series created***

Course materials are in preparation and are being reviewed by EdExcel prior to accreditation. See appendix 1 for an example course outline.

- ***Output 1.2: Course accredited by EDEXCEL***

The accreditation progress is underway and we expect the courses and centre accreditation to be completed by the end of 2009

- ***Output 1.3: Course accredited by the Mauritius Qualifications Authority (MQA)***

We will apply for MQA accreditation as soon as the courses have received approval by EdExcel

Objective 2: To build institutional capacity for marine biodiversity conservation through linking existing national 'node' institutions within a research and training network

- ***Output 2.1: Suitable office premises identified in each country and modified as necessary, relevant permits obtained***

Offices have been established in Comoros, Mauritius and Madagascar. Development of the Madagascar node was delayed by serious political unrest in the country in early 2009.

- ***Output 2.2: Classroom facilities set up***
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Following consultation meetings, a five-year agreement was signed with the government of the Comoros in July 2009 and a two-year agreement with the University of Antsiranana, Madagascar in May 2009. The University of Antsiranana is particularly keen to participate fully in the BTEC courses, because it is currently developing an MSc in Marine Biodiversity, for which the BTEC could serve as a practical module or introductory course. The Centre National de Recherches Oceanographiques in Nosy Be, Madagascar is also interested in acting as a field site for the courses and has sent a representative to planning meetings with the project team in December 2008 and July 2009.

The University of Antsiranana has provided teaching facilities, including a dedicated office which is being furnished from September 2009 and stocked with a library, computers and media equipment in the following quarter. Sir Gaetan Duval Hotel School, Mauritius has agreed to assist

with teaching facilities. The I-CAN offices in each country are all sufficiently large to accommodate any other necessary teaching facilities.

- ***Output 2.3: Research facilities set up***

IT facilities and internet access are currently being established in each country. We are also developing links with local dive centres and boat captains to facilitate fieldwork. All nodes have been equipped with snorkelling equipment, camping equipment and field survey equipment.

- ***Output 2.4: Media centre established***

Media centres are in preparation in all three countries with equipment purchased in the UK and imported from March 2009. All nodes now have access to video and still cameras, underwater housings and editing software.

Objective 3: To deliver the courses to local and international students

- ***Output 3.1: Courses delivered to 20 local students in year 1***

- ***Output 3.2: Courses delivered to 15 international students in Year 1***

The courses are expected to start in July 2010 at the end of the academic year, they have been delayed by the political problems in Madagascar (International travel warnings were in place February – June 2009) and the accreditation process taking longer than expected.

Objective 4: To impact marine conservation efforts at the regional level through creation of an interactive online learning network across the Indian Ocean islands

- ***Output 4.1: Website design and launch***

- ***Output 4.1: Online forum established***

A website for the Network has already been created at www.coastal-academy.org and is currently being developed alongside the online forum and will be online as soon as the courses are finalized. A network of translators has already been established.

- ***Output 4.3: Relevant reports / papers / grey literature database made available online***

These are currently being gathered and catalogued and will be online by the end of 2009.

Objective 5: To train a network of local BTEC trainers

- ***Output 5.1: 6 national trainers trained in Year 1***
- ***Output 5.2: 3 regional trainers trained in Year 1***

A number of potential trainers have been identified and will be trained as soon as the courses are accredited. Resumes have been collected and initial presentations and interviews held in mid-2009.

Objective 6: To ensure long-term financial sustainability

- ***Output 6.1: Business plan developed and reviewed***

A business plan has been produced and reviewed by Mauritian entrepreneurship advisors. The plan will be reviewed and updated quarterly. This business-driven approach to the project will ensure that it is sustainable and will grow in the future rather than face the funding shortages that have affected other projects in the region.

- ***Output 6.2: Corporate sponsorship secured***

Discussions are underway with a number of corporate donors to support students or materials for the courses.

- ***Output 6.3: International publicity and marketing campaign established***

The BTECs will be advertised in late 2009 in the UK through presentations from a team of Comorian staff from the project. Advertising materials are currently in development by a pro-bono graphic design / advertising specialist (recruited in August 2009) and will be finalized and distributed as soon as the courses are accredited.

Appendix 1 : Example course structure – Tropical Biodiversity Management (WORKING DRAFT)

CORE UNIT 1

Unit title	MARINE TROPICAL ECOSYSTEMS
Unit value	40 hours

Unit description

This core unit provides an overview of the various marine tropical ecosystems and the research skills and tools that candidates are expected to be knowledgeable about for adequate identification, monitoring and subsequent data recording and presentation. Other specific areas of attention include an insight on climate change and its impacts on marine biodiversity globally and within the WIO.

