



**School Booklet**  
**Ecuador & Galapagos 2019**

# 1. Structure of the Ecuador Expedition

This expedition combines working on a biodiversity research project with the Kichwa Indians in the Amazon with a week visiting the Galapagos Islands completing a course on Galapagos Island ecology.

The first week of the expedition will be spent in the remote Sani Reserve forest camp which is accessed by long boat along the Napo river and the groups based at this camp will be helping a team of specialists with surveying different taxa. The second week of the expedition is spent on Santa Cruz Island in the Galapagos Islands.

Groups need to arrive at Quito (UIO) airport by 2200hrs on the Monday before the expedition starts. You will be met by a representative from the Quito Airport Suites where you will be staying overnight and be transferred by bus (approximately 10 minutes) to the accommodation. The Quito Airport Suites (<http://hosteriasancarlos.com/>) is in a large walled garden complete with two alpacas! In addition, there is a swimming pool on site and this is where you will have your evening meal. There will be a packed breakfast for the morning. The Opwall representative will meet the groups that evening in the Quito Airport Suites and will brief them on the journey the following morning.

The bus which will be taking the groups over the Andes to the Napo river in Coca will leave the Quito Airport Suites early in the morning and you will be accompanied by a bilingual Opwall representative. The journey time is from 5 – 6 hours. After arriving in Coca and getting your first sight of the magnificent Napo river, the group will board a long boat with outboards and a cover to shade you from the sun. The 2 – 3 hour trip down the Napo takes you into the Ecuadorian Amazon. On arrival at the Sani camp the group disembark and walk along a board walk for 10 minutes to Lake Challuacocha. At the lake the group will get into a series of small canoes and be paddled along the narrow lake (45 minutes) to the research camp.

On the Monday at the end of the week in the Napo this journey is reversed and the group will spend the night in the Quito Airport Suites. On the Tuesday the group will take an early morning flight to Baltra island in the Galapagos which stops in Guayaquil. Note when checking in for the Galapagos flight the groups need to pay a US\$20 transit fee from Ecuador to the Galapagos. The flight to Baltra Island takes around 2 hours and on arrival there is very strong biosecurity to prevent the introduction of pest species, which use sniffer dogs to check the baggage. On landing at Baltra each group member has to pay \$100 entry fee to the Galapagos. Note there is a 1-hour time difference (the Galapagos are 1 hour earlier than mainland Ecuador).

After clearing Customs the group will be met by an Opwall representative and taken on a very short bus ride over Baltra island (10 minutes) to the Itabaca Channel for a 5-minute ferry ride to Santa Cruz Island. Here they will board another bus for the 45-minute ride to the Highland View camp. The group will stay at this camp for Tuesday to Friday nights.

On Saturday morning the group will be moved to a hotel in Puerto Ayora (30 minutes) where they will spend Saturday and Sunday nights. On the Monday morning the group will be transferred by bus and ferry to Baltra airport (1 hour) to catch the 1000hrs flight back to Guayaquil arriving at approximately 1300hrs on the Monday.

