Schools' Booklet Honduras 2024

Contents

1. Study areas and research objectives

This is a field-based module run from the Operation Wallacea Research Facility located within the Cusuco National Park, Honduras. Honduran forests represent part of the Meso-American Forest Corridor hotspot, a region characterised by exceptional species richness as identified by Conservation International. Honduras is the most mountainous country in Central America with 65-80% of land composed of rugged mountains from 300-2850masl, with more cloud forest sites than any other country in Central America (nearly 40). Cusuco is but one of these cloud forest reserves. Cloud forests are associated with high biodiversity and endemism, demonstrated by the fact that 86% of the cloud forest sites are found within the 'Global 200 Priority Forest Ecoregions' identified by the World Wide Fund for Nature (WWF).

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^2) 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.

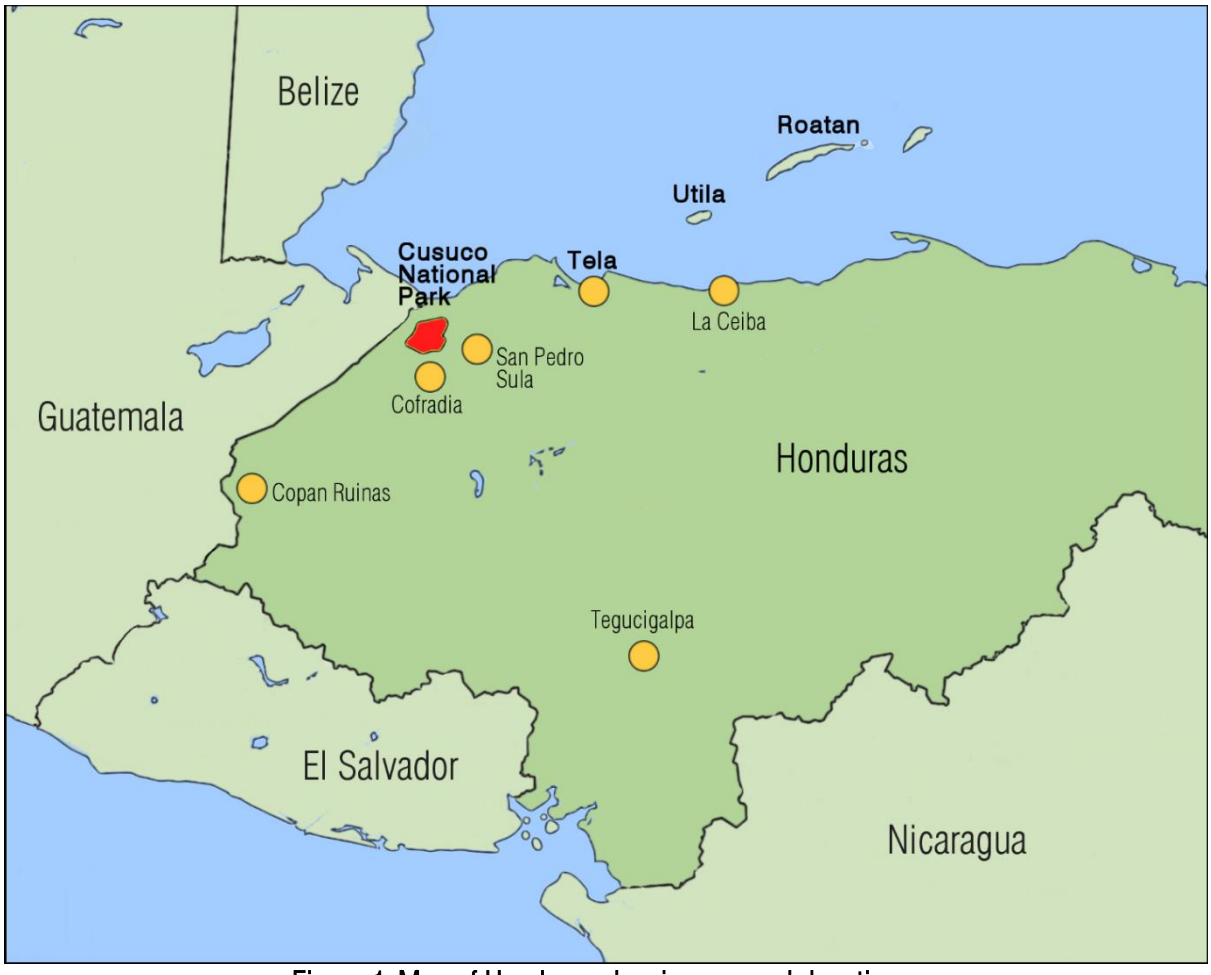

Figure 1-Map of Honduras showing research locations.