Summary of learning outcomes

To achieve this unit a learner must:

1. Show an understanding of the **ecology of marine tropical ecosystems**
2. Acknowledge the importance of current marine and coastal **agreements, conventions and initiatives**
3. Carry out specified **biological survey techniques**
4. Understand the causes of **climate change** and its impacts on **biodiversity**

Summary of the content for each learning outcome

1. Ecology of marine tropical ecosystems

Tropical biodiversity	definition, importance (direct and indirect values), natural disturbances
Tropical ecosystems	coral reef, mangrove and seagrass general ecology, ecological importance and distribution

2. Agreements, conventions and initiatives

International agreements and conventions	Convention on Biological Diversity and the Jakarta Mandate; The Ramsar Convention on Wetlands; World Heritage Convention; United Nations Convention on the Law of the Sea; International Convention for the Prevention of Marine Pollution from Ships (MARPOL)

Regional agreements and conventions	Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region (Nairobi Convention); African Convention on the Conservation of Nature and Natural Resources
Initiatives	World Summit on Sustainable Development, UNESCO Man and the Biosphere Programme (MAB), FAO Code of Conduct for Responsible Fisheries, International Coral Reef Initiative (ICRI), International Coral Reef Action Network (ICRAN), African Protected Areas Initiative (APAI), WWF Eastern African Marine Ecoregion (EAME) Programme, WWF Western Indian Ocean Marine Ecoregion (WIOMER) Programme

3. Biological survey techniques

Species identification tools	simple taxonomy (kingdom, phylum, class, order, family, genus, species); computer based tools (Knowledge base of the Mascarene corals, fish base); identification keys and books
Planning a survey technique	identifying aims and objectives, target species, logistical considerations
Carrying out biological survey techniques	appropriate techniques for survey area (e.g. underwater fish transects, hard and soft substrata sampling methods, reef check)

4. Climate change and biodiversity

Climate dynamics	oceanic circulation, El Niño Southern Oscillation (ENSO), green house gases and their effects, ultraviolet radiation, ozone and CFCs, anthropogenic aerosols, volcanic eruptions, hurricanes, global warming, future climate trends and changes
Impacts of climate change on the environment	loss of genetic diversity, adaptation capacity, sea level and temperature fluctuations, shifts in species distribution and abundance, extinction, ecosystem functioning and productivity (coral reefs, mangroves, pelagic ecosystems)

Assessment criteria for each learning outcome

Learning outcomes	Assessment criteria To achieve each outcome a learner must demonstrate the ability to**:**

1.	Show an understanding of the **ecology of marine and coastal tropical ecosystems**	• Appreciate the value of biodiversity • Recognise principal threats to biodiversity (natural and anthropogenic – more detail later) • Appreciate the consequences of biodiversity loss • Describe the systems of tropical coastal and marine zones
2.	Acknowledge the importance of current marine and coastal **agreements, conventions and initiatives**	• Comprehend the role of governance in marine and coastal management and use of resources at various levels • Appreciate the importance of regional and international initiatives for biodiversity conservation
3.	Carry out specified **biological survey techniques**	• Understand simple taxonomy principles • Demonstrate ability to use various identification tools • Plan and deliver a biological survey • Perform at least three biological survey techniques proficiently
4.	Understand the causes of **climate change** and its impacts on **biodiversity**	• Describe the major climatic processes and how they affect global climate change • Discuss the impacts of climate change on natural systems • Appreciate the consequences of habitat and biodiversity loss

Resources

- ⇨ expedition and biological survey equipment
- ⇨ black/whiteboard
- ⇨ computer and projector
- ⇨ program CDs

Suggested reading

Websites
Seagrass-Watch : http://www.seagrasswatch.org/home.html
Marine Mammal Commission (listing of marine mammal species) : http://www.mmc.gov/species/
Coral list : http://coral.aoml.noaa.gov/mailman/listinfo/coral-list/

Fish base : http://www.fishbase.org/search.php

Knowledge base of the Mascarene corals : http://coraux.univ-reunion.fr/

Ecology of marine and coastal ecosystems

Dorenbosch M et al. (2005) Indo-Pacific seagrass beds and mangroves contribute to fish density and diversity on adjacent coral reefs. *Marine Ecological Progress Series* 302:63-76