## 2. Sani Reserve (Ecuadorian Amazon) Research Objectives and Study Area

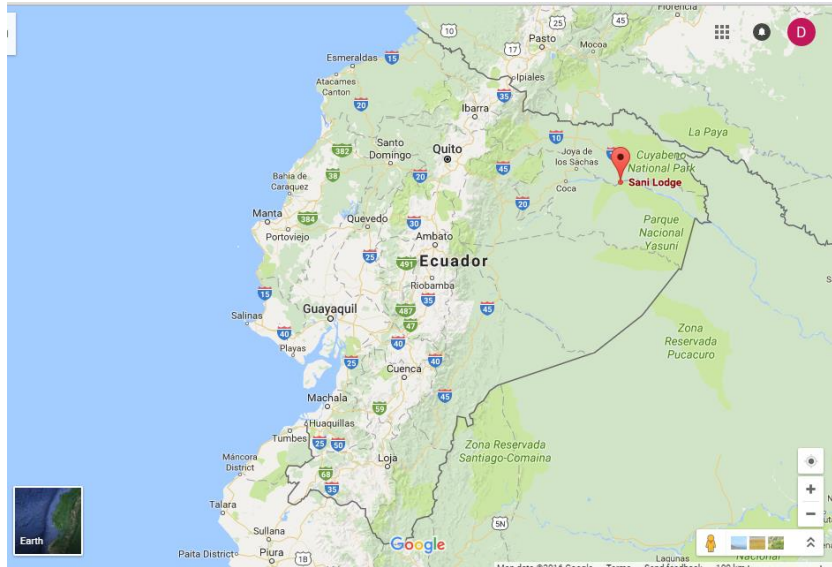
The fieldwork takes place in the Amazon lowland forest of Ecuador around a jungle camp at the Sani Reserve on the Napo River, just north of Yasuni National Park. These forests are recognized as the most biodiverse terrestrial ecosystems in the Western hemisphere

Much of the Amazonian forests of Ecuador are under threat from oil extraction. In the Amazon, oil extraction has traditionally been followed with deforestation of the areas of extraction and has often been of little benefit to the native people on whose land the oil extraction is occurring. The Kichwa Amerindians have managed to protect their forests against proposed oil extraction. In essence, the Kichwa Indians are foregoing income from the oil industry in order to protect the forest, and that income needs to be replaced by an income of the same level or greater in order to ensure the long term protection of the forests. Sani Eco Lodge, an Ecuadorian ecotourism operator, has been working with the Kichwa community to develop ecotourism income that provide sustainable jobs and income from leaving their forests intact. They have constructed a high end ecotourism lodge in the centre of the 40,000 hectares that encompass the Sani Reserve, and a separate field research camp that is being used by the Opwall survey teams, and as a camping experience for the high end ecotourist visitors. This income is helping, but visitor numbers need to be increased in order to provide sufficient long-term funds to prevent the forests being logged. Part of the problem seems to be that there are only a small range of activities available for guests at the Lodge and there is not a great deal of expertise on site about the biodiversity of the various taxa encountered. In 2017 the survey teams produced a detailed habitat and vegetation map of the reserve, established a series of forest monitoring plots, produced a photographic guide to the fish and amphibians of the reserve and an illustrated guide to the mammals likely to be encountered. In addition a series of activities were developed in the local Sani Indian community that could be used for day visits by tourists. In 2018 the first every survey of the butterflies of the reserve was completed. In addition, an illustrated guide to the larger mammals was produced. In 2019 the objective is to build on this work and to achieve the following:

- To produce an illustrated guide of the distribution, habitat preferences and relative abundance of the bird community in the Sani reserve.
- To update the guide to the amphibians and reptiles of the Sani Reserve with any new records made.
- To continue the collection of botanical samples to complete an inventory of the flora
- To re-measure the permanent forest plots so that data on forest dynamics (eg turnover, growth, recruitment) can be quantified
- To update the mammal and primate guide to the reserve with new records and data on distribution and relative abundance
- To extend the range of ecotourism activities involving the Sani Community

### Study Area

The site at Sani is situated on the river Napo, north of the Yasuni National Park (See Map 1 below).



*Map 1. Location in Ecuador of the lowland field site at Sani, Orellana Province, Ecuadorian Amazon*

### 3. Napo River Itinerary

On the Tuesday start date of the expedition the group will travel by bus from Quito over the Andes to Coca (approx. 7 hours) and long boat (3 hours) to the Sani reserve, followed by a 1-hour canoe ride into the forest camp site. The group will arrive in the afternoon which is when the expedition starts. After settling in they will attend lectures on health and safety, introduction to the reserve and the week's schedule.

Learning outcomes from health and safety briefings

- 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
- Safe working practices in remote locations (trekking protocols, crossing rivers, appropriate clothing, sun, safe water and dehydration), communications.