Cusuco National Park

Cloud forests are associated with high biodiversity and endemism, demonstrated by the fact that 86% of the cloud forest sites are found within the 'Global 200 Priority Forest Ecoregions' identified by the World Wide Fund for Nature (WWF). Cusuco National Park holds a special importance and has been described as 'the jewel in the crown' of Honduras' national parks. It has also recently been described as one of the top one hundred parks in the world most important for global biodiversity conservation.
Cusuco National Park, and the adjacent protected "water production zone" (WPZ) is a 56,000ha (560 km2) protected area in the Merendon mountains of northwest Honduras (Fig. 2). Cusuco National Park and the adjacent water protection zone supply all of the water for San Pedro Sula. It is important to assess the water protection zone to compare it to Cusuco National Park. The region ranges from just above sea level in the west to 2425m in the centre. Cusuco comprises a 7,690ha (76.9 km2) core zone surrounded by a 15,750ha (157.5 km2) buffer zone. Both Cusuco and the WPZ encompass several major habitat types: including semi-arid pine forest; moist pine forest; moist broadleaf forest and at elevations above 2000m, dwarf forest which is known locally as bosque enano.

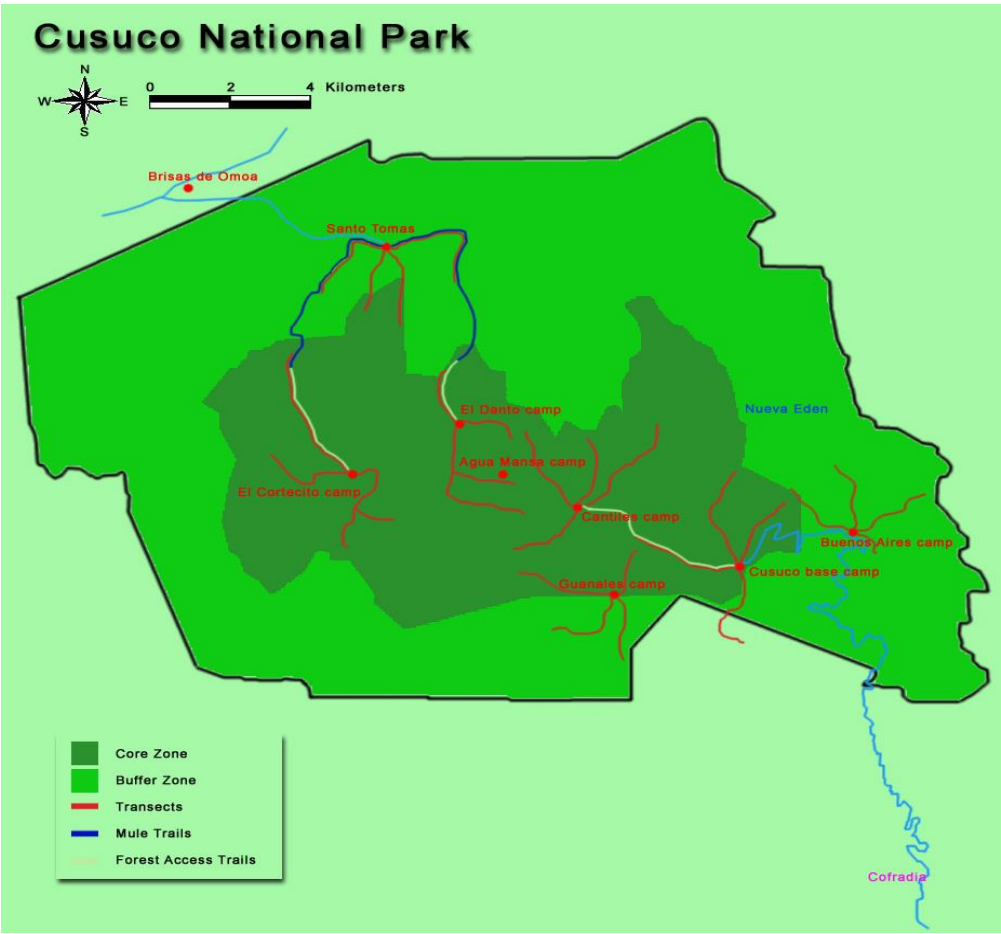

Figure 2-Study sites within Cusuco National Park.