Jackson JBC (1997) Reefs before Columbus. *Coral Reefs* 16 Supplement: S23-S32

garth P (2007) *The biology of mangrove and seagrasses*, Oxford University Pre USA, 2nd edition, 252pp

cClanahan TR, Sheppard CRC and Obura DO (2000) *Coral reefs of the Indi Ocean: Their Ecology and Conservation*, Oxford University Press, USA, 552pp

Sale PF (1999) *The Ecology of Fishes on Coral Reefs*, Academic Press, 754pp

Swaminathan MS (2003) Bio-diversity: an effective safety net against environmental pollution. Environmental Pollution 126(3):287-291

Agreements, conventions and initiatives

The Ramsar Convention on Wetlands : http://www.ramsar.org

Convention on biological diversity : http://www.biodiv.org

Jakarta Mandate : http://www.biodiv.org/programmes/areas/marine
World Heritage Convention : http://whc.unesco.org
United Nations Convention on the Law of the Sea : www.un.org/depts/los
International Convention for the Prevention of Marine Pollution from Ships : www.imo.org

Nairobi Convention : www.unep.org/easternafrica/

African Convention on the Conservation of Nature and Natural Resources : www.iucn.org/themes/wcpa/wpc2003/pdfs/outputs/africa/africa_pasconvention.pdf

World Summit on Sustainable Development : www.johannesburgsummit.org

UNESCO Man and the Biosphere Program : www.unesco.org/mab

FAO Code of Conduct for Responsible Fisheries : www.fao.org

International Coral Reef Initiative : www.icriforum.org
International Coral Reef Action Network : www.icran.org
African Protected Areas Initiative : www.nepad.org
WWF Eastern African Marine Ecoregion (EAME) Program ; WWF Western Indian Ocean Marine Ecoregion (WIOMER) Program: www.panda.org

Biological survey techniques

English S et al. (1997) Survey Manual for Tropical Marine Resources (2nd ed.) ASEAN-Australia Marine Science Project: Living Coastal Resources, Australian Institute of Marine Science, PMB No. 3, Townsville Mail Centre, Australia 4810, 390p.

Kulbicki M and Sarramégna S (1999) Comparison of density estimates derived from strip transect and distance sampling for underwater visual censuses: a case study of chaetodontidae and pomacanthidae. *Aquatic Living Resources* 12:315-325

Lessios HA (1996) Methods for quantifying abundance of marine organisms. In M.A. Lang and C.C. Baldwin (eds.) Methods and techniques of underwater research. Smithsonian Institution, Washington. pp. 149-175.

McClanahan TR et al. (2007) Influence of instantaneous variation on estimates of coral reef fish populations and communities. *Marine Ecological Progress Series* 340:221-234

McCormick MI (1994) Comparison of Weld methods for measuring surface topography and their associations with a tropical reef fish assemblage. *Marine Ecological Progress Series* 112:87-96

McKenzie LJ et al. (2003) Seagrass-Watch: Manual for mapping & monitoring seagrass resources by community (citizen) volunteers. 2nd Edition (QFS, NFC, Cairns) 100pp. C3 REFERENCE ID 72

Samoilys MA and Carlos G (2000) Determining methods of underwater visual census for estimating the abundance of coral reef fishes. *Environmental Biology of Fishes* 57(3):289-304

Thompson A and Mapstone B (1997) Observer effects and training in underwater visual surveys of reef fishes. *Marine Ecological Progress Series* 154:53-63

Watson R and Quinn T (1997) Performance of transect and point count underwater visual census methods. *Ecological Modelling* 104:103-112

Wilson SK et al. (2007) Appraisal of visual assessments of habitat complexity and benthic composition on coral reefs. *Marine Biology* 151(3):1069-1076

Climate change and biodiversity

Ehlers A et al. (2008) Importance of genetic diversity in eelgrass *Zostera marina* for its resilience to global warming. *Marine Ecology Progress Series* 355:1-7

Gilman EL et al. (2008) Threats to mangroves from climate change and adaptation options: A review. *Aquatic Botany* 89(2):237-250

Goulet TL (2006) Most corals may not change their symbionts. *Marine Ecology Progress Series* 321:1-7

Graham NAJ et al. (2006) Dynamic fragility of oceanic coral reef ecosystems. *PNAS* 103(22):8425-8429

Graham NAJ et al. (2007) Lag effects in the impacts of mass coral bleaching on coral reef fish, fisheries, and ecosystems. *Conservation Biology* 21:1291-1300

