



Madagascar Schools' Booklet 2019

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1. Study area and research objectives

As well as boasting some of the most spectacular biodiversity in the world (lemurs, tenrecs, baobabs, and over half of all known chameleon species), much of which is endemic, Madagascar has three broad forest ecosystem types: dry forests in the north, humid rainforest in the east, and spiny forest in the south. The Operation Wallacea surveys are currently concentrating on the dry forest and associated wetlands of Mahamavo in the North, where you will spend your first week. The second week will be spent at a marine research site on the small island of Nosy Be off the North West coast of Madagascar (see fig 1 for locations).



Figure 1. Location of the Madagascar research sites

Mahamavo Forest

The Mahamavo dry forest ecosystem and adjacent wetlands has exceptional biodiversity but much remains to be discovered. Diurnal lemurs include Coquerel's sifaka (*Propithecus coquereli*), common brown lemur (*Eulemur fulvus*), mongoose lemur (*Eulemur mongoz*), with another 3-4 species of nocturnal lemurs. Madagascar is the global centre for chameleons. Two spectacular large species can be found in Mahamavo; *Furcifer oustaleti* and *Furcifer angeli*. The wetlands support the critically endangered Madagascar fish eagle (*Haliaeetus vociferoides*), a flagship species for the area of which only 99 breeding pairs remain in the wild, and Humblot's heron (*Ardea humbloti*), an endangered species.

The Mahamavo forest provides livelihoods for several neighbouring communities in terms of agricultural land, fuel and construction timber, as well as some wild food, hunting and medicinal plants. The wetlands in the coastal area support fisheries, which constitute the main resources for coastal communities. Although this area encompasses all of these land uses, there still remains intact forest that is managed by the local

community. The teams in the Mahamavo forests will be completing an assessment of the area in terms of biodiversity along stratified sampling routes (Fig 2).

The objectives of this to be to monitor how the forest structure and biodiversity changes over time in the community managed forests of Mahamavo, both to document the performance of a community managed area in terms of biodiversity conservation as well as to identify areas where a forest replanting programme could be initiated to extend the forest coverage. In addition the Opwall teams are documenting the biodiversity value of the adjacent wetlands with a view to getting this area upgraded to a Ramsar site.

