
# African Great Rift Valley Schools' Booklet 2017

# Contents

# 1. Expedition Location and structure

This 2-week expedition takes place in and around the Great Lakes of the African Rift Valley in western Tanzania and Malawi. There are 3 distinct locations where the students will be based over the course of the expedition:

1. The village of Kasiba, adjacent to one of the crater lakes in Tanzania (5 days)
2. Nkhata Bay, on the shores of Lake Malawi, in Malawi (7 days including travel)
3. Liwonde Reserve in Malawi, in a safari campsite (1 day)

Students will fly into Dar Es Salam in Tanzania and then take a connecting flight to Mbeya, from where they will take a bus to the first site, Kasiba (4.5 hours approx.), where they will arrive in time to start their expedition on a Tuesday afternoon. After spending the next 5 days living and working in this rural community they will spend a day traveling to Nkhata Bay in Malawi. This requires a bus transfer to the border at Songwe (4 hours approx.), walking across the border into Malawi (a trip of some 100 meters), and then meeting with the bus which will be waiting to drive the groups down to Nkhata Bay (5 hours approx.). After a week at Nkhata Bay the group will move to the Liwonde safari camp (10 hours approx., by bus) where they will overnight, spend a full day on safari before travelling to Lilongwe in time to catch their international flights home on the Monday afternoon.


Figure 1. Map showing the location of the Crater Lakes, Nkhata Bay and the Liwonde National Park

# 2. Objectives

The objectives for the expedition can be separated into four areas: research, cultural exchange, skills training, and wildlife experience.

## 2a. Research

The Rift Valley lakes are outstanding areas of freshwater fish biodiversity and both Lake Tanganyika and Lake Malawi contain more fish species than any other lake in the world. Lake Malawi alone has, at a conservative estimate 850 species of fish, and this is the same level as the fish diversity found on even the most species rich reefs in the World in the Indo-Pacific. Genetic studies have shown that many of these fish species are more closely related to other fish found in the same lake than any other species, indicating that the speciation occurred in the lake. How has this happened, since speciation requires isolation in order for two populations to start differing from each other? These large lakes offer contiguous habitats, so how did sufficient isolation of populations occur to trigger this speciation event and why did this happen mainly in the African crater lakes?

These are the questions that are being addressed by a team of high impact publishing scientists based at Bangor University in the UK. The discovery of a series of small crater lakes just north of Lake Malawi, where the same fish speciation events, albeit on a much small scale, appear to have happened may provide clues to these research questions. The crater lakes differ in depth, nutrient loadings, size and competitor species to the cichlids and the research objectives for the field work at this site are:

- To map the detailed structure and water chemistry of each of the crater lakes
- To identify the fish community in each crater lake and bring back live samples of each of the cichlid populations for breeding experiments
- To describe the aquatic invertebrate community of each lake
- To develop an ecotourism plan to facilitate visits to the Crater Lake Region

The field data observations are a critical part of this study but there will also be follow on genetic sequencing of the samples and mate selection experiments back at Bangor University to determine whether the cichlids in the various crater lakes are true species and how much they have diverged from their parent species.

The second part of the expedition is based at Mayoko Village Beach Lodge at Nkhata Bay and there are two main research objectives for this part of the expedition:

- To compare cichlid species composition and abundance at a range of depths and habitat types around Nkhata Bay. Replicate 50m transects have been installed at 3m, 6m, 9m, 12m and 15m depths around the Bay in different habitat types. The survey teams will be completing Underwater Visual Census surveys of the cichlid diversity and abundance and these data are then being compared with similar studies completed at Kande Bay, approximately 20 miles south of Nkhata Bay.

- To compare the catch per unit effort of the fish landings in Nkhata Bay made by canoe based fishermen using deep water gill nets set overnight. This involves sampling catches of fish from canoes as they come into the beach to take their catch to market. These data are being used as a comparison with the catch per unit effort data using the same methods elsewhere on the lake.