Graham NAJ et al. (2008) Climate warming, marine protected areas and the ocean-scale integrity of coral reef ecosystems. *PLoS ONE* 3(8):1-9

Hoegh-Guldberg O (1999) Climate change, coral bleaching and the future of the world's coral reefs. *Marine and Freshwater Research* 50:839-866

Hoegh-Guldberg O et al. (2007) Coral reefs under rapid climate change and ocean acidification. *Science* 318:1737-1742

Hughes TP et al. (2003) Climate change, human impacts, and the resilience of coral reefs. *Science* 301:929-933

McClanahan TR et al. (2007) Effects of climate change and seawater temperature variation on coral bleaching and mortality. *Ecological Monographs* 77:503-525

Orth RJ et al. (2006) A global crises for seagrass ecosystems. *BioScience* 56(12):987-996

Sheppard CRC (2003) Predicted recurrences of mass coral mortality in the Indian Ocean. *Nature* 425:294-297

Ulstrup KE et al. (2006) Variation in bleaching sensitivity of two coral species across a latitudinal gradient on the Great Barrier Reef: the role of zooxanthellae. *Marine Ecology Progress Series* 314:135-148

Union des Comores (2002) Communication Nationale Initiale sur les Changements climatiques. 12pp. C3 REFERENCE ID 8

Walther GR et al. (2002) Ecological responses to recent climate change. *Nature* 416:389-395

Worm B et al. (2006) Impacts of biodiversity loss on ocean ecosystem services. *Science* 314:787-790

CORE UNIT 2

Unit title HUMAN DIMENSIONS OF MARINE SYSTEMS

Unit value 40 hours

Unit description

This core unit focuses on the importance of human activities within marine systems and the associated assessment and monitoring techniques for sustainable use and management of marine natural resources. Topics include an insight on anthropogenic threats and mitigation measures; an overview of tourism in the coastal zone; an introduction to biological assessment techniques for fishery resources management; general information on aquaculture; and an introduction to socioeconomic research and application in the field.

Summary of learning outcomes

To achieve this unit a learner must:

1. Recognise the **anthropogenic threats and mitigation measures to biodiversity**
2. Understand the elements associated with the **tourism industry**
3. Describe **fishery stock assessment techniques and the management tools** and their application
4. Demonstrate an understanding of the **fisheries by-catch** problem and its potential **solutions**
5. Comprehend the value of and environmental issues in relation to **aquaculture**
6. Demonstrate the ability to conduct a **socioeconomic assessment**, including the writing of a semi-structured interview

Summary of the content for each learning outcome

1.	Anthropogenic threats and mitigation measures to biodiversity	
	Anthropogenic threats	habitat loss/degradation/fragmentation (e.g. coral extraction, aquarium trade, fishing), invasion of non native species, pollution (e.g. sewage, nutrient run-off), climate change
	Mitigation measures	habitat creation/rehabilitation, ecological monitoring programs, protection, law enforcement
2.	Tourism industry	
	Tourism overview	structure and sectors in the tourism industry
	Impacts of tourism	cultural, economic (local economic disruption) and environmental impacts (waste, sewage, buildings)
	Ecotourism and sustainable tourism	definition, benefits, issues
3.	Fishery stock assessment techniques and management tools	
	Stock identification techniques	traditional and genetic based
	Stock dynamics	growth, mortality, reproduction/recruitment rates of individuals and populations, modelling and interpretation (just in extra reading for more advanced students)
	Management tools	quotas, gear restrictions, minimum size, limited entry, closed seasons, MPAs, international law and fisheries policy
4.	Fisheries by-catch and solutions	
	Fisheries by-catch	accidental catch (e.g. sharks, turtles, cetaceans), disruption of ecosystem functionality
	Conservation initiatives	better informed science, new legislation, public pressure, market drivers, improve selectivity of fishing gear (e.g. turtle excluder device, by-catch reduction devices), influence of NGOs
5.	Aquaculture	

	Aquaculture overview	definition, history, world production, types of aquaculture
	Environmental impacts	positive impacts (restock populations, lower dependence on wild stocks of fish, new jobs, feed the worlds growing population), negative impacts (habitat destruction, genetically engineered fish escape, protein balance, alien species introduction, nutrient pollution)
	Future of aquaculture	socio-economic effects (visual pollution, traditional employment vs. aquaculture industry), growing world population needs, profitability and environmental compatibility, new technologies
6.	Socioeconomic assessment	
	Socioeconomic assessment	definition, socioeconomic topics, types (participatory, extractive, product-oriented, process-oriented)
	Preparation and planning	define goals and objectives, study areas and study sites, stakeholders, secondary data, team
	Collecting field data	observations, semi-structured interviews, focus groups, oral histories and survey
	Data analysis	compiling information, quantitative data, analysis workshop, final report