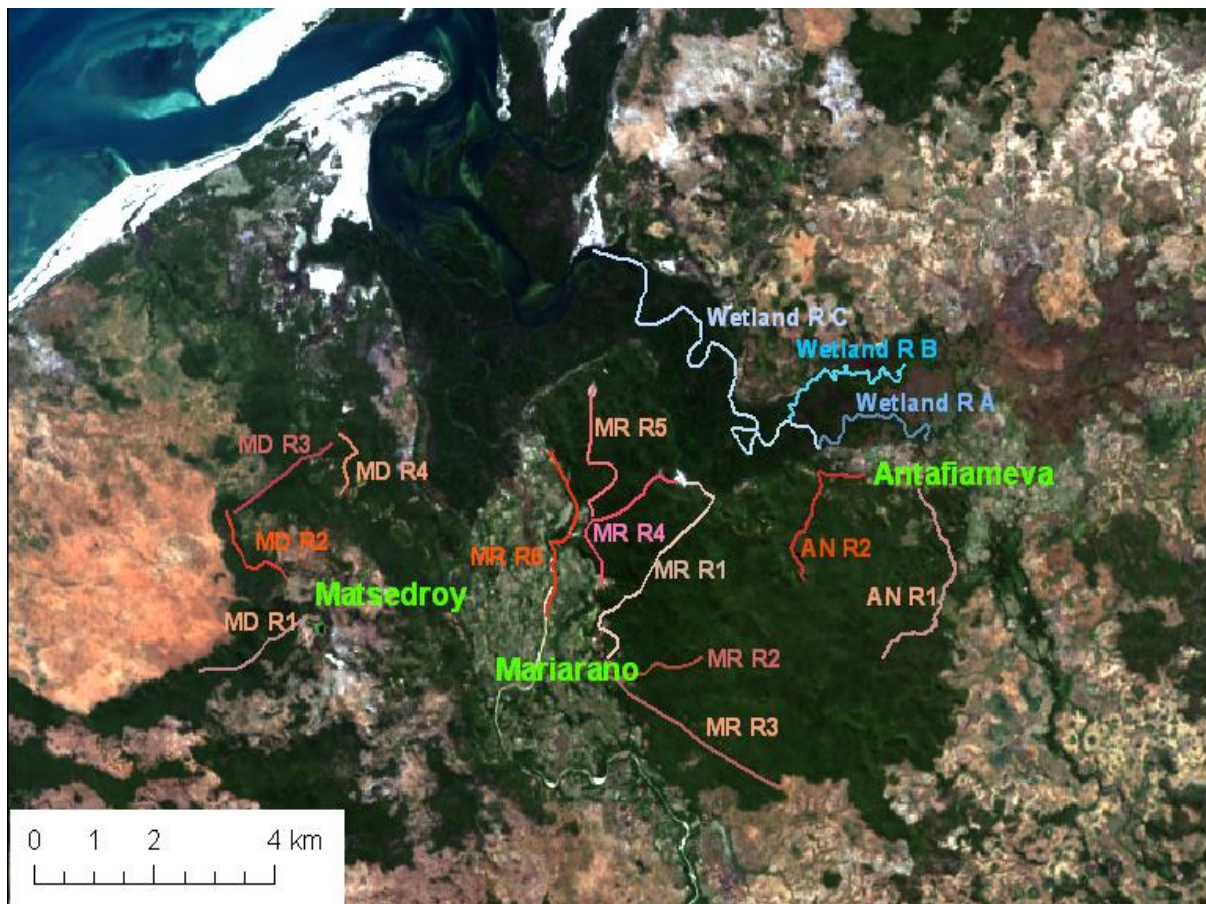


Figure 2. Location of the Mahamavo research sites and stratified sampling routes

Nosy Be

Despite plans by the Madagascan government to expand its network of marine protected areas (MPAs), the country's coral reefs remain under threat from local pressures such as overfishing, and global threats such as climate change. However, surveys by the World Conservation Society found the reefs around islands near Nosy Be, off Madagascar's northwest coast, to be amongst the healthiest anywhere in the Western Indian Ocean. They found live coral cover to have increased in recent years, and fish biomass to be at carrying capacity.

The larger island of Nosy Be is home to a sizeable human population and a bustling tourism industry, likely placing the surrounding coral reefs under increased pressure. Opwall will be working along a gradient of

reef protection, from the strictly protected MPA at Nosy Tanihely to unmanaged reefs further along the coast. Our aims are to establish a technology-driven standardised reef monitoring program which can be combined with data sets from other key bioregions to explore patterns in coral reef functioning from present to future. Via this programme we will then collect long term reef health data across this human use gradient to compare the performance of reefs around Nosy Be to those of more remote locations nearby.

2. Week 1: itinerary in Mahamavo

The students on site will complete five days of training and research. There are three different sites in Mahamavo, base camp at Mariarano village, a secondary camp at Matsedroy and a third camp at Antafiameva which school students do not visit. The school groups arrive at base camp/Matsedroy on Sunday and settle in with an evening orientation lecture. Groups will spend 3 nights at either base camp in Mariarano village or Matsedroy camp and the remaining two nights at the other camp (see table 1 for a rough schedule). On the Friday afternoon the groups will begin their transfer to the marine site at Nosy Be.

Table 1. Indicative timetable for groups starting in Mariarano basecamp. N.B. this table is just an example timetable, the exact timetabling will vary depending on level of fitness, research activities taking place and weather conditions. We endeavour to ensure all students participate in each activity at least once during the trip and stay at both camps.

Time	Schedule A (Mariarano/Mastedroy)
Sunday morning	Travel from Mahajanga to Mahamavo.
Sunday afternoon	Arrive at Mariarano Base Camp Introduction to camp, and health and safety talk Orientation walk of village
Sunday Evening	Lecture 1: Introduction to Madagascar Briefing on forthcoming research activities
Sunday night	Research activities. One from: - Lemur opportunistic sampling - Herp opportunistic sampling - Invertebrate surveys - Amphibian survey
Monday morning	Research activities. One from: - Herp route - Lemur route - Forest bird point counts - Bird mist netting - Butterfly/dragonfly surveys
Monday afternoon	Lecture 2: Biodiversity, biogeography, evolution and endemism Research activities. One from: - Forest structure plot - Malagasy language class/cultural activity - Workshop activity

Monday evening	Briefing on forthcoming research activities
Monday night	Research activities. One from: <ul style="list-style-type: none"> - Lemur opportunistic sampling - Herp opportunistic sampling - Invertebrate surveys - Amphibian survey
Tuesday morning	Research activities. One from: <ul style="list-style-type: none"> - Herp route - Lemur route - Forest bird point counts - Bird mist netting - Butterfly/dragonfly surveys
Tuesday afternoon	Lecture 3: Ecological monitoring in Mahamavo Research activities. One from: <ul style="list-style-type: none"> - Forest structure plot - Malagasy language class/cultural activity - Workshop activity
Tuesday evening	Briefing on forthcoming research activities
Tuesday night	Research activities. One from: <ul style="list-style-type: none"> - Lemur opportunistic sampling - Herp opportunistic sampling - Invertebrate surveys - Amphibian survey
Wednesday morning	Research activities. One from: <ul style="list-style-type: none"> - Herp route - Lemur route - Forest bird point counts - Bird mist netting - Butterfly/dragonfly surveys
Wednesday afternoon	Lecture 4: People and culture of Madagascar Trek from Mariarano to Matsedroy
Wednesday evening	Quiz night
Thursday morning	Research activities. One from: <ul style="list-style-type: none"> - Lemur routes - Herp routes - Bird point counts - Butterfly/dragonfly surveys
Thursday afternoon	Lecture 5: Conservation in Madagascar Research activities. One from: <ul style="list-style-type: none"> - Wetland birds point count

	<ul style="list-style-type: none"> - Forest structure plot - Malagasy language Class/cultural activity - Workshop activity
Thursday evening	Briefing on forthcoming research activities
Thursday night	Research activities. One from: <ul style="list-style-type: none"> - Lemur opportunistic sampling - Herp opportunistic sampling - Frog Sampling - Invertebrate surveys - Amphibian survey
Friday morning	Trek from Matsedroy to Mariarano
Friday afternoon	Village and school visit
Saturday morning	Leave forest site to start transfer to marine site

3. Research activities

Morning Activities

Herpetofauna routes (both camps)

In the course of this activity, a small group of students led by a herpetologist and accompanied by a local guide will walk slowly along a forest sample route. Everyone needs to scan the vegetation and ground carefully for reptiles and amphibians since many species are quite cryptic.