The students will be divided into up to 4 groups of a maximum of 6 - 7 students each which will rotate between these teams spending a day with each (see table 1). Each evening there will be a lecture in the Amazonian wildlife and conservation course. On the evening before joining each team the leader will meet with their group and describe the following day's activities and surveys to be completed so the teams are prepared. Table 1 (below) gives an indicative timetable for week 1.

Day	Group 1 activity	Group 2 activity	Group 3 activity	Group 4 activity
<b>Tuesday</b>	Meet in Quito and bus to forest via Coca and long boat canoe transfer to Sani			
<b>Tuesday evening</b>	Expedition starts. Welcome to Sani camp and intro talks on health & safety and objectives of the research programme			
<b>Wednesday</b>	Bird surveys using point counts and transect surveys	Invertebrate surveys using sweep nets, pitfall traps, flight intercept traps and light traps	Primate and large mammal distribution surveys from DISTANCE, patch occupancy and camera trap surveys. In addition, helping with the vegetation community structure surveys	Reptile and amphibian surveys from standard search areas, use of cover boards and pitlines and spotlight sampling at night
<b>Wednesday Lecture</b>	Lecture 1 Amazonian wildlife and conservation course - Tropical rainforests structure and function Lecture 2: Plant life in the Neotropics			
<b>Thursday</b>	Reptile and amphibian surveys from standard search areas, use of cover boards and pitlines and spotlight sampling at night	Bird surveys using point counts and transect surveys	Invertebrate surveys using sweep nets, pitfall traps, flight intercept traps and light traps	Primate and large mammal distribution surveys from DISTANCE, patch occupancy and camera trap surveys. In addition, helping with the vegetation community structure surveys
<b>Thursday Lecture</b>	Lecture 3: Invertebrates of the Amazon Lecture 4: Reptiles and Amphibians of the Neotropics			
<b>Friday</b>	Primate and large mammal distribution surveys from DISTANCE, patch occupancy and camera trap surveys. In addition, helping with the vegetation community structure surveys	Reptile and amphibian surveys from standard search areas, use of cover boards and pitlines and spotlight sampling at night	Bird surveys using point counts and transect surveys	Invertebrate surveys using sweep nets, pitfall traps, flight intercept traps and light traps
<b>Friday Lecture</b>	Lecture 5: Evolution, classification and birds of the Neotropics			

		Primate and large mammal distribution surveys from DISTANCE, patch occupancy and camera trap surveys. In addition, helping with the vegetation community structure surveys	Reptile and amphibian surveys from standard search areas, use of cover boards and pitlines and spotlight sampling at night	Bird surveys using point counts and transect surveys
Saturday	Invertebrate surveys using sweep nets, pitfall traps, flight intercept traps and light traps			
Saturday Lecture	Lecture 6: Neotropical mammals			
Sunday	Visit to Sani Isla Community village			
Sunday Lecture	Lecture 7: Conservation challenges in the Amazon			
Monday	Long boat and bus transfer to Quito and overnight in Quito			

*Table 1. Example timetable for the Napo River week. Note there may be changes to this schedule.*

## 4. Napo River Biodiversity Monitoring

### Bird Surveys

The lowland Amazon is hyper-diverse for birds (500+ species) and the list of birds seen in the Sani reserve is extensive. However, there is no centrally maintained list or readily accessible information available to guests. Survey work will be done from point counts in the forested areas and from transect surveys along the water course areas. Birds will be identified from both sightings and calls. A call library will be available on site of all the likely species to be encountered. In addition, mist netting will be used to sample some of the understory species.

### Large mammals and primates

This team will be retrieving the images from a network of cameras set up around the camping region of the Sani reserve. This involves trekking considerable distances so during these treks this team will also be completing standard searches for terrestrial, arboreal mammals and game birds to complement the camera trap footage. Camera trap footage from the 2017 expedition has proven the presence of several large cat species, giant river otters, short-eared dogs, giant armadillos and several game bird species amongst others and the 2018 data will be used to update the mammal guide to the reserve.