Assessment criteria for each learning outcome

Learning outcomes	Assessment criteria To achieve each outcome a learner must demonstrate the ability to**:**
1. Recognise the anthropogenic **threats and mitigation measures to biodiversity**	• Recognise the potential anthropogenic threats altering structure and function of tropical coastal ecosystems • Evaluate mitigation strategies for those threats • Investigate the threats to one endangered marine specie and discuss solutions and conservation issues
2. Understand the elements associated with the **tourism industry**	• Critically assess the elements of the tourism industry at a cultural, economic and environmental level • Distinguish between ecotourism and sustainable tourism

		• Recognise the potential benefits and issues of both eco- and sustainable tourism
3.	Describe **fishery stock assessment techniques and the management tools** and their application	• Describe aquatic resources identification techniques • Show ability to interpret simple stock dynamics graphs • Give examples of tools and their application to fisheries management
4.	Demonstrate an understanding of the **fisheries by-catch** problem and its potential **solutions**	• Understand how certain fishing activities have the potential to disrupt the functionality of an ecosystem • Propose conservation initiatives to reduce fisheries by-catch
5.	Comprehend the value of and environmental issues in relation to **aquaculture**	• Recognise the potential benefits of aquaculture • Identify the negative impacts of aquaculture on the environment • Acknowledge the challenge to maintain profitability and environmental compatibility
6.	Demonstrate the ability to conduct a **socioeconomic assessment**, including the writing of a semi-structured interview	• Appreciate the importance of socioeconomic research for management • Demonstrate ability to plan and design a socioeconomic assessment • Compose a semi-structured interview from a fictional case-study • Understand how to analyse and present data

Resources

- ⇨ black/whiteboard
- ⇨ computer and projector
- ⇨ program CDs

Suggested reading

Anthropogenic threats and mitigation measures to biodiversity

Bax N et al. (2003) Marine invasive alien species. *Marine Policy* 27(4):313-323

Cardoso PG et al. (2004) Dynamic changes in seagrass assemblages under eutrophication and implications for recovery. *Journal of Experimental Marine Biology and Ecology* 302:233-248

Dolbeth M et al. (2007) Anthropogenic and natural disturbance effects on a macrobenthic estuarine community over a 10 year period. *Marine Pollution Bulletin* 54:576-584

Halpern BS (2008) A global map of human impact on marine ecosystems. *Science* 319(5865):948-952

Halpern BS et al. (2007) Evaluating and ranking the vulnerability of global marine ecosystems to anthropogenic threats. *Conservation Biology* 21(5): 1301-1315

Tourism industry

Cater E (2007) *Marine ecotourism: between the devil and the deep blue sea*, CABI, 307pp

Davenport J and Davenport JL (2006) The impact of tourism and personal leisure transport on coastal environments: A review. *Estuarine, Coastal and Shelf Science* 67(1-2):280-292

Higham JES (2007) *Critical issues in ecotourism: understanding a complex tourism phenomenon*, Butterworth-Heinemann, 439pp

Kalli De M and Fernando S. *Admission fees: opportunities and challenges of using admission fees as a funding source at a small scale, tourism dependant MPA. Case study of the Bonaire National Marine Park*. Bonaire. 9pp. C3 REFERENCE ID 80

Lansing P and De Vries P (2007) *Sustainable Tourism: Ethical Alternative Marketing Ploy?* Journal of Business Ethics, *72(1):77-85*

L'écotourisme sur l'île de Mohéli (Rapport final) (2005) C3 REFERENCE ID 124

Les sites de conservation et de promotion écotouristiques aux Comores. C3 REFERENCE ID 125

Pearce DG (2008) « Tourism planning in small tropical islands: methodological considerations and development issues in Samoa », *Études caribéennes*, Le tourisme dans les îles et littoraux tropicaux et subtropicaux, [Online], published online the 8th of Septembre 2008. URL : http://etudescaribeennes.revues.org/document1393.html.