The area provides an opportunity to study biodiversity, biogeography, community ecology, factors that impact diversity, environmental management, and issues relating to non-sustainable resource extraction. Although the core zone of the park has historically been relatively undisturbed, recent illegal logging in the core zone has become a problem. The buffer zone is also increasingly threatened by human activities, especially coffee production, land clearance and logging. These threats make it even more critical that Operation Wallacea continues to work in the area.

Operation Wallacea have conducted surveys in Cusuco since 2004 documenting the biodiversity of the park, and monitoring populations to enable effective conservation management. By surveying the WPZ this dataset is further strengthened by reporting biodiversity at greater altitudinal and geographical ranges. A key objective of this research is to leverage funding for the long-term conservation management of Cusuco. Cusuco and the WPZ contain high diversity of habitats and high beta diversity in many taxonomic groups due to the large elevation gradients in the region. The park is a remarkable example of an increasingly threatened habitat and supports populations of many cloud forest specialist species including several which are endemic to Cusuco. These habitats are home to 270 known bird species, 93 Cusuco reptiles and amphibians, 35 bat species and charismatic large mammals such as the mantled howler monkey and Baird's tapir.

The Cusuco research programme has two main objectives – to complete the themed forest ecology research programme and to collect data on the carbon, biodiversity and community benefits of the forest which are then being used as part of a submission for Biodiversity and Carbon credits for funding the long term protection of Cusuco.

The second week will be run from one of the two marine research sites run by Operation Wallacea located in the Bay Islands – one the island of Utila. The main research objective at these sites is to complete annual monitoring of the coral and reef fish communities so the effectiveness of the management strategies between the islands can be assessed.

Utila

Utila is part of the Honduran Bay Islands and is 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 at the Bay Island College of Diving Resort, located on the west side of town. 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.
- To 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, algae 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.

2. Week 1 Itinerary for Schools in Cusuco

The students on site will complete six days of training and research. These are divided into half day sessions totalling: three days of biodiversity lectures and associated survey practical sessions, half a day jungle skills training and two and half days of forest measurements and biodiversity monitoring. Students will arrive in the forest on Wednesday by mid-morning and will attend introductory lectures on health and safety, camp orientation and the schedule for the week for each group. Each of the students will spend a series of nights at one of the Main Camps (Base Camp in the core zone of the Park with accommodation in tents, or Buenos Aires a buffer zone mountain village on the East of the Park with accommodation in local houses) and three days in one of the field camps in the core zone of the Park where accommodation is a mix of hammocks and tents.

An example timetable for the groups is set out below. Note that when there are large numbers, the schools will be divided into two groups (table 1) who will each spend 3 nights in a Main Camp and 3 nights in a field camp. Group 1 will spend the first 3 nights at the Main Camp followed by 3 nights in a fly camp whilst group 2 will start off in the fly camp and finish in the Main Camp. When there are smaller groups (<20) then they will follow either the group 1 or group 2 itinerary below.

The normal schedule will be a dawn start for the teams doing the biodiversity practicals (a little later if the Canopy Access training is being done that morning). These teams will then normally be back late morning and in the main camps there will be a lecture before and after lunch. The afternoon practical will start at approximately 2pm with teams getting back for dinner, which is followed by a lecture and an evening practical.

Day	Group 1 Main Camp/Fly Camp	Group 2 Fly Camp/Main Camp
Wednesday morning	Transfer to Main Camp	Transfer to Main Camp
Wednesday afternoon	Health and safety briefings Light trapping or bat surveys	Trek to field camp
Wednesday evening	Lecture 1 Biodiversity and Rainforest structure	Health and safety briefings and introduction to field camp
Thursday morning	Bird surveys herpetofauna surveys/canopy access training Lecture 2 Adaptation and co-evolution	Butterfly surveys, bird surveys or herpetofauna surveys
Thursday afternoon	Lecture 3 Amphibians and reptiles Training in forest structure measurements	Forest structure surveys
Thursday evening	Light trapping or bat surveys	Jungle training briefing Amphibian and reptile walk
Friday morning	Bird surveys, herpetofauna surveys or canopy access training	Bird surveys or herpetofauna surveys

