Developing Marine Reserves for Biodiversity Conservation and Sustainable Fisheries in Rodrigues

Impacts of Marine Reserves in Rodrigues: Report of a training visit to Shoals Rodrigues, March 2006

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April 2006

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Executive Summary

1. A visit was made by the author to Rodrigues under the Darwin Initiative project *Developing marine reserves for biodiversity conservation and sustainable fisheries in Rodrigues* during 16-28 March 2006. Local support was provided by Shoals Rodrigues.

2. Monitoring fish size changes associated with the introduction of marine reserves had been identified during a previous visit as one key skill where local expertise was lacking. Training of staff from Shoals Rodrigues and the Fisheries Protection Service (FPS) to monitor live fish sizes was continued using wooden fish models of known size. All participants showed improvements in size estimation over the course of a series in-water training sessions. Recommendations for further action are made, including continued snorkel training for FPS staff, continued size estimation training for all potential fish surveyors, and minimum standards for surveyors.

3. A list of apparent new records of fishes for Rodrigues was compiled from fishery and reef monitoring reports produced by Shoals Rodrigues. Recommendations are made for further development of the scientific checklist of fishes of Rodrigues.

4. The potential for other biodiversity documentation is discussed, with particular emphasis on cetaceans, and recommendations made.

Impacts of Marine Reserves in Rodrigues: Report of a Training Visit to Shoals Rodrigues, 17 to 30 March 2006

1. Background

This report summarizes discussions and training carried out during a visit to Rodrigues by Dr. Charles Anderson under the Darwin Initiative project *Developing Marine Reserves for Biodiversity Conservation and sustainable Fisheries in Rodrigues*. This project is funded by the UK Department for Environment, Food and Rural Affairs (DEFRA) from February 2005 to January 2008.

The background to the project and summaries of work carried out to date are given by Edwards (2005), Gell (2005) and Anderson (2005). In brief, the government of Mauritius and the semi-autonomous region of Rodrigues recognise the problems associated with habitat degradation and overfishing in the nearshore waters of Rodrigues. In response, the Rodrigues Regional Assembly plans to declare four marine reserves in the northern Rodrigues lagoon. The purpose of the Darwin Initiative project is to assist with that process, helping to develop a management strategy, building local capacity in marine science, and raising environmental awareness.

In Rodrigues the project acts mainly through the local marine environmental NGO, Shoals Rodrigues. One key element is the provision of training in research methods to staff of Shoals Rodrigues, as well as to the Fisheries Protection Service (FPS). This will support their monitoring of fisheries and habitats both within and outside the new reserves, allowing the effectiveness of the reserves to be assessed.

The main aim of this visit in March 2006 was to continue a programme of training started in September 2005. This training will allow host country partners to monitor the effects of marine reserve establishment on fish populations.

2. Underwater Estimation of Fish Lengths

A major aim of the proposed marine reserves will be to allow overexploited fish populations to recover within the newly protected areas. It is anticipated that, in time, 'excess' fish will move out of the reserves, providing increased catches to fishers even though the area open for fishing is reduced. It will be important to monitor the effectiveness of the marine reserves, not only to justify their cost and continued existence to all stakeholders, but also to identify any weaknesses in their structure and management and to formulate appropriate remedial measures.

Monitoring which is designed to demonstrate the effects of marine reserves on fish populations should at the minimum cover two likely types of change:

a. Changes in fish population **abundance** (exploited fish species might be expected to become more abundant within the marine reserves once they are fully protected there).

b. Change in fish **size** (exploited fishes might be expected to become larger within the marine reserves once they are fully protected there).

Shoals Rodrigues already has in place a standard protocol for recording fish abundance. Selected species are counted along 50m transects as part of a wider coral and marine life monitoring programme. Therefore during my previous visit in September 2005, efforts were concentrated on developing a training programme to allow monitoring changes in fish size. The main aim of my visit in March 2006 was to continue and expand that training.

At present Shoals Rodrigues carries out length frequency sampling of commercial catches from the Rodriguan reef and lagoon fisheries, with much emphasis placed on the important artisanal seine net fishery. It is likely (and desirable) that this on-going catch sampling will remain the major source of fish size data. However, there are two reasons why this should be supplemented by non-fishery data:

a. Most importantly in this case, there should in the future be no fishing within the new marine reserves. Therefore the monitoring of fish sizes within the reserves will require a fishery-independent methodology.

b. More generally, catch sampling provides data on just the exploited subset of any fish population. Changes in fishing practice (e.g. a proposed increase in mesh size for the artisanal seine net fishery) will produce changes in size frequency of the catch, which do not necessarily reflect changes in population. Again, a fishery-independent means of monitoring sizes will be required if the effects of the marine reserves are to be isolated from the effects of any other changes in the fisheries.