When an individual is detected it will be caught (by the trained herpetologist) and the species and location are recorded. Certain morphometric measurements will also be taken. If the species is common all data will be recorded there and then, however more unusual species will be taken back to the camp for photographing and later identification with field guides and keys before the specimen is returned to the location it was caught.

Lemur routes (both camps)

The aim of this activity is to estimate encounter rates, densities and population sizes of day-time lemurs using distance sampling. Groups walk slowly along the route with a lemur specialist and local guide scanning the canopy closely for groups of lemurs. When a group is detected we record the location, the species, the group size and the distance from the route centreline.

Bird point counts (both camps)

Although one will see a lot of birds while walking in the forest, by listening carefully many more can be detected. During a static point count, the majority of observations are actually of bird calls. For this reason students will receive an evening briefing before taking part in point counts in which we will use flash cards and sound recording to teach students the calls of 20 common species. We will also brief student on the key identification points for the commoner forest birds.

In the course of a point count activity, students will walk along a sample route in the early morning with a member of the ornithology team and a local guide, stopping at several sample sites for 10 minutes to undertake point counts. When a group of birds is detected the team will record the species, the group size, the estimated distance to the birds and the method of observation (seen, heard, seen and heard).

Bird mist netting (Mariano camp)

Mist netting is undertaken in order for students to see this sampling technique first hand and to sample cryptic forest bird species which might not be detected by point counts. Nets will be set up in a location that birds are likely to fly through, e.g. a break in the forest. The area of nets and the time open will be recorded in order to compare against other sampling efforts, no matter the duration or time of day.

When birds are caught, the trained ornithologist will demonstrate how they are removed from the net and handled. Each individual will be identified to species and students will be encouraged to make the identifications themselves, if necessary with reference to copies of field guides. The ornithologist will demonstrate how to take standard morpho-metric measurements (wing, tarsus, head, and tail with metal rulers) and weights are taken with a Pesola balance and bag. Birds will also be metal ringed with SAFRINGS. Blood samples might be taken. Students will help in these activities by passing equipment or scribing or by making measurements on birds handled by the ornithologist.

Butterfly/dragonfly Survey

The aim of this activity is to identify and estimate the abundance of butterflies and dragonflies using a pollard count. Groups walk slowly along the route with an invertebrate specialist and local guide scanning a 2.5meter area around them, if a butterfly or dragonfly is seen the species is identified and recorded. If the species is hard to identify in air then it should be caught with a net so a closer inspection can be made and the species identified.

Afternoon Activities

Wetland bird counts (Matsedroy camp)

This is quite a simple opportunistic sampling activity. Volunteers will visit three beautiful freshwater lakes on foot in the course of 2 hours accompanied by an ornithologist and local guides and make counts of wetland birds on each lake on that sampling occasion. The students will notice that the bird communities that live in and around these lakes differ hugely from those that live in and around the estuarine areas.

Forest structure plots (both camps)

The aim of making measurements in a stratified sample of plots in the forests in Mahamavo with the aim of tracking changes in the biophysical properties of the forest such as canopy height, sapling density and basal area. In the course of 2018 we will make structural measurements on about 90 forest plots. We hope that each school volunteer will be able to assist with 2 plots during their time in Mahamavo. Students will make measurements on forest plots in groups of 6-8 with a team leader and local guide.

The team navigates along the sample route using the 'go to' function on their GPS until they find the sample site to be surveyed. Plot locations are marked at their NW corner by a piece of labelled pink flagging tape on the sample route. Plots are 20m squares. Upon arrival at a plot the team must lay a 20m measuring

tape from the marked corner backwards along the sample route toward the start of the route. Next, the group must measure the bearing along this tape and calculate two bearings normal to this (at 90 degrees) on either side of the route. The bearing which is closest to north is selected to decide whether the plot will be positioned on the right or left of the route. Following this algorithm ensures that plots are positioned in the same location relative to the defined corner every year. Two students will then take a 20m measuring tape and a compass and follow the selected bearing for 20m into the forest at both ends of the original tape laid along the sample route. By this stage the group should have marked three sides of a 20m square plot. At this point, the groups should be able to judge whether the plot is going to turn out in a square, if it isn't they need to check the bearings and re-plot the area. Now the team should distribute the measuring equipment and arrange themselves along the sample route edge of the plot at 3-4m intervals with the team leader in the centre. Now everyone walks slowly into the plot until they are lined up along the back edge.