### Habitat and Vegetation Community Surveys

These surveys will be linked to the large mammal and primate surveys and will involve collecting plant material for identification of key species. A flora of the reserve is being prepared and specimens of

previously unidentified species will need to be collected and preserved for sending to an herbarium. In addition, forest quadrat surveys will be completed on previously established plots to characterize the dynamics of the forest (turnover, growth, recruitment etc).

## Herpetofauna Survey

The techniques for these surveys involve active searching at a fixed width of 5m either side of the transect line in the late morning when reptiles and amphibians are most active. In addition, pitlines and cover boards will be used to provide extra sampling effort. The output from this survey will be to update the digital guide to reptiles and amphibians found in the reserve with an assessment of the likelihood of encountering each species.

## Invertebrate Surveys

This team will be completing surveys of the showy and large invertebrate species likely to be encountered in the reserve. A variety of capture methods will be used including sweep nets, flight intercept traps, pitfall traps and light traps. The main groups being surveyed are the butterflies, moths, beetles, spiders, scorpions, bees and wasps, snails and slugs. All species captured will be identified and photographed.

In addition to these surveys the groups will also be completing an Amazonian wildlife and conservation course which comprises lectures and related activities/discussions on: Tropical rainforests biogeography and ecology, plant life in the Neotropics, fish of the Amazon, evolution, classification and birds of the Amazon, amphibians and reptiles of the Amazon, forest mammals and conservation challenges in the Amazon.

**Lecture 1:** Tropical rainforests: biogeographical and ecological perspectives. Plant species and use.

- How do you define a rainforest and how are they distributed globally
- The history of South American rainforests and cloud forests
- Species richness and diversity of rainforests – biodiversity hotspots
- Why there are so many species in tropical rainforests
- Natural dynamics and nutrient cycling in rainforests
- The structure of the rainforest – trees, lianas, herbs & epiphytes
- Characteristics of rainforest trees – angiosperms, gymnosperms, diversity and competition.
- Mosses and Liverworts
- Defining ecosystem services and the role of plant life
- Forests and carbon – introducing REDD+

**Lecture 2:** Plant Life in the Neotropics

- Rainforest strata
- Vegetation adaptations
- Ecosystem services
- Plant usage by local communities
- Carbon storage
- REDD+ and carbon schemes

**Lecture 3:** Invertebrate of the Amazon

- What is an invertebrate

- Butterfly collections from 2018 field season
- Survey techniques including light traps

**Lecture 4:** Evolution, classification and birds of the Neotropics

- Principles and history of taxonomy, evolution and classification
- Predators – Owls, vultures, kites, eagles, hawks and falcons
- Large forest birds – Chahalacas, tinamous, guans
- Parrots, Hummingbirds, Trogons and Quetzals, Motmots, Toucans and Barbets
- Woodpeckers and woodcreepers, Antbirds
- Lekking species – cock-of-the-rock, manikins.
- Survey techniques for birds including soundscapes

**Lecture 5:** Amphibians and reptiles of the Neotropics - Describing and identifying herpetofauna examples of Amazonian species.

- Evolution of Neotropical herpetofauna – biogeography and history
- Ecuadorian herpetofauna – ecology and conservation status
- Mimicry and adaptation
- Threats and conservation (habitat loss, chytrid fungus)
- Herpetofauna survey techniques

**Lecture 6:** Neotropical forest mammals

- Neotropical mammals – biogeography and history
- Ecuadorian mammals – ecology and conservation status
- Bat diversity, ecology and survey methods
- Primate conservation
- Large mammal survey techniques (distance sampling, patch occupancy sampling and camera trapping)

**Lecture 7:** Conservation challenges in the Amazon: Threats from environmental change and resource pressures

- Threats to wildlife in Ecuador
- The drivers of land use change and climate change in Ecuador
- Conservation in a biodiversity hotspot – protected areas
- Poverty and conservation - Community conservation: the example of Sani Ecolodge
- Ecuador's response to Climate change and Conservation, REDD+.
- Natural Forest Standard as a way of packaging forests

Workshop/ Discussion: Round up of the weeks activities and the contributions the students have made to the research. What they can do when they get home.