## 2b. Cultural Exchange

In addition to the intrinsic benefits of working and living in Tanzania and Malawi for 2 weeks and meeting a large number of local staff throughout this time, the students will have a specific cultural exchange focus whilst they are in the village of Kasiba in Tanzania. Here they will be living in dormitories in the village secondary school, where most days there will be classes running. Part of the itinerary for the students will include spending time with one or more of the classes in the school, helping to organise environmental awareness workshops, participating in Swahili lessons, and helping the students with their English (which is taught widely at secondary school level in Tanzania).

## 2c. Skills training

Whilst in at Kasiba all students will be taught the various survey techniques needed in order to participate in the lake surveys. In addition to this, throughout the 2 weeks the students will attend a series of lectures constituting an African Rift Valley Ecology and Evolution course:

### African Rift Valley Ecology and Evolution course.

The first part of this course which is taught at the Crater Lakes site covers much of the A level, AP or IB syllabus on genetics and speciation but goes into more depth on mechanisms of speciation. The second part of the course gives an overview of the Rift Valley, fishery exploitation and the discoveries made about early hominids in this region and is taught at the Maru research centre. The final lecture in the course is given at the Liwonde National park and covers some of the management issues faced by large game reserves in East Africa.

The course will have the following lectures each of which will have associated exercises or discussions:

*Lecture 1: Adaptive Radiation* – the process by which species diversify rapidly when environmental opportunities arise (eg after a major extinction event). Examples of adaptive radiation including Darwin's finches on the Galapagos Islands, Anole lizards in the Caribbean and cichlids in Lake Malawi. How evolutionary adaptations can be measured over just a few years using the example from the Galapagos finches

*Lecture 2: How do species form?* – history of thinking on species from the 18$^{th}$ century ideas that species were immutable, through Cuvier's assertion in the early 19$^{th}$ century that species went extinct in major floods and new species then arose through to Darwin and Wallace's theories of how speciation were forming. Darwin thought that natural or sexual selection drives speciation with or without separation. In the 20$^{th}$ century the concept that geographical isolation was necessary for speciation. Genetic sequencing studies showed that the founder effect of small isolated populations had little role to play in speciation. Natural selection and how speciation occurs with or without geographical isolation. Possible mechanisms of ecological speciation – blocks genes on genomic islands, divergent mate preferences and role of sexual selection, developmental plasticity and epigenetics.

*Lecture 3: Species concepts and tests* – what is a species? Biological species concept definition is a group of organisms that can interbreed or potentially interbreed if geographically isolated. How are asexually reproducing species such as bacteria or protozoa classified as species. The problems of hybridisation, ring species, schrono species and other problems with the species concept. Linnean classification system based on morphological species concept. Genetic species concept and phylogenies. Discovery of cichlid species diversity in Lake Malawi and early concepts of how these species arose. Lake

Malawi is a complex ecosystem and difficult to study. Advantages of the much simpler crater lakes where speciation has occurred. Attempt to discover how genetic isolation between fish populations occurs.

*Lecture 4: Invasive species and hybridisation* – examples of invasive species. History and disastrous consequences of Nile perch introduction to Lake Victoria. Disastrous introduction of the cane toad into Australia to control the cane beetle. Tilapia introductions and the effects of hybridisation on loss of native Tilapia species.

*Lecture 5: Formation of the African Rift Valley and characteristics of the lakes* – the ongoing formation of the East African Rift system, which stretches thousands of kilometres across the African Continent from the Red Sea to the Indian Ocean, is a complex one and has been an area of debate amongst geologists for many decades. The first part of this lecture explores the different theories proposing how this region formed. There is description of the geography of the Rift Valley, followed by an introduction to plate tectonics and a discussion of the mechanisms contributing to the process of rift formation in East Africa. The second part of the lecture outlines the features of the many remarkable lakes of the Rift Valley, then provides a detailed account of the physical and human geography and ecology of Lake Malawi.

*Lecture 6: Fishery management of Lake Malawi* – fishing methods used across the lake. History of fishery management of the lake and current problems faced by the fishery. Collection of fish for the pet trade.