Thus, if fish sizes are to be monitored in the new marine reserves, it will have to be done without catching them. There is no easy and entirely accurate means to do this. However, experience elsewhere has shown that divers and snorkelers can be trained to estimate fish lengths underwater to within acceptable levels of accuracy.

The Training Programme

In September 2005, 2 staff of Shoals Rodrigues and 5 staff of the Fishery Protection Service (FPS) received training in underwater estimation of fish lengths using wooden models (Anderson, 2005). In March 2006, 3 staff of Shoals Rodrigues and the same 5 FPS staff received additional training in underwater fish length estimation.

Details of the training procedure, and the results obtained, are given in Annex 1. In summary, the same 20 plywood models used in September 2005 were reused. These models were in the shapes and covering the full size range (11-48 cm total length) of fishes exploited in the lagoon and shallow reefs of Rodrigues. They were painted either black or white (10 of each) and clearly marked with individual numbers. The models were set out underwater to either side of a 50m tape/transect. Participants were required to snorkel along the transect and record their estimates of model length on an underwater writing slate. After each open water session, at a debriefing session, feedback was given on the true lengths of the fish models so that participants could judge their own performance and (hopefully) improve during the next session.

Five in-water training sessions were conducted, with individual trainees attending 1-4 sessions. (Due to poor weather, additional snorkelling and diving sessions were cancelled). The main outcomes may be summarized as follows:

a. The ability of all participants to estimate fish model lengths accurately and without bias clearly improved over the course of the training sessions.

b. Participants from Shoals Rodrigues were more efficient at locating models and were better at estimating their sizes than participants from FPS. This was a reflection of the higher level of snorkelling experience of those from Shoals Rodrigues.

c. For Shoals Rodrigues participants the training demonstrated that it is possible to estimate fish lengths underwater to an acceptable level of accuracy, but that that it is not a straightforward exercise, requiring practice and concentration.

d. For FPS participants, most of whom had limited prior in-water experience, the main outcome was undoubtedly their increased interest and confidence. Most are still some way from being of a standard suitable to carry out actual monitoring, but all demonstrated and voiced an enthusiasm to improve their skills in order to do so.

Recommendation: Fisheries Protection Service personnel should continue snorkel training with Shoals Rodrigues on a regular basis to further improve their water skills. Ideally this should include lifesaving training.

Recommendation: Shoals Rodrigues staff who will be involved in fish monitoring should continue regular training to improve their underwater size estimation skills. In particular, they should have a 'refresher' session of fish-length estimation and achieve a set standard of performance using the wooden fish models before attempting 'live' estimation.

Species to be Monitored

Species chosen for monitoring should have ideally have (individually or collectively) the following attributes:

- Be easily identified to species underwater
- Be regularly seen underwater (The commonest species caught, the Rabbitfish *Siganus sutor*, is apparently rarely seen by snorkelers or divers)
- Include a range of ecological types (e.g. predators, herbivores, coral grazers, territorial, roving, etc)
- Include both reef-associated and lagoon-associated species
- Include some species that are targeted by Rodriguan fisheries and some that are not targeted ('controls').

The total number of species to be monitored for size should not be too large, otherwise the work-load may become too great, and the possibility of confusion increases. A dozen, carefully chosen species should provide a good indication of size changes associated with the introduction of marine reserves.

During my last visit in September 2005, a provisional list of fish species suitable for length monitoring was presented for discussion (Anderson, 2005). Shoals Rodrigues staff have subsequently modified the list, and settled on the following 12 species for size monitoring:

1	Four-saddle Grouper	*Epinephelus spilotoceps*
2	Black-saddle Coralgrouper	*Plectropomus laevis*
3	Blacktail Snapper	*Lutjanus fulvus*
4	Spangled Emperor	*Lethrinus nebulosus*
5	Yellowstripe Goatfish	*Mulloidichthys flavolineatus*
6	Yellowfin Goatfish	*Mulloidichthys vanicolensis*
7	Bluefin Jack	*Caranx melampygus*
8	Blackback Butterflyfish	*Chaetodon melannotus*
9	False-eye Sergeant	*Abudefduf sparoides*
10	Bluebarred Parrotfish	*Scarus ghobban*
11	Picasso Triggerfish	*Rhinecanthus aculeatus*
12	Bluespine Unicornfish	*Naso unicornis*

3. Biodiversity Documentation

The proceedings of the First International Marine Biodiversity Workshop for Rodrigues held in 2001 (Oliver and Holmes, 2004) provide an excellent introduction to a number of groups of marine organisms. However, not all marine life groups are covered, and even for those that are, the listings are not complete. Updating knowledge of Rodriguan of marine biodiversity should be an on-going activity for Shoals Rodrigues. Accurate and comprehensive listings of selected components of marine biodiversity are of great value for ongoing monitoring activities, as well as providing important inputs to broader studies of taxonomy, biogeography and conservation.

