



**Opwall Schools' Booklet  
Bay Islands 2019**

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## 1. Study Areas and Research Objectives

The Bay Islands region is made up of eight large islands and 53 smaller islets found at the southern extent of the Mesoamerican Barrier Reef (MAR) in the Western Caribbean. The MAR is the second largest barrier reef in the world and stretches 1000 km along the coast of Central America from the northern tip of the Yucatan Peninsula, through the coastal waters of Belize and Guatemala, and down to the Bay Islands, which lie 15-60 km off the coast of mainland Honduras.

Honduras is Central America's second largest country, and boasts not only a mountainous landscape with dense montane and cloud forest, but also many Caribbean Islands which are surrounded by the second largest barrier reef in the world. Despite this, the biodiversity of Honduras has been less studied than other countries in Central America such as Costa Rica, Panama and Belize. Honduras is approximately 43,278 square miles (112,092 km<sup>2</sup>) and is home to more than 6,000 species of vascular plants, of which 630 are orchids; around 250 known reptile and amphibian species, more than 700 bird species, and 110 mammal species, of which roughly half are bats. The 2 million acre Rio Plátano Biosphere Reserve in the Honduran Mosquitia (eastern Honduras) was recognized as Central America's first Biosphere Reserve in 1980 by the United Nations Educational and Scientific Organization (UNESCO), and in 1982 UNESCO Rio Plátano was also named as a World Heritage Site.



Figure 1-Map of Honduras showing research locations

## Utila

Utila is part of the Honduran Bay Islands, and is also a popular dive tourism destination by budget travellers and backpackers. Having once been part of British Honduras, the language spoken on Utila is English, and the culture of the island is different from the Spanish speaking mainland. There is a small town on the southeast of the island, which is home to a small local population as well as the bulk of the tourism industry. Operation Wallacea are based in the Coral View Beach Resort and Research Centre around half an hour walk from the town, on the edge of a large mangrove lagoon. There is currently very limited protection for the coral reefs around Utila, despite the importance of these systems to the dive tourism industry and the economic benefits this brings to the local economy. As a result, there has been a significant impact from overfishing and other factors such as pollution from Utila town. Operation Wallacea conducts two main activities on Utila: (1) to collect data on ecosystem health which can be used to inform local government and management organisations on how best to protect their reefs and manage their marine resources, and (2) as a site of novel scientific research to increase our understanding of how coral reefs function and the impact that various threats have on them. Specifically, the main objectives of research on Utila are:

- Yearly monitoring of the status of the reefs around Utila, to determine the health of the reef system and the level of impact from human activities.
- Conducting high quality research with the aim of producing suitable studies for peer review and establish the Marine Research Station as an internationally recognised centre for quality marine research.
- Explore potential management strategies to mitigate the devastating ecological effects of the Caribbean lionfish invasion.
- To study the interactions between key groups of benthic organisms, particularly coral, seaweed and sponge, which is critical in determining the overall health of the coral reef and the associated fishery it can support.
- To determine the population dynamics of the ecologically important sea urchin population, and assess levels of recovery after the recent Caribbean-wide disease-led mass mortality.
- To gain a deeper understanding of behaviours exhibited at cleaning stations and the role that they play in maintaining healthy coral reefs in the Caribbean.

## Roatan

Roatan is the largest of the Bay Islands, which form a chain off the northern coast of Honduras. With a human population of approximately 50,000, fishing has historically been an important source of income to the island. However, recent decades have seen a large increase in tourism, and this sector now forms the island's most important income stream. The language spoken on Roatan is English, having once been part of British Honduras, and consequently the culture is noticeably different from the Spanish-speaking mainland. There are several small towns and villages dotted around the island, and the tourism facilities are spread across the island. Operation Wallacea partner with Ecodivers, which is located in an area called West End. Roatan has been progressive in terms of Honduran marine conservation, with the Roatan Marine Parks actively working to protect the reefs for some time. The focus of Operation Wallacea on Roatan is to collect baseline data on ecosystem function and health. Roatan provides a great example of the benefits that can be provided by the establishment of a well policed Marine Protected Area (MPA), and the data we collect throughout the summer will hopefully be instrumental in helping the formation of other equally successful MPAs throughout the Caribbean. Specifically, the main objectives of research on Roatan are:

- To quantify the percentage cover of key benthic groups to provide a proxy of coral reef health, including the ecosystem architects scleractinian corals.
- To assess the populations of ecologically important sea urchins on coral reefs around West End, as a representative site of a post-mortality population.
- To conduct surveys for the invasive lionfish, and conduct dissections of captured individuals to collect data on their morphology and dietary habits.
- To assess how diversity and reef health are maintained in a system dominated by fish-grazing in the absence of healthy sea urchin populations.