*Lecture 7: Human evolution in the Rift Valley* – the discovery of "Lucy", the partial skeleton of a 3.2 million year old australopithecine early hominid, by Donald Johanson in 1974 famously highlighted the importance of the Rift Valley region in the Evolution of Humans. This lecture explores the role that the Rift Valley has played in piecing together the story of how we evolved. It starts with a brief introduction to anthropology and builds upon concepts of classification introduced in lecture 3. The taxonomy of primates is outlined, and anatomy important to the understanding of human evolution is discussed. Significant early hominid discoveries are then presented, with a particular emphasis on those found in the Rift Valley. Finally, there is a discussion of recent theories of human evolution including ideas on how the environment in the region presented different selection pressures to our early ancestors.

*Lecture 8: Management of large game reserves* - the national park and game reserve system in East and South Africa. The main mammalian predators and herbivores and how they occupy different ecological niches. The 'Tragedy of the Commons': Why open-access resources need to be controlled. The benefits of fencing reserves and economic benefits from well run National Parks. Poaching in East Africa, bushmeat and firewood harvesting.

## Aquatic training at Lake Malawi

Whilst in Malawi, students will participate in one of three courses:

*PADI Open Water*; This is the default course in which the majority of students will participate. Those completing this course will end up with a PADI Open Water dive qualification which is the first qualification on the Professional Association of Dive Instructors (PADI) scheme for SCUBA diving. The course consists of theory work, gaining pre-diving skills in confined shallow water, which is done in the lake just off the private beach and then 4 dives to a maximum depth of 18m. The course will occupy the full time that the groups are on site. Those students arriving having completed the theory and confined water skills with a PADI Dive Instructor at home (known as a referral) will be able to complete the rest of the course in 2-3 days and then spend the rest of their time helping with the qualified diving team on the research projects.

*Please note, medical screening is necessary in order to determine whether a participant is medically suitable for SCUBA diving. For participants with certain medical conditions (such as asthma) this may include needing to visit a dive medic prior to coming out to site.*

*Cichlid identification and in-water survey techniques (including SCUBA);* Those who already have a recognised dive qualification will participate in this course. After an initial check dive this group will need to spend most of their first 2 – 3 days learning the 30+ species of cichlids likely to be encountered on the surveys. This involves classroom learning and twice daily dives to test out the survey methodology and to improve identification skills. At the end of this period there will be a test where the main surveyor records the diversity and abundance of the cichlid species along a transect and the students swimming with this surveyor independently record their own data from the same transect and the results are compared. Those students passing this test can then go on to help record data from other transects albeit with accompany dive staff. Those that don't reach the required level of skill or have joined the qualified diver team part way through the week having completed their Open Water dive training from a referral, will be able to provide support for the trained surveyors in the transect surveys. In addition there will be morning surveys of landings of deep water fish.

*Cichlid identification and in-water survey techniques (not including SCUBA);* This course is for those who do not wish to SCUBA dive or are not medically able to SCUBA dive. These students will complete the same training as for the qualified divers helping with the transect surveys, but the practicals will be done by snorkelling. Those that pass the test will then be able to complete the 3m transect surveys. In addition the group will help with the fish landings surveys.

## 2d. Wildlife experience

The time spent at Lake Kasiba and in Lake Malawi will be an excellent opportunity for students to learn about the fauna of these lake systems. Additionally, both areas have large numbers of bird species and some very interesting fauna (such as Baobab trees). No visit to the African Rift Valley is complete however without seeing some of the large game species that provide such a draw for tourists to east Africa. The time spent in Liwonde at the end of the trip will offer just this opportunity.

The Liwonde National Park has a total area of 538 $km^2$ and is approximately 50km by 15km at the widest point. This Park has not suffered such high levels of poaching as other Parks in Malawi. This is partly because around 5 years ago the Malawi government fenced the Liwonde National Park in the same way as practised in the very successful South African National Parks. Having open boundaries leads to constant conflict between the animals and local farmers and poaching of animals in other Malawi National Parks has been so high that animal densities are very low. In Liwonde National Park elephants for example have been sufficiently protected that their numbers have increased from 200 to over 1000 animals. The Park is now being managed by Africa Parks, a South African company and they are replacing the existing fence with a South Africa style fence that prevents elephants from crossing. The idea is to then move 200 of the elephants up to Nkhotakota NP because the grazing pressure is currently too high in Liwonde. The Park also has 1000 buffalo plus Sable, Kudu, Impala, Water Buck, Black Rhino and Leopards. Africa Parks plan to release lions, cheetah and zebra into the Park during 2017 once the fenceline has been upgraded throughout.