Scheyvens R and Momsen J (2008) Tourism in Small Island States: From Vulnerability to Strengths. *Journal of Sustainable Tourism*, 16 (5):491-510

Stolk P et al. (2007) Artificial Reefs as Recreational Scuba Diving Resources: A Critical Review of Research. *Journal of Sustainable Tourism*, 15(4):331-350

(in press) Confronting tourism's environmental paradox: Transitioning for sustainable tourism

Amin SH (1983) The Law of fisheries in the Persian Arabian Gulf. *Journal of Maritime Law and Commerce* 14(4):581-593 C3 REFERENCE ID 135

De San M. (1983) Profil de la Pêche Artisanale aux Comores, FAO: 18 C3 REFERENCE ID 91

International Collective in Support of Fishworkers (2006) *Fishing communities and sustainable development in Eastern and Southern Africa: the role of small-scale fisheries*. ESA Fish Workshop, Dar Es Salaam, Tanzania 69pp. C3 REFERENCE ID 86

Van Der Elst RP et al. (2005) Fish, fishers and fisheries of the Western Indian Ocean: their diversity and status, a preliminary assessment. *Philosophical Transactions of the Royal Society of London* 363:1-22 C3 REFERENCE ID 85

Graham NAJ et al. (2007) Lag effects in the impacts of mass coral bleaching on coral reef fish, fisheries, and ecosystems. *Conservation Biology* 21:1291-1300

Fisheries by-catch and solutions

Bachem SJ (2003) By-catch mitigation tools: selecting fisheries, setting limits, and modifying gear. *Ocean and Coastal Management* 46(1-2):103-125

Cox TM et al. (2007) Comparing effectiveness of experimental and implemented by-catch reduction measures: the ideal and the real. *Conservation Biology* 21(5):1155-1164

Davis PZR and Poonian CNS (2007) Incidental capture of the Dugong, *Dugong dugon*, in gillnets, Moheli, Union of the Comoros. In Kizska J and Muir C (eds). Ist Regional Workshop on incidental catches of non-targeted marine species in the western Indian Ocean. Workshop Proceedings 13-15th November 2006. Mayotte, France. C3 REFERENCE ID 63

Kiszka J et al. (2008) Incidental catch of marine mammals in the southwest Indian Ocean: a preliminary review. *The International Whaling Commission Publications* 11pp.

Lewison RL et al. (2004) Understanding impacts of fisheries by-catch on marine megafauna. *Trends in Ecology and Evolution* 19(11):598-604

Marsh H (2000) Evaluating management initiatives aimed at reducing the mortality of dugongs in gill and mesh nets in the Great Barrier Reef world heritage area. *Marine Mammal Science* 16(3):684-694 C3 REFERENCE ID 60

Matsuoka T et al. (2005) A review of ghost fishing: Scientific approaches to evaluation and solutions. *Fisheries Science* 71(4):691-702

Poonian C et al. (2008) Rapid assessment of Sea turtle and marine mammal by-catch in the Union of the Comoros. *WIOMSA Journal* (in revision)

Read AJ (2008) The looming crisis: interactions between marine mammals and fisheries. *Journal of Mammalogy* 89(3):541-548

Walker RCJ et al. (2005) Notes on the status and incidental capture of marine turtles by the subsistence fishing communities of South West Madagascar. *Western Indian Ocean Journal of Marine Science* 4(2):219-225

Werner T et al. (2006) Fishing techniques to reduce the by-catch of threatened marine animals. *Marine Technology Society Journal* 40(3):50-68

Pillay TVR and Kutty MN (2005) Aquaculture: principles and practices. (2nd ed.) Wiley-Blackwell, 624p.

Pullin RSV et al. (2007) Indicators for the sustainability of aquaculture p. 53-72 In TM Bert (ed.) Ecological and genetic implications of aquaculture activities. Kluwer Academic Publishers, Dordrecht, The Netherlands.

Socioeconomic assessment

Bunce L et al. (2000) Socioeconomic manual for coral reef management. 2nd edition. GCRMN and Australian Institute of Marine Science, Townsville, 251pp.

Cinner J and Fuentes M (2006) A baseline socioeconomic assessment of marine protected areas in Madagascar. A report prepared for the Wildlife Conservation Society, Madagascar C3 REFERENCE ID 72

Herman SJC (2000) Collected essays on the economics of coral reefs. CORDIO 244p.