Next, the team slowly moves back towards the sample route. Every time that a woody stem is encountered that is greater than 5cm in diameter (this will be demonstrated first with some example of too small and big enough stems) the student should use a short measuring tape to measure the circumference of the stem (in cm) at breast height i.e. about 1.3m above the ground. They need to call out this measurement to the team leader who will write it down. They must also estimate the height of the tree and call this out to the team leader. During this activity the volunteers need to co-ordinate with their neighbours on their left and right sides to ensure all stems are counted (none missed, none measured twice). Eventually after about 15m everyone will end up back on the sample route.

The students then need to each go to ten random locations in the plot and estimate canopy cover. This is accomplished with a canopy scope (a plastic CD jewel case cover marked with 25 black dots). This is held towards the sky at arm's length and the number of black dots with sky behind counted and reported to the team leader.

Next four pieces of cord 8m long are stretched out in 4 random locations in the plot to form four 2m square quadrats. The students then need to count the number of woody stems (of any size, including the tiniest 1mm wide) in the plot and report this to the team leader.

Malagasy language class/cultural activities (both camps)

During your stay in the Mahamavo forest we endeavour to integrate with the local community as much as possible. Learning some key words and phrases can go a long way, particularly when no one in the village speaks any English, so you will be given a Malagasy language class. In Mariarano there is a village school, and if this is open during your stay we will see if a short visit can be arranged in order to meet the local children. If you wish you can bring pencils, crayons, chalks, pens, French: English dictionaries, footballs and toys and this will be accepted gladly! We also meet local people and are able to watch local crafts such as basket and mat-making taking place. There is a football pitch in the village and fun matches can be arranged with the locals too. In Matsedroy we aim to have at least one evening learning local dances and listening to Malagasy music, often played on traditional instruments, plus sporting activities with the local guides and staff such as boule and football.

Workshop Activity

Each scientist on site will prepare a small workshop/activity so depending on their area of research/interest this will vary. Examples of workshops include bird ID skills, debate session, guest lecture etc.

Evening Activities

Herp routes at night (both camps)

Methods for herp routes are the same at night as they are by day. The reason for sampling at night is that a different community of reptiles and amphibians is active so it's necessary to sample by day and night to record them all. Additionally, dissertation students investigating niche separation and colour change in chameleons and geckos (which are more easy to find at night) will collect data on each individual in-situ including height above ground, canopy cover above individual, branch circumference where found, temperature of individual and substrate where found and individual body length (excluding and including tail). Chameleons and geckos will be caught and taken to camp for analysis using a field spectrometer and will be released at the location where they were found the next day. The team leader carries a massive torch for spotlighting reptiles. Everyone else needs their own head torch.

Lemur routes at night (both camps)

Aims and methods as for lemur routes by day. The reason for sampling at night is that a different community of lemurs is active so it is necessary to sample by day and night to record them all. It's also much more likely that rare carnivores e.g. Falanouc (*Eupleres goudotti*) will be sighted opportunistically at night.

Timed frog catching surveys (both camps)

Amphibians play a vital role in the ecosystems where they are found. Students will be able to assist a herpetologist in a monitoring programme for amphibians in Mahamavo. Students will be split into groups of 6 and be tasked with catching as many frogs as possible around one of three of the Matsedroy lakes, or the river or rice paddy fields at Mariarano for a defined period of time (40minute). Students will be able to assist in the weighing and measuring of frogs before their release. Students will be taught about the importance of frogs as bio-indicators and how they can help us understand how the surrounding land use is affecting the conditions of the water bodies within the Mahamavo area.

Invertebrate Surveys (both camps)

Invertebrates are one of the most numerous and diverse taxa on the planet but are often overlooked. Students will be able to assist an entomologist in sampling for spiders, scorpions and beetles in Mahamavo many of which are new to science. Students will be split into groups of 6 and be tasked with catching whatever insects they find within a specified search area. Students will then come back to camp and be taught how to prepare specimens and help create a reference collection of the area.

4. Lectures and learning outcomes

Lecture 1: Introduction to Madagascar

An introduction to the habitats and biodiversity of Madagascar. Students will also learn about the threats to wildlife and the aims of the scientific work they will be involved in.

A Level keywords

- Biodiversity; conservation; sustainability; threats; ecosystems;

Discussion/Activity – if time, a brief quiz/info session on the geography of Madagascar.

Lecture 2: An extraordinary Island – biodiversity, biogeography and evolution of wildlife in Madagascar.

An introduction to evolution and the unique situation of Madagascar. Students will learn about the biogeography of the island and why there are such high numbers of unusual species. The early impact of humans will also be discussed.

A level keywords

- Evolution; speciation; species; endemism; gene pool; variation; adaptive radiation; isolation
- Adaptation
- Human impact

Discussion/Activity – Discussion on the word ‘biodiversity’ and the ‘Evolution Card’ challenge

Lecture 3: Ecological monitoring in Mahamavo

This lecture looks at survey techniques used to monitor the various different taxonomic groups. It compares the advantages and disadvantages of different surveys.

A level keywords

- Ecological monitoring; Distance sampling, bird point count, capture methods

Discussion/Activity – The bird sampling activity – students are given a survey to plan and choose the most appropriate option.

Lecture 4: People and culture of Madagascar

This lecture looks at the geography, history, culture and heritage of Madagascar and what life holds for the modern Malagasy.