## 2. Bay Islands Expedition Activities

The students will complete six days of training and research in marine science in Utila, followed by a further six days in Roatan with a day allocated for travelling between sites.

During the first week in Utila, students have the option of completing their PADI Open Water dive qualification (see section 2.1). If students are already dive trained or opting to snorkel they will immediately begin the Caribbean Reef Ecology course (see section 2.3). A third alternative is to complete the theory and confined water practicals before coming out and then completing 4 open water dives on-site to achieve the PADI Open Water qualification, moving on to the reef ecology course for the remainder of the week. This is known as an Open Water Referral Course (see section 2.2).

During the second week in Roatan, newly certified divers will progress on to the Caribbean Reef Ecology course (see section 2.3). Those students who have completed this course in their first week will complete a week of survey techniques and data collection (see section 2.4).

### 2.1 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 300m swim with mask, fins and snorkel.

### 2.2 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.

Referral students will have completed all of their dive theory and confined water dives before coming out to the field. This means that they will have time on site to join the Caribbean Reef Ecology course and to get involved with the lectures and practicals that have been outlined in section 2.3.

## 2.3 Caribbean Reef Ecology

Table 1 shows an example timetable of the activities that students undertaking the Caribbean Coral Reef Ecology Course will complete over the week. The practical element of the reef ecology course can be completed either by 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 Caribbean Coral Reef Ecology course covers a range of topics suitable to support A-Level, IB and AP biology and geography students over a range of different syllabuses. Lectures will be supported by a mixture of in-water and land-based practicals. 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, to be presented at some point throughout the two-week expedition.

### 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 and 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 Caribbean

**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, vii. Lionfish invasion
- Potential management solutions

**Land-based activity:** quadrat building

**In-water activity:** assessing levels of coral bleaching using PADI's 'Coral Watch' guideline

### Lecture 4: The Diversity of Coral Reefs I

- An introduction to taxonomy
- Classifying a green alga
- Classifying a sea cucumber
- Classifying the stoplight 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:** video analysis

**In-water activity:** urchin collection

### **Lecture 6: The Diversity of Coral Reefs III**

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

**Land-based activity:** urchin practical

**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:** lionfish practical

**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

Time	Thursday		Friday		Saturday		Sunday		Monday	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
0700	Lecture 1: paperwork and talks briefing	In-water activity: checkout	Lecture 3: equipment building	In-water activity: fish point out	Lecture 5: SVS analysis	In-water activity: urchin collection	Lecture 7: lionfish dissection	In-water activity: Rapid Reef Assessment	Talk preparation	In-water activity: beach clean up
1000	In-water activity: checkout	Lecture 1: talks briefing	In-water activity: coral watch	Lecture 3: equipment building	In-water activity: urchin collection	Lecture 5: urchin measuring	In-water activity: seagrass	Lecture 7: lionfish dissection	In-water activity: beach clean up	Talk preparation
1200	Lecture 2: reef complexity practical	In-water activity: skin diver skills	Lecture 4: talk preparation	In-water activity: coral watch	Lecture 6: urchin measuring	In-water activity: invert point out	Lecture 8: talk preparation	In-water activity: seagrass	Talks session	In-water activity: fun snorkel/dive
1500	In-water activity: skin diver skills	Lecture 2: reef complexity practical	In-water activity: fish point out	Lecture 4: talk preparation	In-water activity: urchin return and invert point out	Lecture 6: SVS analysis	In-water activity: Rapid Reef Assessment	Lecture 8: talk preparation	In-water activity: fun snorkel/dive	Talks session
Evening	Opwall Science Talk		Science Talk		Pub Quiz		Science Talk		Free Night	

Table 1. Indicative timetable for students completing the Caribbean Coral Reef Ecology Course. Note there may be changes to this itinerary depending on fitness of students, weather conditions or operational issues on site and the exact order of activities throughout the week may differ from the proposed timetable below. The timetable outlined above is an example of how a week on site may look – the exact details will vary.