Malleret King D et al. (2006) SocMon WIO manual (french) C3 REFERENCE ID 116

Malleret King D et al. (2006) SocMon WIO manual (english) C3 REFERENCE ID 115

Moberg F and Folke C (1999) Ecological goods and services of coral reef ecosystems. *Ecological Economics* 29(2): 215-233

Polasky S (2008) Why conservation planning needs socioeconomic data. *PNAS* 105(18):6505-6506

Traditional Marine Resource Management and Knowledge Information Bulletin (SPC Coastal Fisheries Programme): http://www.spc.int/Coastfish/News/Trad/trad.htm

CORE UNIT 3

Unit title MARINE PROTECTED AREAS (MPAs)

Unit value 40 hours

Unit description

This core unit introduces and develops theoretical and practical aspects of Marine Protected Area management with reference to local case studies and a significant fieldwork component. The final section of this unit focuses on the various marine habitat restoration techniques.

Summary of learning outcomes

To achieve this unit a learner must:

1. Comprehend the concepts involved in the **establishment of MPAs**
2. Understand subject-specific principles, theory and practice related to **management of MPAs**
3. Carry out specific **habitat restoration** techniques

Summary of the content for each learning outcome

1. Establishment of Marine Protected Areas

	MPAs theory	definition, types and categories of MPAs (including reserves for species/habitat), aims and objectives, benefits
	Establishment of MPAs	design and zonation, effectiveness of protected areas, levels of protection, legislation and enforcement
2.	Management of Marine Protected Areas	
	Long term monitoring programmes	importance of monitoring programmes in improving management, designing a monitoring programme (resource and capacity limit, appropriate indicators), types of monitoring programmes (habitats, fisheries, physical conditions, socio-economic)
	Surveillance and enforcement	compliance issues, equipment for surveillance, surveillance tasks (i.e. respect of regulations and legislation, fees and licenses paid etc.), understanding the wider national legal framework, stakeholder involvement, training and appropriate behavior
	User conflicts	types of conflicts, conflict resolution methods, steps in resolving a conflict
	Stakeholder consultations and the participatory approach to management	levels of participation, identifying stakeholders, participatory techniques
	Infrastructure	construction vs. environment, main building and facilities, planning buildings (i.e. location, size, design, construction material etc.)
	Management structures	strengths and weaknesses, co-management, community based management, top down/bottom up
	Financial planning and management	various funding sources (i.e. trust funds, grant proposals writing, volunteer schemes, user fees), budgets, accounting, financial plans
	Evaluating success	interest in marine protected area management effectiveness evaluation, methodology
3.	Habitat restoration	
	Choosing a restoration technique	identifying aims and objectives, target area, ecological and logistical considerations, costs and benefits
	Carrying out a restoration technique	coral transplant, mangrove and seagrass reseeding

Assessment criteria for each learning outcome

Learning outcomes	Assessment criteria
	To achieve each outcome a learner must demonstrate the ability to**:**

1.	Comprehend the concepts involved in the **establishment of MPAs**	• Appreciate the importance of MPAs • Give examples of the factors involved in setting up an MPA
2.	Understand subject-specific principles, theory and practice related to **management of MPAs**	• Appreciate the importance of long term monitoring programmes • Show capacity to build a management plan from a hypothetical case study
3.	Carry out specific **habitat restoration** techniques	• Plan a habitat restoration project • Appreciate the importance of ecological and logistical considerations for habitat restoration • Perform at least one habitat restoration technique proficiently

Resources

appropriate expedition and biological survey equipment, black/whiteboard, computer and projector, program CDs

Suggested reading

International news and analysis on Marine Protected Areas: http://depts.washington.edu/mpanews/

Pomeroy RS et al. (2004) How is your MPA doing?: A guidebook of natural and social indicators for evaluating Marine Protected Area management effectiveness. IUCN, 215p.

Pomeroy RS et al. (2005) How is your MPA doing? A methodology for evaluating the management effectiveness of marine protected areas. Ocean and Coastal Management 48(7-8):485-502

Bosire JO et al. (2008) Functionality of restored mangroves: A review. Aquatic Botany 89(2):251-259

Ellison AM (2001) Mangrove restoration: Do we know enough? Restoration Ecology 8(3):219-229

Kairo JG et al. (2001) Restoration and management of mangrove systems – a lesson for and from the East African region. South African Journal of Botany 67:383-389

Levy LSG et al. (2008) Fixed and suspended coral nurseries in the Philippines: Establishing the first step in the "gardening concept" of reef restoration. Journal of Experimental Marine Biology and Ecology 358(1):86-97

Lewis III RR and Gilmore RG (2007) Important considerations to achieve successful mangrove forest restoration with optimum fish habitat. Bulletin of Marine Science 80(3):813-837