A level keywords

- Culture; globalization.

Discussion/Activity – Quiz on Madagascar

Lecture 5: Conservation in Madagascar

This lecture discusses conservation priorities and protected areas in Madagascar, looking at the conflicts between wildlife and people and the possible effects of climate change. It also looks how data collected in Mahamavo can be used to see patterns and trends in biodiversity and its subsequent use in conservation management

A level keywords

- Biodiversity
- Conservation; management; national parks
- Human impact; climate change

Discussion/Activity – Which works better, in-situ or ex-situ conservation?

At the end of the week of practicals, lectures and discussion topics the students should have completed the following learning outcomes:

- Be able to describe the endemism of various Madagascar taxa
- Be able to identify the major habitats occurring across Madagascar and an understanding of the geography of Madagascar

- Be able to identify 10 endemic Madagascar birds
- To understand the assumptions upon which point counts are based
- Be able to identify 5 Malagasy herpetofauna species
- To understand different methods for surveying herpetofauna – pitlines, standard searches and spotlighting
- To be able to identify 5 mammal species
- Be able to describe how lemurs are unique and their social structure
- Understand the conservation management issues in Madagascar.

5. Week 2: itinerary in Nosy Be

The students will complete five days of marine education and training between their arrival on Nosy Be on the Sunday morning and their departure the following Friday afternoon to start their journey home. These five days are structured according to the options selected for the week; Reef Ecology Course (with practicals by either diving or snorkelling), PADI Open Water or Dive Referral (see sections below).

6. Indian Ocean Reef Ecology Course

Table 2 shows an example timetable of the activities that students undertaking the Indian Ocean Coral Reef Ecology Course will complete over their week in Nosy Be. The timetable includes each of the elements that will be completed during the week but the timing of the sessions may vary. The practical element of the Reef Ecology Course can be completed by either diving or snorkelling. If students are already qualified divers by the time they arrive on site, they will be required to complete a compulsory check dive with a PADI Professional at the start of the course. The Indian Ocean Coral Reef Ecology course is designed to provide an introduction to coral reef ecology and other major tropical marine habitats. Lectures will be supported by in-water practicals. All boat based activities though are subject to safe launching conditions and if the waves are too high on a particular day then the boat based activities for that day will have to be cancelled and alternative practicals scheduled.

In addition to the lectures, students will also be expected to complete a small group task throughout the course of the week. Students will be provided with an information pack at the start of the week, which will give them detailed information about an important topic in coral reef ecology/conservation. On the Thursday afternoon at the end of their stay, they will present their findings to the group in as an imaginative way as possible!

Table 2. Example timetable for Indian Ocean Coral Reef Ecology Course students. Note that this is a guide and the order of activities may change. There may also be changes to this itinerary depending on fitness of students, weather conditions or operational issues on site.

Day	Schedule for Reef Ecology Students
Sunday morning	Arrive Nosy Be
Sunday afternoon	Orientation / Welcome talks / PADI documents
Sunday evening	Lecture 1 - The Blue Planet
Monday morning	In water practical 1 - Check Dive or Skin Diver
to	In water practical 2 - Coral reef complexity

Friday afternoon	Lecture 2 - An Introduction to Coral Reefs
	Lecture 3 - Conservation of Coral Reefs
	In water practical 2 - Assessing bleaching using 'Coral Watch'
	In water practical 3 - Fish identification
	Lecture 4 - The Diversity of Coral Reefs I
	Lecture 5 - The Diversity of Coral Reefs II
	In water practical 4 - Coral identification
	In water practical 5 - Invertebrate identification
	Lecture 6 - The Diversity of Coral Reefs III
	Lecture 7 - Mangroves and Seagrass
	In water practical 6 – Seagrass zonation
	In water practical 7 – Rapid reef assessment I
	Lecture 8 - The Future of Coral Reefs
	In water practical 8 - Rapid reef assessment II
Saturday morning	Depart Nosy Be

7. PADI open water diver course

This course consists of three different elements of learning; dive theory (knowledge development), confined water dives and open water dives. Each component plays its own role in the students' development to meet the performance requirements and objectives they need to become a qualified diver.

Please be aware that as a part of the PADI Open Water Course, all students will be required to complete some basic stamina tests on site. Student divers will need to demonstrate that they can comfortably maintain themselves in water too deep in which to stand by completing a 10-minute swim/float without using any swimming aids. Students will also have students complete a 200m continuous surface swim or a 300 m swim with mask, fins and snorkel.

Table 3. Example timetable for PADI Open water students. Note there may be changes to this itinerary depending on progression through the course, fitness of students, weather conditions or operational issues on site.

Day	Activity
Sunday morning	Arrive Nosy Be
Sunday evening	Lecture 1 – The Blue Planet
Monday morning	Orientation / Welcome talks / PADI documents
to Friday afternoon	Dive theory 1 + 2
	Confined water 1
	Confined water 2
	Lecture 2 – An Introduction to Coral Reefs
	Confined water 3
	Open Water 1

	Dive theory 3 + exam
	Open water 2
	Open water 3
	Lecture 3 – Conservation of Coral Reefs
	Open water 4 & Dive certification
	Lecture 5 – The Diversity of Coral Reefs II
	Lecture 6 – The Diversity of Coral Reefs III
	Lecture 8 – The Future of Coral Reefs
	Fun dive
	Social activities
	Social night
Saturday morning	Depart Nosy Be

8. PADI open water referral course

For those students who have completed both the dive theory and confined water sessions prior to expedition they can complete their PADI Open Water Referral Course on site. The students will first complete a check dive with their instructor to demonstrate that they still remember and can confidently perform the necessary skills to progress on to complete their open water dives.