Fishes

Heemstra et al. (2004) have provided an updated checklist of the fishes of Rodrigues, listing a total of 493 species. This list is certainly incomplete. Heemstra et al. (2004) themselves suggest that there may be a total of about 600 coastal fish species at Rodrigues, while the total fish fauna, including pelagic and deep water species, might approach 1000 fish species.

Several fish species not recorded by Heemstra et al. (2004) have been recorded by Shoals Rodrigues staff during the course of their on-going fish monitoring activities, particularly from the seine net fishery (Lynch et al, 2003-2005). Those records were summarized by Anderson (2005: Annex 3). During this present visit additional new records were compiled from recent Shoals Rodrigues reports (Hardman et al., 2006a, 2006b & 2006c); these records are compiled below in Annex 2. They cannot be considered as confirmed, definite records, but they do demonstrate that many 'new species' do await adequate documentation. In most cases it will be necessary to obtain a specimen to confirm identification. This is especially the case for fish families where field identification is not always straightforward. Useful website: www.fishbase.org

Recommendation: Shoals Rodrigues staff involved in fisheries monitoring and reef monitoring should keep an active look-out for fish species not included in the checklist of Heemstra et al. (2004). Whenever possible, specimens should be obtained, otherwise photographs may suffice to substantiate records in some cases.

Recommendation: Voucher specimens should be deposited at an appropriate international institution (e.g. the Natural History Museum, London).

Recommendation: Shoals Rodrigues should continue to cultivate collaboration with big game fishermen, with divers and others to source specimens or photos of new fish species.

Cetaceans

As noted by Anderson (2005), the cetacean fauna of Rodrigues appears to be completely unstudied. The most recent regional review (de Boer et al., 2002) makes no mention of Rodrigues, while Payet (2005) alludes to the general dearth of cetacean research in the Mascarene region. Nevertheless, inspection of bathymetric charts, and discussions with Shoals Rodrigues staff, Fishery Protection Service staff and fishermen suggests that there are likely to be good numbers of whales and dolphins in the waters immediately around Rodrigues.

Cetaceans are an important component of most marine habitats, and particularly nearshore pelagic areas such as those surrounding Rodrigues. Furthermore, Rodrigues lies within the

International Whaling Commission's (IWC's) Indian Ocean Sanctuary (IOS) (Leatherwood and Donovan, 1991). Within the IOS, which includes all waters of the Indian Ocean as far south as 55°S, all great whales are protected from commercial exploitation, and benign research is encouraged. Furthermore, there is an acknowledged need to expand and diversify income-generation from tourism in Rodrigues, and cetacean-watching may provide one such opportunity. Useful website: www.wdcs.org

Shoals Rodrigues is in a good position to initiate a basic research cetacean programme. This is beyond the scope of the current Darwin Initiative project, but it is well within the remit of Shoals Rodrigues. As a first step Shoals Rodrigues staff should continue to document all incidental records of cetacean sightings and strandings. A few recent records of cetaceans from Rodrigues are listed in Annex 3. A more systematic survey could be developed as funding became available. Options, in approximate order of cost, could include: regular shore-based monitoring of cetaceans from one or more of the prominent headlands at the eastern side of the island (where the lagoon is relatively narrow and deep ocean water could be surveyed by telecope); regular monitoring from the passenger ferries that ply between Mauritius and Rodrigues; dedicated monitoring from big-game fishing boats operating out of Rodrigues.

Recommendation: Shoals Rodrigues should document all incidental records of cetacean sightings and strandings.

Recommendation: Shoals Rodrigues should investigate the possibility of initiating regular shore-based monitoring of cetaceans from one or more of the prominent headlands at the eastern side of the island.

Recommendation: Shoals Rodrigues should investigate the possibility of obtaining funding to conduct an offshore cetacean survey.