## 5. Napo River Week Learning Outcomes

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

- Be able to define a rainforest
- Be able to describe the key fauna found in South American lowland forests



- Be able to describe natural forest dynamics and nutrient cycling
- Describe how biodiversity hotspots are defined
- Be able to identify at least 20 Amazonian forest birds
- Be able to identify at least 10 Amazonian forest herpetofauna
- Identify the major threats and conservation efforts of Amazonian forest mammals

## 6. Galapagos week

During this week groups will complete a Galapagos Island ecology course which will cover the following topics: Introduction to the Galapagos Islands, vegetation zones and how species arrived, introduction to the Galapagos marine environment, fish and invertebrates of the Galapagos, endemic species of the islands, marine megafauna of the Galapagos, adaptive radiation and conservation of the Galapagos. Alongside the lecture series, students will also complete associated land and marine based practicals.

The students will be divided into groups and complete the activities described below.

Day	Group 1	Group 2	Group 3	Group 4
Tuesday morning	Arrive and transfer to site	Arrive and transfer to site	Arrive and transfer to site	Arrive and transfer to site
Tuesday afternoon	Lecture 1: An introduction to the Galapagos	Lecture 1: An introduction to the Galapagos	Lecture 1: An introduction to the Galapagos	Lecture 1: An introduction to the Galapagos
Wednesday morning	Discover Scuba/Snorkels 1 & 2	Geology of the Galapagos practical #1 exploration of the Highland View Lava Tunnels	Vegetation lecture 2 followed by vegetation practical #1 via exploration of the highlands transitional zone	Vegetation lecture 2 followed by vegetation practical #1 via exploration of the highlands transitional zone
Wednesday afternoon	Lecture 3: Endemic species of the islands	Lecture 3: Endemic species of the islands	Lecture 3: Endemic species of the islands	Lecture 3: Endemic species of the islands
Thursday morning	Geology of the Galapagos practical #1 exploration of the Highland View Lava Tunnels	Discover Scuba/Snorkels 1 & 2	Geology of the Galapagos practical #1 exploration of the Highland View Lava Tunnels	Geology of the Galapagos practical #1 exploration of the Highland View Lava Tunnels
Thursday afternoon	Lecture 4: Adaptive Radiation	Lecture 4: Adaptive Radiation	Lecture 4: Adaptive Radiation	Lecture 4: Adaptive Radiation
Friday Morning	Vegetation lecture 2 followed by vegetation practical #1 via exploration of the highlands transitional zone	Vegetation lecture 2 followed by vegetation practical #1 via exploration of the highlands transitional zone	Discover Scuba/Snorkels 1 & 2	Geology Practical #2 Exploration of natural sinkholes and coastal mangroves kayaking practical on the Itabaca channel
Friday Afternoon	Lecture 5: Marine Environments; Fish and Invertebrates of the Galapagos	Lecture 5: Marine Environments; Fish and Invertebrates of the Galapagos	Lecture 5: Marine Environments; Fish and Invertebrates of the Galapagos	Lecture 5: Marine Environments; Fish and Invertebrates of the Galapagos
Saturday Morning	Geology Practical #2 Exploration of natural sinkholes and coastal mangroves kayaking practical on the Itabaca channel	Santa Fe (Barrington Island) kayaking practical of different types of mangroves and species	Santa Fe (Barrington Island) kayaking practical of different types of mangroves and species	Discover Scuba/Snorkels 1 & 2
Saturday Afternoon	Lecture 6: Conservation and Marine Megafauna of the Galapagos	Lecture 6: Conservation and Marine Megafauna of the Galapagos	Darwin Research Station Visit	Darwin Research Station Visit
Sunday Morning	Santa Fe (Barrington Island) kayaking practical of different types of mangroves and species	Geology Practical #2 Exploration of natural sinkholes and coastal mangroves kayaking practical on the Itabaca channel	Geology Practical #2 Exploration of natural sinkholes and coastal mangroves kayaking practical on the Itabaca channel	Santa Fe (Barrington Island) kayaking practical of different types of mangroves and species
Sunday Afternoon	Darwin Research Station Visit	Darwin Research Station Visit	Lecture 6: Conservation and Marine Megafauna of the Galapagos	Lecture 6: Conservation and Marine Megafauna of the Galapagos
Monday morning	Fly home	Fly home	Fly home	Fly home