Once referral students have successfully completed the final stages of their PADI Open Water course, they will be able to progress on to the Indian Ocean Coral Reef Ecology course. Although there will not be enough time to run the full course, referral students will be able to join at a stage where they can get the chance to learn about the application of survey techniques in the marine environment and how that supports the management of coral reefs.

9. Reef ecology lectures

Lecture 1: The Blue Planet

- Quick fire facts to excite students about the marine world
- Who would win in a fight between a great white shark and a killer whale?
- Why is the sea blue?
- Why is the sea salty?
- Why are whales so important?
- Where did life originate?

Land-based activity: presentation briefing

In-water activity: check dive/snorkel

Lecture 2: An Introduction to Coral Reefs

- Coral biology; growth, development, feeding and reproduction
- Importance of the symbiotic relationship between corals and photosynthetic microalgae
- What are coral reefs and where are they found?

- Introduction to the Indian Ocean

Land-based activity: assessing the complexity of a coral reef

In-water activity: coral ID dive

Lecture 3: Conservation of Coral Reefs

- The value of coral reefs
- An introduction to macroalgae
- Competition between macroalgae and hard coral; phase-shifts
- Local threats to coral reefs that stimulate phase-shifts; i. Destructive fishing, ii. Coral mining, iii. Overfishing, iv. Water pollution, v. Coastal development, vi. Disease,
- Potential management solutions

Land-based activity – quadrat building

In-water activity – assessing levels of coral bleaching using PADI's 'Coral Watch' guidelines

Lecture 4: The Diversity of Coral Reefs I

- An introduction to taxonomy
- Classifying a green alga
- Classifying a sea cucumber
- Classifying a parrotfish

Land-based activity: talk preparation

In-water activity: fish ID dive

Lecture 5: The Diversity of Coral Reefs II

- Coral reef food webs
- Fish herbivory
- Invertebrate herbivory
- Filter feeding
- Predation

Land-based activity: benthic video analysis

In-water activity: fish ID dive

Lecture 6: The Diversity of Coral Reefs III

- An introduction to behaviour
- Parasitism
- Commensalism
- Symbiosis
- Camouflage
- Fish sensory systems

Land-based activity: stereo-video data analysis

In-water activity: invertebrate ID dive

Lecture 7: Mangroves and Seagrass

- Mangrove adaptations
- Seagrass adaptations
- Ecosystem services and functions
- Importance of habitat connectivity
- Threats to mangroves and seagrasses

Land-based activity: mangrove exploration

In-water activity: seagrass practical

Lecture 8: The Future of Coral Reefs

- Rising sea surface temperature
- Ocean acidification
- The structure of a reef in 2100
- Conservation management

Land-based activity: talk preparation

In-water activity: Rapid Reef Assessment

10. Links to A Level

The following tables (Tables 4 & 5) highlights how your Opwall expedition relates to the AS and A level syllabuses across all exam boards. The red and blue blocks indicates that the keywords listed are covered on our expedition (through lectures, practicals or in discussion topics) and that these keywords are also within AS or A level topics as shown.

Table 4: Highlighted in Black are topics that you might experience at your research site. Key: C = Cambridge. Pre-U, C.int = Camb. Int. CCEA = N.Ireland; Ed/Sal = Edexcel Salters, S= SQA ; Edex = EdExcel ; IB = International Bacc; AP=Advanced Placement (v. 20/11/14)