	Lecture 4 Cloud forest birds	
Friday afternoon	Lecture 5 Cloud forest mammals Jungle training/canopy access training	Forest structure survey
Friday evening	Light trapping or bat surveys	Jungle training briefing Amphibian and reptile walk
Saturday morning	Jungle training/canopy access training	Forest structure survey
Saturday afternoon	Trek to fly camp	Trek back to Main Camp
Saturday evening	Introduction to field camp	Lecture 1 Rainforest structure and biodiversity
Sunday morning	Butterfly surveys, bird surveys or herpetofauna surveys	Bird surveys, herpetofauna surveys/canopy access training Lecture 2 Adaptation and co-evolution
Sunday afternoon	Forest structure surveys	Lecture 3 Amphibians and reptiles Training in forest structure measurements
Sunday evening	Jungle training briefing Amphibian and reptile walk	Light trapping or bat surveys
Monday morning	Bird surveys or herpetofauna surveys	Bird surveys, herpetofauna surveys or canopy access training Lecture 4 Cloud forest birds
Monday afternoon	Forest structure survey	Lecture 5 Cloud forest mammals Jungle training/canopy access training
Monday evening	Jungle training briefing Amphibian and reptile walk	Light trapping or bat surveys
Tuesday morning	Forest structure survey	Jungle training/canopy access training
Tuesday afternoon	Trek back to Main Camp	Forest structure survey
Tuesday evening	Lecture 6 Conservation Synthesis Social evening	Lecture 6 Conservation Synthesis Social evening
Wednesday morning	Travel to marine site	Travel to marine site

Table 1. Example timetable for week 1. Note there may be changes to this schedule depending on size of groups, fitness of students, weather conditions, operational problems or timing of the canopy access training.

3. Jungle Skills

There will be briefings on introduction to the forest camps, how to identify risks throughout the Cusuco sites and to mitigate these risks and health and disease issues. Each group will have to learn how to live in tents and hammocks and be shown how to select a safe camp site, make fires, dig latrines, field cooking, water sterilisation etc. During their walks into and out of the camp they will have constant reinforcement of the health and safety messages and, whenever possible, identifications of common trees, birds and reptiles encountered.

Learning outcomes:

- Awareness of dangerous plants and animals - from the briefings and demonstrations in the field
- Awareness of disease and health issues working in a tropical rainforest -from the medical briefings and additional information given by the accompanying medic
- Safe working practices in remote locations- this is to do with trekking procedures, river crossings, taking water, hat, sunblock, organising communication etc and is partly from the lectures and partly field experience
- Establishing a temporary fly field camp -from experience gained in the field camp and is aiming at ensuring they know how to sling a hammock and be able to stay in the forest overnight

4. Example Forest Measurements*

Assessment of habitat type and level of habitat degradation provides the backbone to biodiversity monitoring programmes and assessment of ecosystem health. Assessment of a range of habitat variables and monitoring of habitat changes over time can be used to interpret variation in space and time of faunal diversity and abundance. Modelling of habitat quality and animal distribution patterns can then be used to predict changes to the ecosystem caused by a range of management plans as a means of choosing the most effective method of land management for a given area. In addition, these data are being used to calculate the carbon standing stock in the forest as a key component of the carbon and biodiversity credit application being submitted for the Park.

Students will work in a group to complete surveys of 20m x 20m habitat plots. The first task for the team at each site will be to mark out the 20m X 20m square around using the marked corners. Once the 20m X 20m square has been positioned the tapes will need to be tied off and bisecting tapes positioned so that four 10m X 10m quadrants are positioned within the 20m X 20m square. During this process care should be taken to minimise damage to the site. The teams are then divided into three groups: growth rates and dead wood estimation, canopy openness and spatial heterogeneity of the site and regeneration rates.

The growth rates team will complete dbh (diameter at breast height) measurements on all trees with dbh values $>$30cm. If the tree is tagged the tag number will be noted and if no tag is present, then a new tag will be fixed. This team will then record the length and circumference of any fallen trees or branches ($>$20cm circumference) as an indication of turnover within the forest. Note only the part of the fallen tree or branch within the 20m x 20m site should be measured and the total volume of dead wood should be recorded on the data sheet.