Other Groups

While fishes are perhaps the most obvious component of the lagoon and reef fauna, many other groups are present and play key roles in the Rodriguan reef ecosystem. The study of any group would undoubtedly pay dividends. However, creatures that are conspicuous but are rare (in space and time) are particularly suited to this type of on-going documentation. Their rarity means that an outside expert on a relatively short visit is unlikely to record more than a small fraction of the total fauna. On the other hand, their conspicuous nature means that a local researcher is likely to come across many species over the course of a few years. Obvious examples of such animals include the sea slugs (Opisthobranch Molluscs) and the marine flatworms (Polyclad Platyhelminthes). Useful website: www.seaslugforum.net

During the course of this visit a small collection of sea slugs was made, and one Shoals Rodrigues staff member (Sydney Perrine) briefed on collection, preservation and identification techniques. Provisional contact was made with a research group active in Ophisthobranch taxonomy to work up these and any subsequent specimens.

Recommendation: Collection of sea slugs should be continued on an opportunistic basis. Only 1or 2 of each species should be collected; all specimens must be fully documented with colour photos or drawings and full notes; all specimens should be held in preservative until a batch can be forwarded to an international expert for working up and eventual publication.

Recommendation: Individual Shoals Rodrigues staff should be encouraged to 'adopt' particular faunal or floral groups for on-going study, ideally in collaboration with an acknowledged international expert.

5. Acknowledgements

This visit was funded by the Darwin Initiative and facilitated by Dr. Al Edwards of Newcastle University. I am most grateful to the Director of Shoals Rodrigues, Eric Blais, and all the Shoals staff, particularly Scientific Coordinator Dr. Emily Hardman, Research and Training Officer Jovani Raffin, Technical and Training Assistant Sydney Perrine, Menon Chinien-Chetty and Sabrina Desiré for their hospitality and support.

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Annex 1

Summary of Results from Fish-length-estimation Training Sessions

The proposed declaration of several Marine Reserves around Rodrigues should provide some opportunity for overexploited reef fish populations to recover. Any recovery should be apparent in two ways: (1) an increase in fish abundance, and (2) an increase in fish size.

Changes in abundance can be monitored relatively easily by making regular counts on standard transects. Monitoring changes in fish size is less straightforward, simply because it is not possible to actually measure live, free-swimming fish. Therefore it is necessary to make estimates of fish length underwater. This introduces many potential sources of error, and it is necessary to complete training to improve size estimation skills before any monitoring can be started.

Training Programme

During September 2005, four open-water training sessions were carried out for 2 Shoals Rodrigues staff and 5 FPS staff. The Shoals Rodrigues staff were better at estimating sizes than FPS staff, reflecting their greater in-water experience. Nevertheless, all participants showed marked improvements in fish length estimation over the course of the training period.

In March 2006 further training was provided for the same 2 Shoals Rodrigues staff and the same 5 FPS staff. In additional, one other staff member from Shoals Rodrigues participated.

After an initial briefing session, there were five open-water training sessions. Participants were required to swim along a 50m tape transect, set out on the bottom, near which 20 wooden fish models had been deployed (18 models deployed in training session 1, and one model lost during the course of training session 5). Each fish model was of different size and had a number painted on its side. Participants recorded their estimate of length for each model on an underwater writing slate. After each session, in a short debriefing session back at the Shoals Rodrigues office, the true lengths of each model were revealed so that each participant could assess their own performance, and make appropriate improvements during the following session.

Training Schedule

Monday 20 March

Morning: Briefing session for Shoals Rodrigues staff followed by snorkel training session, Anse aux Anglais (3 participants)

Tuesday 21 March

Morning: Briefing session for FPS staff (5), and later for UNDP-MPA staff (1)

Wednesday 22 March

Morning: Second snorkel training session for officers of the Fisheries Protection Service (5) and Shoals Rodrigues staff (2)

Friday 24 March

Morning: Third snorkel training session, off Jean Tac for FPS officers (5)

Afternoon: Fourth snorkel training session, off Jean Tac for FPS officers (5) and Shoals Rodrigues staff (1)

Saturday 25 March

Morning: Fifth snorkel training session, near Ile Hollandais for FPS (5) and staff of Shoals Rodrigues (2). Debriefing for FPS trainees

Afternoon: Debriefing for Shoals Rodrigues staff

Participants

Dr. Charles Anderson, training consultant, for Shoals Rodrigues
Mr. Eric Blais, Director, Shoals Rodrigues
Mr. Jovani Raffin, Research and Training Officer, Shoals Rodrigues
Mr. Menon Chinien-Chetty

Mr. Marcelin Raffaut, Ag. Senior Fisheries Protection Officer, FPS
Mr. Marclay Peermamode, Fisheries Protection Officer, FPS
Mr. George Eric Jolicoeur, Fisheries Protection Officer, FPS
Mr. Johnson Ah Kang, Fisheries Protection Officer, FPS
Mr. Wendy Grandcourt, Fisheries Protection Officer, FPS

In addition the following participated in an initial briefing session:

Mr.Jean Rex Pierre Louis (UNDP MPA project)

Results

Results are summarized in Tables 1-6. Table A1-1 summarizes bias in size estimation by each participant during each training session. A negative number indicates that on average the participant underestimated the size of the models, while a positive number indicates that model sizes were overestimated. The larger the number, the larger the bias in estimation. In this and subsequent tables, a number in parentheses indicates that lengths were not recorded for all fish models and that the result in the table has been raised to the total number of models deployed.