Topic	Biology	AQA		C	CCEA		C.Int		Ed/Sal		OCR		SQA		WJEC		AP	IB	
		S	2		S	2	S	2	S	2	S	2	H	A	H	S	2		
Evolution, Classification and DNA	Evolution; Speciation; Species; Endemism; Gene pool; Allopatric; Sympatric; Isolation; Variation; Adaptive radiation Adaptation; Wallace; Darwin		◆	◆	◆		◆	◆		◆	◆		◆	◆		◆	◆	◆	
	Classification; Taxonomy; Binomial system; Dichotomous Keys	◆		◆	◆		◆	◆	◆	◆			◆	◆				◆	
	PCR; Genome sequencing; Genetic fingerprinting; DNA profile		◆	◆	◆				◆		◆	◆				◆	◆	◆	
Ecology and Ecosystems	Ecology; Habitat; Niche; Abiotic; Biotic		◆	◆	◆		◆		◆	◆	◆					◆	◆	◆	
	Biome; Ecosystems; Rainforests; Deserts; Coral reefs; Mangroves; Marine; Coasts; Hot arid; Semi-arid; Woodland Bush; Tropics; Tropical		◆	◆		◆	◆					◆				◆	◆	◆	
	Populations; Competition; Interspecific; Intraspecific; Predator Prey; density dependent; independent: Symbiosis		◆	◆		◆	◆					◆				◆	◆	◆	
	Succession; Climax community		◆			◆				◆	◆	◆				◆		◆	
	Biodiversity	◆		◆	◆		◆	◆	◆	◆					◆		◆	◆	
	Practical work; Field techniques; Ecological sampling; Random sampling; Transects; Capture, mark, release and recapture; Biodiversity indexes; Data handling and; presentation; Quadrats; Statistical testing; Measuring; GIS; Research tools		◆	◆		◆				◆	◆	◆	◆	◆		◆	◆	◆	
	Written reports; Research project; Report; Case studies			◆					◆				◆	◆		◆	◆	◆	
Agriculture, Human activities, Conservation and Sustainability	Sustainability	◆		◆					◆	◆		◆				◆			
	Agriculture; Agricultural impact; Agricultural exploitation; Cultivation crops; Food production; Sustainable agriculture; Sustainability; Forestry; Timber; Deforestation; Fisheries; Over fishing; Deforestation; Human management; Human effects; Human activities	◆				◆						◆	◆			◆	◆		
	Fair-Trade; Coffee; Rain Forest Alliance; Ecotourism; Tourism; Carbon trading; Greenhouse gas emission control (REDD)															◆			
	Indicator species; Pollution; Climate change; Global warming Carbon footprint; Fossil fuels		◆	◆		◆				◆	◆		◆				◆	◆	
	International conservation; Endangered species; Invasive species; Biological control; Pests; CITES; Ethical, Local; Global	◆	◆	◆		◆		◆				◆	◆	◆			◆		◆
	National Parks; Wildlife reserves							◆										◆	
	Environment; Environmental monitoring; Environmental impact; SSSI																		
Behaviour	Animal behaviour; Primate Social behaviour; Courtship; Territory; Co-operative hunting; Herbivores; Grazing	◆		◆	◆		◆					◆	◆	◆		◆	◆	◆	

Topic	Geography, APES and ESS	IB ESS	APE S	AQA		CCEA		Edex		OCR		WJEC	
				Geography									
	Levels: S=AS 2=A2			S	2	S	2	S	2	S	2	S	2
Evolution, Classification and DNA	Evolution; Speciation; Species; Endemism; Gene pool; Allopatric; Sympatric; Isolation; Variation; Adaptive radiation Adaptation; Wallace; Darwin												
	Classification; Taxonomy; Binomial system; Dichotomous Keys	◆											
	PCR; Genome sequencing; Genetic fingerprinting; DNA profile												
Ecology and Ecosystems	Ecology; Habitat; Niche; Abiotic; Biotic	◆	◆							◆			
	Biome; Ecosystems; Rainforests; Deserts; Coral reefs; Mangroves; Marine; Coasts; Hot arid; Semi-arid; Woodland Bush; Tropics; Tropical	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
	Populations; Competition; Interspecific; Intraspecific; Predator Prey; density dependent; independent; Symbiosis	◆	◆										
	Succession; Climax community	◆											
	Biodiversity	◆	◆		◆			◆					
	Practical work; Field techniques; Ecological sampling; Random sampling; Transects; Capture, mark, release and recapture; Biodiversity indexes; Data handling and; presentation; Quadrats; Statistical testing; Measuring; GIS; Research tools	◆	◆		◆	◆		◆		◆	◆	◆	
	Written reports; Research project; Report; Case studies	◆	◆		◆		◆	◆		◆	◆		
Agriculture, Human activities, Conservation and Sustainability	Sustainability	◆	◆		◆		◆			◆	◆		
	Agriculture; Agricultural impact; Agricultural exploitation; Cultivation crops; Food production; Sustainable agriculture; Sustainability; Forestry; Timber; Deforestation; Fisheries; Over fishing; Deforestation; Human management; Human effects; Human activities	◆	◆		◆		◆						
	Fair-Trade; Coffee; Rain Forest Alliance; Ecotourism; Tourism; Carbon trading; Greenhouse gas emission control (REDD)						◆	◆		◆	◆		◆
	Indicator species; Pollution; Climate change; Global warming Carbon footprint; Fossil fuels	◆	◆				◆	◆		◆			
	International conservation; Endangered species; Invasive species; Biological control; Pests; CITES; Ethical, Local; Global	◆			◆					◆			
	National Parks; Wildlife reserves								◆				
	Environment; Environmental monitoring; Environmental impact; SSSI												
Behaviour	Animal behaviour; Primate Social behaviour; Courtship; Territory; Co-operative hunting; Herbivores; Grazing												

Table 5: Highlighted in Black are topics that you might experience at your research site. Key: C = Cambridge. Pre-U, C.int = Camb. Int. CCEA = N.Ireland; Ed/Sal = Edexcel Salters, S= SQA ; Edex = EdExcel IB ESS = Env Systems and Societies; APES = Advanced Placement Env. Science (v. 20/11/14)

11. Reading lists and research questions

Many students are now involved in producing Research 'Essays' or 'Projects' as part of their 2 year educational programme and many hope to carry this out whilst on an Opwall Expedition. If you are an IB school you will be involved in the EE or Extended Essay or if in the UK an EPQ or Extended Project Qualification. Those involved in CoPE will also have a similar project carrying out some research. There are many similar projects in most countries.