The canopy openness and spatial heterogeneity team will estimate the openness of the canopy by taking a reading with a canopy scope facing the largest opening in the canopy from the centre of each of the four quadrants and one from the centre of the overall 20m X 20m square. If any of these points is closer than 1m to a tree trunk, then the observation point should be moved slightly so that it is at least 1m from the

nearest tree trunk. The perspex square needs to be held 20cm from the eye and has a number of dots engraved on the square. The observer counts the number of dots that coincide with gaps in the canopy.

20m tapes will have been used to bisect the 20m X 20m site in order to produce the four quadrants. The canopy openness and spatial heterogeneity team will use a 3m pole marked in 0.5m segments and record

the number of vegetation touches on the pole in each 0.5m segment up to a maximum of 10 touches, every 1m along these bisecting tapes. If one of the positions coincides with a tree assume each of the 0.5m segments include vegetation.

The regeneration rate team will position a 2m X 2m square randomly within each of the four 10m x 10m quadrant and the number of woody saplings <1.5m counted.

* Note that our methods are continually being reviewed and so slight changes may be necessary between years in order to get the most relevant data. We do our best to inform before the expedition if any changes are made to the protocols.

5. Biodiversity Monitoring

The following are the practicals with on-site briefings that will be completed by each group:

Scan search sampling of herpetofauna

The students will practice transect sampling by walking along a transect line in the forest and searching for reptiles and amphibians on either side of the transect line. Many of the transect lines connect with a stream. While at the stream they will use systematic scan searching of amphibians. All animals caught along the transect line or in the stream will be identified. Skin swabs of amphibians will also be collected as part of the ongoing monitoring of the chytrid fungus. There will also be an accompanying lecture to reinforce the skills that are learnt in the field.

Light trapping of invertebrates

A light trap will be set to monitor nocturnal invertebrates such as moths and jewel scarab beetles. Students will assist the scientists to set-up traps and will be reminded of the advantages and limitations of this sampling method. The light trap will then be left for a period of time, in which a short briefing will be given to support the learning outcomes. Students will return to the light trap to identify the various species caught. Lepidopterans are covered in the invertebrate lecture.

Bat mist netting

This practical will involve working with the bat scientist in the evening to set and empty mist nets. The captured bats will be identified and the main identification features explained.

Butterfly surveys

In this practical the groups will learn how to set and use baited van Sommeren traps to sample butterflies in the canopy and at mid canopy heights. In addition, they will learn how to use transect-based timed Pollard counts to monitor the butterflies at ground level.

Bird surveys

This practical session will also include a lecture on Neotropical birds. Two different types of bird surveys are run in Cusuco, Mist nets and point counts. Students will either join a survey at sample points along the transects recording early morning bird calls and sightings or join a team for early morning mist-netting of birds. Point counts involve standing in an outward facing circle with an experienced ornithologist in the centre and recording all birds seen or heard over a 10-minute, noting the time of the record and estimating distance from the count point. Mist netting involve setting up mist nets on transect, and checking the nets regularly for catch. An experienced ornithologist will explain the process of IDing individuals, collecting morphometric data, before releasing. The sessions are conducted early in the morning when birds are most active.

Spotlight surveys for amphibians and reptiles

This practical will involve spotlight surveys of river after dark with a herpetologist to assess frog communities and opportunistically sighted reptiles. Species encountered will be identified and the main identification features explained.

6. Biodiversity lectures

Lecture 1: Biodiversity, Hotspots and Monitoring

An introduction to Biodiversity and Cusuco National Park. Students will learn about the meaning of biodiversity and how this applies to Cusuco. They will also look at the structure and importance of rainforests and the long-term collection of monitoring data to identify trends and patterns in populations.

- What is biodiversity?
- What is a species?
- Measuring diversity and diversity gradients.
- Why measure biodiversity and why is it important?
- Endemism

- Other important things to know about – the IUCN Red lists and Biodiversity Hotspots
- Cusuco National Park
- Monitoring methods

Discussion/Activity: Discussion on the word 'biodiversity'. Short video on Biodiversity.
Key words: Biodiversity; Species; Ecosystems; Rainforest; National Parks; Endangered species

Lecture 2: Herpetofauna and adaptation

This lecture looks briefly at the process of evolution and the unique situation for Honduras. It then considers two forms of adaptation as shown by mimicry in the forest, before going into detail about the different groups within amphibians and reptiles. The lecture finishes by looking at herpetofauna specific to the cloud forest and Cusuco before focussing on the case study of Chytrid fungus, which is responsible for severe declines and extinctions of amphibians worldwide and is a hot topic of science research at present.