## 2.4 Survey Techniques and Data Collection

Those students who complete the Caribbean Reef Ecology course in their first week will spend their second week assisting our scientists with data collection across a variety of research projects, via either diving or snorkelling. This may include, but is not limited to:

- Underwater Visual Census (UVC): this standardised survey technique gives students the opportunity to use the ID skills gained from the Caribbean Coral Reef Ecology course to assess the abundance and diversity of fish populations in the study system.
- Line intercept video surveys: students will use videographic techniques to film benthic transects in-water. Videos will then be uploaded and analysed back on land to quantify the relative abundances of key benthic components, including hard and soft corals, macroalgae and sponges.
- Macro-invertebrate belt transects: students swim in a zig-zag pattern 1m either side of a 50m long transect to create a survey area of 100m<sup>2</sup>. All macro-invertebrates encountered within this area are recorded, including abundances of the keystone herbivore *Diadema antillarum* (the long-spined sea urchin).
- 3D modelling: using single GoPro cameras, students will film 2x2m benthic quadrats. The video can then be uploaded and manipulated to create a 3D model of the underlying reef architecture from which key measures of habitat structure are calculated. These data can be used in conjunction with those collected on the biodiversity surveys to identify the drivers of abundance and diversity in the study system.
- Lionfish dissection: fortunately, lionfish are relatively rare around the Bay Islands as culling programmes implemented by the well-established dive industry have kept their numbers low. However, students may have the opportunity to work with lionfish scientists to dissect individuals and gather key data pertaining to their stomach contents, sex and level of maturity. All these data are important for assessing the efficacy of grass-roots culling initiatives throughout the Caribbean.
- Urchin biometrics: *D. antillarum* will be removed from the reef and brought back to site where key biometric information, such as weight, test (body) diameter, mouth diameter, and length of longest spine, will be recorded. These biometrics will support the in-water abundance data and provide key information about the underlying health of the urchin populations.

Throughout both weeks, students will meet regularly with Operation Wallacea scientists who will give talks about the specifics of their research projects. Alongside the educational courses and surveys, students will be expected to complete an independent research project over the course of their two-week expedition and will present their findings to the group at the end of their second week.

### 3. Links to A-levels

The following two tables highlight how your Opwall expedition relates to the AS and A-level syllabuses across all exam boards. The red and blue blocks indicate that the keywords listed are covered on our expedition (through lectures, practical's or in discussion topics) and that these keywords are also within AS or A-level topics as shown.

Topic	Biology	AQA		C	CCEA		C.Int		Ed/Sal		OCR		SQA		WJEC		AP	IB	
	Levels: S=AS 2=A2 H=Highers	S	2		S	2	S	2	S	2	S	2	H	AH	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: 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	Geography, APES and ESS	IB ESS	APES	AQA		CCEA		Edex		OCR		WJEC			
				Geography											
				S	2	S	2	S	2	S	2	S	2		
<b>Evolution, Classification and DNA</b>	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														
<b>Ecology and Ecosystems</b>	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	◆	◆		◆		◆	◆		◆	◆				
<b>Agriculture, Human activities, Conservation and Sustainability</b>	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														
<b>Behaviour</b>	Animal behaviour; Primate Social behaviour Courtship; Territory; Co-operative hunting; Herbivores; Grazing														

Table: 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).

## 4. Reading and Research Questions

Many students are now involved in producing Independent Research Projects (IRP) 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 task in which they carry 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 this 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.

Many of you will also have seen the Wallace Resource Library (WRL) which 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.

Wallace Resource Library – <http://wallaceresourcelibrary.com>

Do also make use of the research library on the Opwall website - <http://www.opwall.com>

### How does it work?

Once you have an idea send an email to [schoolresearchprojects@opwall.com](mailto: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.