*Table 3. Indicative timetable for the Galapagos week. Note there may be changes to this schedule.*

## 7. Galapagos Island Ecology Lectures

The Galapagos Island Ecology lecture course will consist of the following lectures:

### Lecture 1: An introduction to the Galapagos

- Discovery of the islands and population
- Formation of the islands
- Humboldt, Cromwell and warm water currents
- Effects of El Nino on the islands
- Darwin in the Galapagos
- Island speciation
- Predicting island species numbers from size and physical complexity of the island and distance from the mainland
- Threats to the islands

### Lecture 2: Vegetation zones and how species arrived

- Main vegetation zones
- Colonisation from wind blown organisms
- Colonisation over the sea
- Colonisation by flight
- Arrival of invasive species

### Lecture 3: Endemic species of the islands

- What is endemism?
- Galapagos Red List terrestrial species
- Examples of endemic birds – Darwin's finches, flightless cormorants and penguins, Lava gull, Galapagos Hawk
- Other important bird species – Blue footed Boobies, Greater Flamingo, Waved Albatross
- Reptiles – marine iguanas, giant tortoises, lava lizard, Galapagos racers

### Lecture 4: Adaptive radiation

- Adaptation and fitness
- Camouflage and aposematism
- Mimicry
- Darwin's finches
- Adaptive radiation in giant tortoises

### Lecture 5: Marine environments; Fish and Invertebrates of the Galapagos

- Vertical stratification of the sea and linkage to biodiversity
- Coral reefs
- Marine mounts
- Hydrothermal vents
- Fish biology
- Herbivorous fish ecology – parrotfish, surgeonfish, damselfish
- Carnivorous fish ecology – grunts, butterflyfish, triggerfish, frogfish
- Classifying invertebrates
- Examples of Cnidaria

- Examples of Crustacea
- Examples of echinoderms

## **Lecture 6: Conservation and Marine Megafauna of the Galapagos**

- Extinction rates
- Control of invasions
- Reintroductions
- El Niño
- Galapagos marine protected areas
- Challenges of being large and benefits of an aquatic existence
- Electroreception
- Shark finning and impacts on shark populations
- Whale ecology
- Fur seals and sealions
- Turtles

## **8. Galapagos Practicals**

### **Practicals of the Transitional and Humid Zones**

These two half day practicals will be based in Highland View and consist of guided walks with an experienced naturalist explaining about the vegetation changes across the reserve and the birds and other animals encountered.

### **Geology**

This is a visit to the lava tubes with a specialist guide who will explain about the geology of the islands and the formation of the lava tubes that the students will be able to see.

### **Guided Visit to the Coastal Arid and Mangrove Zones**

This full day practical with a professional local naturalist guide is in the Tortuga Bay National Park. The first part of the visit is through the arid coastal zone and here the guide will be showing the students the typical *Opuntia* cacti, spiny bushes and small trees including Manzanillo tree (poison apple tree). Then there is a walk along a 1km long beach and a chance to snorkel next to the mangroves. This is an excellent site for marine iguanas and the guide will explain about their ecology and the students will complete some scan and focal sample behavioural observations on the marine iguanas. The final session explains about the mangroves and some of associated species such as the bright red Sally Lightfoot crabs and Lava Herons.

### **Diving**

One day of the course is dedicated to gaining a diving experience. For those with no previous diving experience they will be completing a Discover Scuba dive. Since not all students will be able to dive at the same time, those not completing skills or doing their Discover Scuba dive will be snorkeling with a Dive Instructor in the water with them who will be teaching the identification of some of the fish species encountered. For the qualified divers their first dive will be a check dive with a Dive Instructor whilst the

second dive will be concentrating on learning some of the fish species encountered. For those who have completed the referral elements of the PADI Open Water dive training course (ie the theory and confined water skills), there will be two dives with a maximum of 8 students and 2 Dive Instructors in the water with them at any time. Both of these dives will concentrate on learning the skills needed to complete the full Open Water course. The dive location used for these dives and snorkel practicals has huge shoals of fish, sealions, turtles, sharks and marine iguanas so should be interesting.