- Evolution
- Evolution of herpetofauna in Central America
- Amphibians
- Reptiles
- Snakes and venoms
- Herpetofauna in cloud forests
- Amphibian decline and Chytrid

Discussion/Activity: Herp ID test
Key words: Evolution; Allopatric; Wallace; Darwin; Adaptation; rainforest

Lecture 3: Invertebrates and adaptation

This lecture is split into two parts. Firstly, it introduces the importance of invertebrates (particularly insects) and introduces the concept of ecosystem services. It then goes over the main invertebrate groups studied in Cusuco and why they are ideal study systems and important indicators of ecosystem health. The second part of the lecture looks at adaptation, demonstrated in the form of mimicry in the forest (Batesian and Mullerian). The lecture concludes by looking at some strong evolutionary studies using the same invertebrate groups that Cusuco researchers study with the help of students.

- Invertebrate diversity
- Lepidoptera, Hymenoptera & Coleoptera
- Adaptation
- Aposematism
- Mimicry – Batesian and Mullerian
- What makes a good indicator species
- Example studies on indicator species

Discussion/Activity: Butterfly or Moth quiz, adaptation activity where students discuss the different adaptation of cloud forest species
Key words: Adaptation, aposematism, camouflage, mimicry, Batesian, Mullerian, indicator species

Lecture 4: Neotropical birds

In this lecture the main birds of Cusuco are discussed along with an idea on how to identify birds in the field. It examines different aspects of bird biology and ties this in with both natural selection and sexual selection, for example: morphological adaptations, feeding, courtship behaviours and reproduction. The lecture finishes with a discussion of survey methods used by scientists in the forest.

- Bird evolution and classification

- Bird anatomy and adaptation
- Courtship and mating systems
- Songs and calls
- Bird identification
- Birds as indicators of ecosystem health
- Bird surveys and monitoring

Discussion/Activity: How to survey birds and an optional Bird ID test
Key words: Classification; field techniques; indicator species; behaviour; courtship.

Lecture 5: Neotropical Mammals

The main mammals of Cusuco are reviewed and linked to the concepts of evolution and adaptation which have been previously covered, followed by a summary of sampling techniques used in the forest.

- Mammal evolution
- Mammal diversity
- Mammals in Cusuco
- Baird's tapir and relevant studies
- Sampling techniques
- Conducting a small mammal survey

Discussion/Activity: Mammal ID test
Key words: Habitat; niche; Rainforest; Field techniques; Transects; mark and release; conservation; mammals.

Lecture 6: Conservation, Operation Wallacea & Cusuco National Park

This lecture looks at conservation issues in Cusuco National Park and surrounding area, in addition to the importance of long-term biodiversity monitoring data and its application to carbon-trading schemes such as carbon and biodiversity credits.

- Conservation and the Opwall conservation model
- Opwall project in Cusuco National Park
- Pressure-state-response monitoring
- Cusuco monitoring data
- Carbon trading and biodiversity credits

Discussion/Activity: Round-up of the weeks' activities and the contributions the students have made to the research.
Key words: Conservation; REDD; Carbon trading; GIS; Threats; Fair Trade

7. Learning Outcomes from Week 1

The students should achieve the following learning outcomes from the fieldwork, practicals, lectures and discussions/activities:

- Be able to define a rainforest and cloud forest
- Be able to describe the key fauna found in Central American cloud forests
- Give examples of cryptic, warning colourations, Batesian and Mullerian mimic species
- Be able to identify 5 species of herpetofauna in Cusuco
- Describe the Chytrid fungus and its impact on amphibian populations worldwide
- Describe how snakes are classified according to their teeth and venom

- Describe different bird survey techniques
- Be able to identify 10 species of cloud forest bird
- Describe survey techniques used to monitor mammal populations.
- Be able to identify 10 species of cloud forest mammal
- Be able to describe the carbon and biodiversity credit schemes

8. Week 2 Itinerary

The students will complete six days of training in marine science. Students will catch the mid-afternoon ferry from La Ceiba and arrive on Utila Wednesday evening. Accommodation on Utila is in shared rooms with air conditioning.