During initial training in September 2005, there was a very large bias during the first training session but this improved with subsequent training sessions. In this round of training, most participants recorded their largest bias during their second or even third training session. However, nearly all recorded their lowest bias in the final training session. Another point to note is that, as in September 2005, initial bias was mainly negative, i.e. most participants overcompensated for magnification due to use of a diving mask underwater.

Table A1-1. Summary of estimates of bias in underwater fish length measurements over five training sessions by nine participants

Bias	Training Session					Final
	1	2	3	4	5	average
Jovani	[6]					-
Charles	[21]	78	82	40	[17]	0.9
Eric (SR)	[-17]	53			[0]	0.0
Menon	[-20]	-81		16	7	0.4
Raffaut		-85	111	81	32	1.6
Peermamode		[-12]	[-55]	[26]	18	0.9
Ah-Kang		37	111	85	[40]	2.0
Eric (FPS)		[-7]	[21]	42	[7]	0.4
Wendy		[-87]	[-4]	[-55]	-26	-1.3

In both September 2005 and March 2006, participants from Shoals Rodrigues performed better than those from FPS (Table A1-2). This is largely a reflection of the greater experience of the Shoals Rodrigues participants with both snorkelling and underwater monitoring. In addition, the Shoals participants recorded a lower average bias in March 2006 than in September 2006, while the performance of FPS staff deteriorated very slightly over the same period.

Table A1-2. Summary of average estimates of bias in underwater fish length measurements by participants from the two organizations during two training periods

Average Bias	Training Period	
	Sept 2005	March 2006
Shoals Rodrigues	0.50	0.43
Fisheries Protection Service	0.68	0.72

Table A1-3 summarizes accuracy of size estimation by each participant during each training sessions. The larger the number, the less accurate the estimation. Again, the worst results were often recorded in the second training session, but in almost every case the best result was recorded during the final training session.

Table A1-3. Summary of estimates of accuracy in underwater fish length measurements during five training sessions by nine participants

Accuracy	Training Session					Final
	1	2	3	4	5	average
Jovani	[23]					-
Charles	[41]	90	82	42	[31]	1.6
Eric (SR)	[39]	59			[34]	1.7
Menon	[65]	81		34	[24]	1.2
Raffaut		121	111	83	48	2.4
Peermamode		[43]	[95]	[50]	44	2.2
Ah-Kang		91	115	95	[46]	2.3
Eric (FPS)		[58]	[72]	64	[43]	2.2
Wendy		[94]	[74]	[86]	46	2.3

In both September 2005 and March 2006, participants from Shoals Rodrigues were more accurate in estimating fish model lenghts than those from FPS (Table A1-4). Again, this is largely a reflection of the greater experience of the Shoals Rodrigues participants with both snorkelling and underwater monitoring. Nevertheless, FPS participants did record a marked improvement in performance between the two training periods. Note that the numbers presented in Table A1-4 indicate, for example, that FPS participants estimated fish model lengths with an average accuracy of ±2.3cm in March 2006. It should be emphasized, however, that these are average figures; estimates of individual fish lengths could be up to 10 cm out.

Table A1-4. Summary of average estimates of accuracy in underwater fish length measurements by participants from the two organizations during two training periods

Average Accuracy	Training Period	
	Sept 2005	March 2006
Shoals Rodrigues	1.8	1.5
Fisheries Protection Service	4.0	2.3

Table A1-5 summarizes numbers of fish model lengths recorded (out of 20 in most cases) by each participant during each training session, and as such provides an index of 'efficiency'. The larger the number, the more effective the participant was in locating and recording the fish models.

Table A1- 5. Summary of 'efficiency' in underwater fish length measurements during four training sessions by eight participants

Efficiency	Training Session						
	1	2	3	4	5	Total	%
No.models	18	20	20	20	19/20	78	
Jovani	18					18	100%
Charles	18	20	20	20	19	97	100%
Eric (SR)	18	20			19	57	100%
Menon	15	20		20	19	74	96%
Raffaut		20	20	20	20	80	100%
Peermamode		18	16	18	20	72	90%
Ah-Kang		20	20	20	19	79	100%
Eric (FPS)		19	15	20	19	73	91%
Wendy		19	19	19	20	77	96%

Once again, Shoals Rodrigues participant were better at locating and recording models than FPS participants, but the latter showed a remarkable improvement in performance between the two training periods (Table A1-6).