Precht WF (2006) Coral Reef Restoration Handbook. CRC Press, 363pp.
Rinkevich B (2008) Management of coral reefs: We have gone wrong when neglecting active reef restoration. Marine Pollution Bulletin 56(11):1821-1824
Ruiz-Jaen MC and Aide M (2005) Restoration success: How is it being measured? Restoration Ecology 13(3):569-577
Shafir S et al. (2006) Steps in the construction of underwater coral nursery, an essential component in reef restoration acts. Marine Biology 149(3):679-687
Stone K et al. (2008) Factors influencing community participation in mangroves restoration: A contingent valuation analysis. Ocean and Coastal Management 51(6):476-484
Sutthacheep TYM and Petttongma R (2006) Coral reef restoration projects in Thailand. Ocean and Coastal Management 49(9-10):562-575

OPTIONAL UNIT 1

Unit title: PROJECT REPORT WRITING AND PUBLISHING ARTICLES

Unit value: 10 hours

Unit description:

This optional unit will provide the students with the skills to write various professional project reports and scientific papers for publication.

Summary of learning outcomes:

To achieve this unit a learner must:

1. Demonstrate the ability to **plan and compose a scientific paper**
2. Understand the basic requirements to **publishing a scientific article**
3. Understand how to produce an accurate

Summary of the content for each learning outcome:

1. Plan and compose a scientific paper

Plan: objectives, hypotheses,

Format: title, authors, abstract, table of contents, introduction, experimental techniques and methods, results and discussion, summary/conclusions, references, appendices

References: writing a standardised bibliography (book, article, website), pertinence of references, plagiarism

2. Publishing a scientific article

Authors: deciding the implication of each author in writing the paper

Journal: finding a journal, specific guidelines for submission

OPTIONAL UNIT 2

Unit title: REMOTE SENSING AND GIS

Unit value: 10 hours

Unit description:

This optional unit introduces the students to a basic theoretical and practical understanding of remote sensing and GIS as tools for supporting research studies and management initiatives. Through a case study, students will also get acquainted to the implementation and the issues associated with managing a GIS project. Additionally, students will learn how to collect data with a GPS and get acquainted with data incorporation into GIS using one of the software packages available.

OPTIONAL UNIT 3

Unit title: DATA RECORDING/PRESENTATION AND APPLIED STATISTICS

Unit value: 10 hours

Unit description: This optional module is aimed at the students who wish to gain further knowledge on how to record, present and analyse ecological and socioeconomic data collected in the field. Appropriate basic statistical techniques will be taught using computer-based statistical programs.

Summary of learning outcomes:

To achieve this unit a learner must:

1. Demonstrate proficiency in **data recording and presentation**
2. Carry out specific **univariate and bivariate statistical techniques**

Summary of the content for each learning outcome:

1. Data recording and presentation

Recording data: designing datasheets, completing datasheets in the field, incidental observations

Computer spreadsheets: accuracy, quality control, tables, graphs, suitability of each format for displaying data

2. Univariate and bivariate statistical techniques

Basic statistics: mean, standard error, correlation, regression, pair-wise tests, ANOVAs, statistical computer programmes

Assessment criteria for each learning outcome:

Learning outcomes	Assessment criteria for pass
1. Demonstrate proficiency in **data recording and presentation**	• Log comprehensive field notes • Formulate a biological survey datasheet • Record data accurately • Assess data for reliability • Utilise computer systems for data storage • Present survey data
2. Carry out specific **univariate and bivariate statistical techniques**	• Proficiency in statistical data analysis • Choose appropriate statistical tests • Interpret statistical values/outcomes • Utilise statistical computer programs

OPTIONAL UNIT 4

Unit title: FUNDING MECHANISMS

Unit value: 10 hours

Unit description:

This optional unit introduces and develops the practical skills required for successfully obtaining funds for conservation initiatives. Candidates practise recognising and justifying conservation requirements and suitable management initiatives. In addition, logistical requirements of project planning are covered such as budgets and timetables.

Summary of learning outcomes:

To achieve this unit a learner must:

1. Demonstrate the ability to compose a **grant proposal**, including budgets and timetables.
2. Show an understanding of the **reporting requirements** of conservation donors.

Summary of the content for each learning outcome:

1. Grant proposals

Approach to proposal-writing: identifying donors, identifying conservation requirements

Planning a project: budget forecasting, timetables

2. Reporting requirements of conservation donors

Progress reporting: scientific reports, recording weekly achievements

Project management: accounts, time management