## Visit to Santa Fe Island

This will involve a day trip by boat to another island in the Galapagos called Santa Fe or Barrington island. Here the group will have the opportunity to go ashore between the sea lions roosting on the beach and look for the endemic Barrington Land Iguana. The Barrington Leaf-toed Gecko is another endemic on this island.

## 9. Links to biology, geography, and environmental science syllabuses

The following tables suggest how specifications for Biology, Geography, and Environmental studies might link with your expedition experience though lectures, practicals or in discussion topics; keywords are used for the matching topics. Topics that have been greyed-out are unlikely to be relevant at this expedition location.

Table 3: Biology.

Topic	Biology	AQA		C	CCE A		C.Int		Ed/Sal		OCR		SQA		WJE C		A P	IB
		S	2		S	2	S	2	S	2	S	2	H	A	S	2		
	<b>Levels: S=AS 2=A2 H=Highers</b>											H	A					
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			♦					♦			♦	♦		♦	♦	
<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 4: Geography and Environmental Science.

Topic	Geography, APES and ESS	IB ESS	AP ES	AQA		CCEA		Edex		OCR		WJE C	
				S	2	S	2	S	2	S	2	S	2
	Levels: S=AS 2=A2			S	2	S	2	S	2	S	2	S	2
<b>Evolution,</b>	Evolution; Speciation; Species; Endemism; Gene pool; Allopatric; Sympatric; Isolation; Variation; Adaptive												

Classification and DNA	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															

## 10. Reading 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 but it is often difficult to find out exactly what is happening at each Opwall research site. To help in this, we have produced a 'Research' lookup database on the Opwall website – <http://opwall.com/epq-research-topic/> but you can also 'download' a more detailed version as an Excel Spreadsheet.

The database lets you find out what is happening at each site and there are links to pdf files and video clips. You can search the 'database' using a variety of filters such as research area and location.

Once you have decided on an area you need then to consult with your tutor and then at some stage (preferably months before you go) contact the Opwall country manager to see how appropriate your research question is for your expedition location.

The type of EPQ or EE 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.

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.

Demo version – <http://wallaceresourcelibrary.com>

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

### Books

Ghazoul, Jaboury and Douglas Sheil. *Tropical rain forest ecology, diversity and conservation*. Oxford: Oxford University Press, 2010.

Forsyth, Adrian and Ken Miyata. *Tropical nature: life and death in the rain forests of Central and South America*. Beaverton, OR: Touchstone Press, 1987.

Kricher, John. *The Neotropical companion*. Princeton, NJ: Princeton University Press, 1999.

Dawkins, Richard. *Galapagos: The Islands That Changed the World*. 2007

Barrett, Paul. *Law of the Jungle*. 2014



## **Guides for flora and fauna**

Alwyn Gentry (1995) Field Guide to Woody Plants of Northwest South America: Colombia, Ecuador, Peru. University of Chicago Press

Diego Tirira (2007) Mamíferos del Ecuador [In Spanish]

Robert Ridgley and Paul Greefield (2001) The Birds of Ecuador. Cornell University Press.

George C McGavin (2010) Insects. DK Handbooks.

David L. Pearson and Les Beletsky (2013) Ecuador and the Galapagos Islands (Travellers' Wildlife Guide)

David Horwell (2011) Galapagos Wildlife (Bradt Travel Guides)

Pierre Constant (2007) Marine Life of the Galapagos: The Diver's Guide to Fish, Whales, Dolphins and Marine Invertebrates

Paul Humann (2007) Reef Fish Identification: Galapagos

## **Electronic media**

Free Spanish lessons and material <http://www.bbc.co.uk/languages/spanish/>