Table A1-6. Summary of average estimates of accuracy in underwater fish length measurements by participants from the two organizations during two training periods

Average Efficiency	Training Period	
	Sept 2005	March 2006
Shoals Rodrigues	100%	99%
Fisheries Protection Service	70%	95%

In summary, the following points are relevant:

1. Shoals Rodrigues staff showed only marginal improvement in final performance between September 2005 and March 2006. This reflects their initial high standard of performance. Nevertheless, participants did show an overall improvement in performance during the course of the individual training sessions held in March 2006. The implication is that practice at fish model length estimation should be carried out immediately before attempting live fish length monitoring.

2. FPS personnel showed a marked improvement in performance during March 2006 compared with September 2005. This reflects both the additional training given, and the extra snorkelling practice they undertook in the interim.

Anderson (2005) recommended that anyone carrying out actual fish size monitoring should achieve a set standard of performance with fish models of known size before carrying out live monitoring. He suggested that a bias score of less than ±10, an (in)accuracy score of less than 40 and an 'efficiency' score of at least 39 (in each case based on estimates for 20 models averaged over 2 trials) would be sufficient. For the most part, Shoals Rodrigues staff have met these standards, while FPS staff have not.

Annex 2

Fishes of Rodrigues – potential updates to checklist of Heemstra et al. (2004)

Heemstra et al. (2004) presented a checklist of coastal fishes known from Rodrigues up to 2003. They recorded a total of 493 species, most on the basis of specimens or photographs, but a few on the basis of sight records. During the course of fisheries and reef monitoring (particularly sampling of seine net catches), Shoals Rodrigues staff have recorded a number of fish species not reported by Heemstra et al. (2004). Reviewing those reports, Anderson (2005) noted 26 potential new records, together with a number of other possible records and name changes. Subsequently, Shoals Rodrigues has produced three annual survey reports for 2005, which list additional likely new records (Hardman et al., 2006a, 2006b & 2006c); these are listed below. In all cases, photos or specimens are required to confirm likely new records.

Notation:
* Species not listed by Heemstra et al. (2004), but already noted by Anderson (2005)
** Species not listed by Heemstra et al. (2004) or Anderson (2005)
? Species of questionable occurrence

Carcharinidae (Requiem Sharks)

?*Carcharhinus leucas* (Valenciennes, 1839)
Bull sharks are apparently seen regularly at one particular dive site off the south coast near Mourouk (pers. comm. to RCA, 25.9.05).

Elopidae (Tenpounders)

***Elops machnata*
Recorded by Hardman (2006b). Previously unrecorded from Rodrigues. Specimens required.

Albulidae (Bonefishes)

***Albula glossodonta*
Recorded by Hardman (2006b). Previously unrecorded from Rodrigues. Specimens required.

Belonidae (Needlefishes)

Tylosaurus crocodilus (Peron and LeSueur, 1821)
Recorded by Hardman et al. (2006b). Heemstra et al. (2004) recorded *Tylosaurus* sp. As noted by Heemstra et al. (2004: Table 2), specimens are required to confirm identification.

Syngnathidae (Pipefishes and Sea Horses)

*Seahorse
One unidentified seahorse recorded by Hardman et al. (2006c: Table A6), from lagoon algal/seagrass sampling site L1.

Fistulariidae (Flutemouths)

Fistularia commersonii Rüppell, 1838

Recorded by Hardman et al. (2006b). Heemstra et al. (2004) recorded *Fistularia* sp. *F. commersonii* is a shallow-water species, and is characterized by the presence of blue markings; the only other species likely to occur is *Fistularia petimba*, which lives in deepwater and has red markings. A single individual was seen closely by the author while snorkelling off Jean Tac on 24 March 2006; the blue dorsal marking were clearly seen. Specimen still required.

Serranidae (Groupers)

**Epinephelus spilotoceps* Schultz, 1953

Recorded by Hardman et al. (2006a & 2006c).

Lethrinidae (Emperors)

**Lethrinus xanthochilus* Klunzinger, 1870

Recorded by Hardman et al. (2006b).

Mullidae (Goatfishes)

Parupeneus macronema (Lacepède, 1801)

Recorded by Hardman et al. (2006b). Recorded by Heemstra et al. (2004) on the basis of an underwater sight record only. Specimen required to confirm identification.