One of the key features of all of these 'Essays' or 'Projects' is that you have to choose your own research question. To help in this, please do have a look at the Independent Research Projects page available on our website: <https://www.opwall.com/schools/educational-benefits/independent-research-project/>. This booklet also contains detailed information on the research projects you will be involved in and this may help you to locate your particular area of interest.

The type of IRP will vary but it is less suitable for individual investigations where you collect your own primary data although in some cases you might be able to get hold of raw data and you will often have the opportunity to help collect some of the data yourself. You will certainly have the opportunity 'on-site' to meet up with the scientists involved which will allow you to get a deeper insight into your research question.

The Wallace Resource Library (WRL) contains many datasets based around the research being carried out and it has been prepared by the actual Opwall scientists involved. It is a very valuable source of ideas with comprehensive datasets to look at and study.

WRL: www.wallaceresourcelibrary.com

Do also make use of the research library on the Opwall website: www.opwall.com

How does it work?

Once you have an idea send an email to schoolresearchprojects@opwall.com with your initial ideas and contact details so that one of the academic staff working with Opwall can contact you to discuss possible research questions. We can also send you further information to help you choose a suitable title for your research site.

Once you have decided on a title you will then be asked to complete a registration form (supplied on request) which we can then forward to the appropriate country manager or scientist. This will then inform those at the research site about what you are hoping to achieve plus for us to give you as much assistance as we can.

In some cases, we will also be able to provide you with data sets from previous years which some students will find very useful.

Deadlines

Although each school will be operating their own schedule we would like registrations to be completed at least 3 months before their expedition begins although the earlier the better.

Books

Bradt H (2011) Madagascar 10 (Bradt Travel Guide).Bradt Travel Guides; 10 edition.

Morris P, Hawkins F, Andrews M (1998) Birds of Madagascar: A photographic guide. Pica Press

Garbutt N (2007) Guide to the Mammals of Madagascar. Christopher Helm Publishers Ltd.

Mittermeier RA, Konstant WR, Hawkins F and Louis EE (2010) Lemurs of Madagascar.Conservational International US 3rd Edition.

Glaw F and Vences M (2006) Field guide to the amphibians and reptiles of Madagascar.Vences & GlawVerlagGbR 3rd edition.

Schuurman D, Bradt H, Garbutt N (2003) Madagascar Wildlife: A visitors guide. Bradt Travel Guides 2nd Edition.

Mittermeier RA, Louis E, Richardson M and Konstant W (2008) Lemurs of Madagascar. Conservation International.

Sutherland WJ (2006) Ecological Census Techniques:A Handbook (2nd Edition). Cambridge University Press, Cambridge.

Internet

Field Checklist of the Birds of Madagascar: www.madagascar-library.com/r/1740.html

Guides for Madagascar – Use search facility (type guides): www.madagascar-library.com/search.html

Research areas and activities being carried out in Madagascar:

- Niche separation and the impacts of disturbance on avian communities in dry forest, Madagascar
- Acoustic techniques for monitoring forest birds
- Bird point counts and mist
- Wetland birds by boat: survey follows a route through mangroves and out into an estuary with mud flats recording all the wetland bird species
- Forest structure plots: measurements to estimate the amount of carbon stored in woody vegetation
- Forest land tenure and conservation revenue sharing in protected areas of northern Madagascar
- Economic impacts of tourism and conservation in the Mahamavo forests, northern Madagascar
- Assessment and valuation of ecosystem service provision in Madagascar
- Tree biodiversity and ecosystem function
- Spatial behavioural ecology of the Malagasy Giant Hognose snake
- Ecology of amphibians in Mahamavo
- Thermal ecology and UV-B requirements of chameleons, skinks and geckos
- Colour and colour change in the chameleons, Uroplatus geckos or Phelsuma geckos of Mahamavo

- Population ecology of Nile crocodiles in Madagascar
- Population ecology of colubrid snakes or chameleons in Madagascar
- Microhabitats and niche partitioning in chameleons, skinks, geckos or snakes in Madagascar
- Herpetofauna routes: sample routes scanning the vegetation and ground carefully for reptiles and amphibians
- Herpetofauna routes: Spotlight surveys are also done in the evening
- Occupancy modelling for nocturnal lemurs, carnivores and bush pigs with camera traps in Madagascar
- Small mammal trapping: Small mammal traps are baited and set in the evenings and students will then check traps and help process any captures in a morning session
- Monitoring bat populations in Madagascar using acoustic methods
- Demography and spatial ecology of the endangered Coquerel's sifaka
- Ecology and behaviour of nocturnal lemurs in the dry deciduous forests of north western Madagascar
- Lemur routes Groups walk slowly scanning the canopy closely for groups of lemurs.
- Species distribution modelling in Madagascar
- Landscape ecology in Madagascar
- Community ecology in Madagascar
- Ecology of leaf litter ants
- Developing monitoring protocols for REDD in Madagascar
- Evaluation of biodiversity monitoring methods in Madagascar
- Reef fish and coral communities in Nosy Be, Madagascar