The students have the option of completing their PADI Open Water dive qualification (see section 10). If they are already dive trained, or don't want to dive then they can do the Caribbean Reef Ecology course on Utila, with the practical's carried out either by diving or snorkelling (see section 9). A third alternative is to complete their theory and confined water practicals at home, leaving just 4 open water dives to complete the course and achieve the PADI Open Water qualification on site (see section 11). They will then move onto the reef ecology course for the remainder of the week. Students will be occupied in the evenings with a series of science talks, documentary viewings and discussions/activities relative to the ecology course, as well as being able to enjoy the beautiful settings of whichever of our marine sites they are visiting.

9. Coral Reef Ecology Course

Table 2 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. On the Monday afternoon at the end of their stay, they will present their findings to the group in as an imaginative way as possible!

Lecture 1: Introduction to Coral Reefs

- Assessing current knowledge of marine ecosystems
- How the world learns about science and the environment
- The concept of charismatic species
- Introduction to hard and soft corals
- Coral anatomy, feeding and reproduction

Land-based activity: Group research project briefing
In-water activity: Check dive/snorkel

Lecture 2: Importance of Coral Reefs

- Discussing how coral reefs are important (biodiversity, productivity etc)
- Furthering examples with fisheries and coastal protection

- How does tourism contribute to importance?
- How coral reefs are distributed globally
- The intermediate disturbance hypothesis

Land-based activity: Reef Complexity
In-water activity: Buoyancy skills

Lecture 3: Reef Species and Interactions

- Defining interaction types
- Discussing competition, predation and symbioses
- Deep dive into parrotfish (discussing their importance and interactions)
- Deep dive into butterflyfish (discussing their importance and interactions)
- Deep dive into damselfish (discussing their importance and interactions)

Land-based activity: Urchin Morphometrics
In-water activity: Coral and invertebrate ID

Lecture 4: Reef Threats and Mitigation Attempts

- Required conditions for coral growth and survival
- Threats to coral reefs
- Outlining ocean acidification, unsustainable fishing practices and phase shifts
- Ecological resilience
- The future of coral reefs

Land-based activity: Quadrat Building
In-water activity: Fish ID

Lecture 5: Underwater Surveys: Theory and Execution

- What is marine monitoring, and what considerations need to be made?
- An introduction to the benthic environment (benthos)
- How can the benthic environment be surveyed?
- An introduction to the midwater environment (fish)
- How can the benthic environment be surveyed?

Land-based activity: Analysing Quadrat Data
In-water activity: Benthic Assessment Using Quadrats

Lecture 6: Mangroves & Seagrasses

- Introduction to mangroves
- Adaptations of mangroves to their environment
- Introduction to seagrasses
- Adaptations of seagrasses to their environment
- Ecosystem functions of mangroves and seagrasses

Land-based activity: Benthic Video Analysis
In-water activity: Benthic Assessment Using Video

Lecture 7: Marine Megafauna (South Africa and Madagascar ONLY)

- Introduction to megafauna

- Outlining sharks and their ecosystem functions
- Whales & pinnipeds, and what separates them?
- How have turtles adapted to the ocean?
- The importance that megafauna play in conservation

Land-based activity: Group research project presentations
In-water activity: Favourite Survey/ Fun Dive

ID Lecture 1: Invertebrates and Corals

- Sponges
- Non-sessile invertebrates
- What is an invertebrate / coral?
- Defining ecosystem architects
- Coral morphologies

ID Lecture 2: Fish

- There is no such thing as a fish!
- How do we describe fish?
- The different body shapes
- How to describe markings / patterning
- Examples of local reef fish

Table 2: 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 vary.

	Day One	Day Two	Day Three	Day Four	Day Five
Lecture / Land-Based Practical	Lecture 1: Introduction to Coral Reefs	Lecture 3: Reef Species and Interactions	Lecture 4: Reef Threats and Mitigation Attempts	Lecture 5: Underwater Surveys: Theory & Execution	Lecture 6: Mangroves and Seagrasses
Lecture / Land-Based Practical	Group research projects -briefing	Urchin morphometrics	Microplastic survey	Benthic video analysis	Coral Watch - briefing
In-Water Practical	Check dive	Coral and invert ID	REEF Survey	Benthic assessment using video	Coral Watch
Lunch					
Lecture / Land-Based Practical	Lecture 2: Importance of Coral Reefs	ID Lecture 2: Fish	Instillation of an MPA: debate	How to survey a reef	Group research projects - prep time
Lecture / Land-Based Practical	Reef complexity	REEF Survey Briefing	Lionfish dissection	Benthic video analysis	Group research projects - final presentations
In-Water Practical	Buoyancy skills	Fish ID	Benthic assessment using quadrats	Seagrass Spotter	Fun dive/ favourite survey
Dinner					
Evening Activity	ID Lecture 1: Coral and Invertebrates	Coral Atlas -analysis		Seagrass Spotter - data entry	

10. 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.