**Parupeneus rubescens* (Lacepède, 1801)

Recorded by Hardman et al. (2006b).

Parupeneus trifasciatus (Lacepède, 1801)

Recorded by Hardman et al. (2006b) as *Parupeneus bifasciatus*, a junior synonym (Randall and Myers, 2002; Heemstra et al., 2004).

Carangidae (Jacks)

**Caranx sexfasciatus* Quoy and Gaimard, 1825

Recorded by Hardman et al. (2006b).

**Gnathodon speciosus* (Forsskål, 1775)

Recorded by Hardman et al. (2006b).

**Scomberoides lysan* (Forsskål, 1775)

Recorded by Hardman et al. (2006b).

Chaetodontidae (Butterflyfishes)

Chaetodon interruptus Ahl, 1923

Referred to in Hardman (2006a & 2006c) as *Chaetodon unimaculatus*. For many years the Indian Ocean and Pacific Ocean varieties of this Butterflyfish have been considered 'forms' or subspecies of one Indo-Pacific species (*Chaetodon unimaculatus* Bloch, 1787). Current opinion is that the two forms should be considered as two valid species (Allen et al., 1998; Heemstra et al., 2004).

Chaetodon kleinii Bloch, 1790

Recorded by Heemstra et al. (2004) on the basis of a sight record only. One pair seen clearly by the author while snorkelling near Ile Hollandais on 25 March 2006. Photographic confirmation desirable.

Pomacentridae (Damselfishes)

**Abudefduf vaigiensis* (Quoy and Gaimard, 1825)

Recorded by Hardman et al. (2006a).

Stegastes punctatus (Quoy and Gaimard, 1825)

Recorded by Hardman et al. (2006a & 2006c) as *Stegastes lividus*, a species now regarded as a Marquesan endemic (J.E. Randall, pers. comm.). Anderson (2005) was in error in suggesting that this species was not recorded by Heemstra et al. (2004); it is not recorded in their checklist, but it is illustrated in their Fig. 7.

Labridae (Wrasses)

Anampses meleagrides Valenciennes in Cuvier and Valenciennes, 1839

Recorded by Hardman (2006b). Recorded by Heemstra et al. (2006) on the basis of a sight record only. Photos or specimen required.

***Thalassoma quinquevittatum* (Lay and Bennett, 1839)

Recorded by Hardman (2006b). Not previously recorded from Rodrigues. Photos or specimen required.

Scaridae (Parrotfishes)

Calotomus viridiscens (Rüppell, 1835) / *Calotomus carolinus* (Valenciennes, 1840)

Recorded by Hardman et al. (2006b) as *C. carolinus*. Recorded by Heemstra et al. (2004) as *Calotomus viridiscens*. These parrotfishes are generally considered to be sibling species, *C. carolinus* being widespread in the Indo-Pacific species, while *C. viridiscens* is confined to the Red Sea. However, the differences between the two are limited to colour pattern, and as pointed out by Heemstra et al. (2004: Table 2) both forms occur in South Africa, so *C. calotomus* is likely a junior synonym of *C. viridiscens*. Specimens and photos showing fresh colours required.

Chlorurus sordidus (Forsskål, 1775)
Chlorurus strongylocephalus (Bleeker, 1854)

Recorded by Hardman (2006c) under the generic name *Scarus*. Several parrotfish species, including these ones, were split from the genus *Scarus* by Bellwood (1991).

**Scarus viridifucatus* (Smith, 1956)

Recorded by Hardman et al. (2006b).

Sphyraenidae (Barracudas)

**Sphyraena jello* Cuvier, 1829

Recorded by Hardman et al. (2006b).

Acanthuridae (Surgeonfishes)

**Acanthurus mata* (Cuvier, 1829)

Recorded by Hardman et al. (2006b).

****Acanthurus nigricans** Linnaeus, 1758

Recorded by Hardman (2006b). This is a Pacific species, that is known only from the eastern-most portions of the Indian Ocean. Possible mis-identification?

Additional References

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Annex 3

Cetacean Records

It is likely that over 20 species of whale and dolphin regularly inhabit the waters around Rodrigues. However, to date there has been no survey of cetaceans in this area. Five records collected incidentally during my previous visit in September 2005 are noted in Anderson (2005). Below are a few additional records of cetaceans collected incidentally during March 2006.

Unidentified Dolphin

A group of about 20 dolphins were seen by RCA from the headland at Baladirou at 1030h on the morning of 26.3.06. They were about 1 km off the reef and were heading east at some speed. They were too distant to allow identification, but their apparent size and shape suggested spinner or common dolphin.

According to Yann Colas (game fishing boat skipper, pers. comm., 26.3.06) a group of about 30 dolphins, which he could not identify, is regularly seen at the same location on the East Bank (an isolated seamount c50 miles east of Rodrigues) whenever he visits for fishing.

Pilot Whale (*Globicephala* sp.)

Yann Colas (game fishing boat skipper, pers. comm., 26.3.06) also reported seeing a group of pilot whales about 8 miles off the NE side of the island near the edge of the shelf in early January 2006. He reported that these were the only pilot whales he had seen at Rodrigues, but that they were common near Reunion where he operated before. The species most likely to be seen around the Mascarenes is the tropical Shortfin Pilot Whale (*Globicephala macrorhynchus*) but the presence of the temperate Longfin Pilot Whale (*G. melas*) might also be possible (perhaps particularly during the austral winter).

Sperm Whale (*Physeter macrocephalus*)

One sperm whale of about 10-11m length was washed up dead near Mourouk on the southeast side of the island in early February 2006. It has been buried, and there are plans to display the skeleton at the proposed giant tortoise park at Plaine Corail. Some further information is likely to be recorded in local newspapers.

Annex 4

Itinerary

Thu 16 March	Depart Malé 0730. Depart Maldives International Airport 0930 on Emirates (EK556) for Dubai. Arrive Dubai 1630.
Fri 17 March	Depart Dubai 0250 on EK701. Arrive Mauritius 0920. Depart Mauritius 1440 on Air Mauritius (MK130). Arrive Rodrigues 1610. Transfer to guesthouse (Residence Foulsafat at Jean Tac).
Sat 18 March	Full day at Shoals Rodrigues office. Orientation meetings with Shoals Rodrigues Director Eric Blais and Scientific Officer Dr. Emily Hardman. Briefing to Shoals staff on purpose of visit. Read relevant Shoals documents. Afternoon dive cancelled due to poor weather.
Sun 19 March	Morning snorkel at Grand Baie; abundance of algae and sea cucumbers, and absence of corals and large fish obvious. Afternoon snorkel at Jean Tac. Checking fish monitoring lists.
Mon 20 March	Morning briefing and training (reef fish monitoring) snorkel off Anse aux Anglais for Shoals Rodrigues personnel (3). Afternoon review of fish monitoring lists and island fish checklist.
Tue 21 March	Morning at Shoals Rodrigues office. Briefings for officials from Fisheries Protection Service (5) and for official of UNDP MPA project (1). Afternoon dive at Passe Grand Bassin (regular Shoals monitoring site). Evening discussions with Shoals staff on problems relating to implementation of marine reserves.
Wed 22 March	Morning snorkel off Grande Baie for officers of the Fisheries Protection Service (5) and from Shoals Rodrigues (2): reef fish monitoring training. Afternoon entering data from morning's training session. Exceptional rains flood Shoals Rodrigues office.
Thu 23 March	Rains continue. Schools closed, buses stopped and Shoals Rodrigues office closed due to flooding. Water in lagoon reduced to zero visibility by terrestrial run-off. Snorkel training sessions cancelled. Recent Shoals reports reviewed for additions and corrections to checklist of fishes of Rodrigues.
Fri 24 March	Morning training snorkel session (third) off Jean Tac for officers of the Fisheries Protection Service (5). Afternoon training snorkel session (fourth) off Jean Tac for officers of the Fisheries Protection Service (5) and Shoals Rodrigues (1). Data entry.
Sat 25 March	Morning training snorkel session (fifth) near Ile Hollandais for officers of the Fisheries Protection Service (5) and staff of Shoals Rodrigues (2). Debriefing for trainees from Fisheries Protection Service followed by farewell meeting at FPS headquarters. Afternoon at Shoals Rodrigues office. Data entry and analysis. Debriefing for Shoals Rodrigues staff.
Sun 26 March	Morning walk along coast from Jean Tac to Baladirou and return. Dolphin watching from headland at Baladirou. Midday meeting with Yann Colas, skipper of game fishing boat to discuss options for Shoals Rodrigues to charter boat for survey work beyond reef. Depart guesthouse 1510. Depart Rodrigues on Air Mauritius (MK131) at 1645. Arrive Mauritius 1815.
Mon 27 March	Depart Mauritius on Emirates (EK702) at 0020. Arrive Dubai 0650. Transfer to hotel. Preparation of mission report.
Tue 28 March	Depart Dubai on EK558 at 0350. Arrive Maldives International Airport 0855. Arrive at home in Malé 1000.