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

Time	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
0700	**Transfer**	**Theory:** Knowledge Development 1	**Theory:** Knowledge Development 3	**Theory:** Knowledge Development 5	**Theory:** Revision / catch up session	**Talks Preparation**
1000	**Transfer**	**Dive:** Confined Water 1 **Activity**: Equipment set up	**Dive:** Confined Water 3 **Activity:** 15 Minute Float	**Dive:** Confined Water 5	**Dive:** Open Water 2	**Dive:** Open Water 4
1200	**Transfer**	**Theory:** Knowledge Development 2	**Theory:** Knowledge Development 4	**Theory:** Knowledge Development 6	**Theory:** Final Exam	**Talks Session**
1500	**Transfer**	**Dive:** Confined Water 2 **Activity**: Swim test	**Dive:** Confined Water 4	**Dive:** Open Water 1	**Dive:** Open Water 3 **Activity**: Skin Diver	**Dive:** Catch up dive / fun dive
Evening Activity	Arrival/ Welcome Talk	Science Talk	Documentary	Trivia Night	Science Talk	Free Night

11. 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 9.

12. 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.

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
	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 5: Highlighted in Black are topics that you might experience at your research site. Key: IB ESS = Env Systems and Societies; APES = Advanced Placement Env. Science (v. 20/11/14)

Topic	Environmental Science APES and ESS	IB ESS	APES	UK Geography A Levels AQA, Edexcel, eduqas and OCR
Evolution, Classification and DNA	Evolution; Speciation; Species; Endemism; Gene pool; Allopatric; Sympatric; Isolation; Variation; Adaptive radiation Adaptation; Wallace; Darwin	◆		There has been a complete revision of UK Geography A levels. Although our expeditions are possibly not going to be as relevant to Geographers as they are to Biologists there are a significant number of topics covered by the various examination boards in which matching occurs with reference to: • human impact on ecosystems • ecosystems in general • biodiversity • sustainability • fair trade • work of NGOs • deforestation • GIS • carbon trading • climate change
	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	◆	◆	• case studies linked to biomes such as rainforests. All exam boards expect experience of field investigation techniques, statistical use and data manipulation which are very relevant to their experiences whilst on location at their expedition site. Almost all boards now require an independent investigation by students which fits really well with the present IRPs although the topic chosen must relate to their exam syllabus so topics such as the biodiversity credit scheme are possible choices. Their IRPs are between 3,000 and 4,000 words and should take up 4 days minimum to achieve. AQA have defined primary data as "Primary data is defined as unmanipulated data, either collected in the field or a raw dataset" which will work well with past data sets and the research data they help to collect when on their expedition. Specific detailed exam board matching is available on request.
	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			

13. Reading and Research Questions

IRPs or Individual Research Projects

In the last few years an increasing number of students joining our research programmes take this opportunity to undertake IRPs. These research projects take many different forms, but what they all have in common is the need to pose and answer a research question. Examples of these include Extended Project Qualification (EPQ), Extended Essay (EE) for IB, as well as many different projects specific to various education systems worldwide.

We can support a selection of different topics for either essay-based research projects or data-led research projects that are tailored towards what the students will experience on site. It is a fantastic opportunity for a student to witness first-hand many of the aspects of their research question and, in many cases, they will have access to samples of past datasets for their project. Students may also have the opportunity to talk with the actual scientists involved which will give them a convincing 'slant' to the way in which they answer their research question.

For success with IRPs, careful planning is needed by the student and a lot of the work will be done prior to their expedition. They will need close guidance from their school supervisor, and the scientists in the field need to be briefed so that support can be provided where they can. If you or your students are interested in undertaking a research project with us, you should contact roger.poland@opwall.com

For more information visit the Opwall website - https://www.opwall.com/schools/educational-benefits/independent-research-project/.