# 3. Itinerary and site facilities

The expeditions start at Kasiba in the Crater Lakes region at 16:00hrs on a Tuesday. You will need flights which arrive in Dar es Salaam on the Monday before your expedition starts and the group will overnight in Dar before taking a morning flight to Mbeya on the Tuesday and being transferred by bus to Kasiba. The expedition finishes at Lilongwe International Airport in Malawi on Monday at and the group can fly back to Dar arriving at around 1400hrs ready to catch international flights back home on the Monday after 18:00 hrs.

## 3a. Crater lakes

For the first 5 days the groups based at the Crater Lakes will be staying in a local school, in dormitories, a short walk from the beautiful Kasiba Lake. There are bunk beds, latrine toilets and jungle showers at this camp and the students will be immersed in a Tanzanian community.

After initial briefing the group will be split into four teams each of which rotate between the different activities:

*Bathymetric map and water quality team* – this team will be using small boats with a depth finder to produce a bathymetric map of the lakes. Positions will be fixed using a range finder and triangulation. At every metre across the lake a temperature, oxygen and conductivity metre will be used to gain data from each 2m depth. Secchi disc measurements will also be taken every 5m across the lake. In addition water samples from different depths will be taken and then filtered through plankton netting to determine the plankton communities at different depths.

*Fish community structure team.* The requirement to determine exact location for each species limits the fish capture techniques that could be deployed. The best method for sampling is likely to be using an ROV (remotely operated vehicle) or go-pro cameras at differing depths, possibly supplemented by angling.

*Benthic invertebrate fauna team.* Benthic invertebrate sampling around the edges of the lakes can be done using hand nets and grab sampling, as well as turning stones to see what invertebrates are underneath. Grab sampling can also potentially be done at a greater depth using a "grab" on a rope. with The samples captured will be sorted in trays with magnifying lenses into various Orders and stored for later identification at Bangor University.

*Ecotourism development and cultural team.* Students in Tanzania are taught to communicate and discuss ideas in English at the latter stages of secondary school. As part of a cultural exchange some time will be spent by each group working with some of the local students on an environmental awareness workshop where issues surrounding protecting the environment and using natural resources are discussed. There will also be the opportunity to participate in Swahili lessons to learn some of the local language. Another objective is to develop a 'Crater Lake trail' that would encourage tourists to use homestays in the villages and explore the region. However, for this to be written up, data need to be collected on what homestays would be available, what activities visitors could enjoy in each village (attractions, walking trails, birding spots etc). The ecotourism team would collect these data and prepare suggested walking trail information including bird, mammal and herpetofauna species likely to be seen.

## 3b. Nkhata Bay

At the end of these first 5 days the group will travel to the Songwe border crossing with Malawi and then be taken by bus to the Mayoko Village Beach Lodge in Nkhata Bay, Malawi. Accommodation here will be in shared dormitories set on the side of a hill leading into the Lake. There are shared bathrooms and shower blocks, and there is a dining room and rest areas overlooking the lake.

Students' itineraries will be dictated by the course that they are participating in (see section 2c), but each day will consist of one or two classes and in-water practical sessions, which will occur just off the shore at the Mayoko Lodge.

## 3c. Liwonde National Park

At the end of the time in Nkhata Bay the group will travel by bus down to the Liwonde National Park where they will be able to see many of the charismatic species that draw tourists to East Africa.

Accommodation will be in thatched dormitories in the Liwonde Safari Camp with separate toilet and shower blocks in the camp. The camp is currently unfenced although there are several guards who operate through the night to ensure the elephants and hippos don't come into camp.

The group will spend 2 nights and a full day in Liwonde and all students will complete a boat based safari and a vehicle safari with experienced local guides.

## 3d. Draft Itinerary

The following is an *example* itinerary to demonstrate how these various activities would fit together during the expedition.

| Day | Group 1 activity | Group 2 activity | Group 3 activity | Group 4 activity |
|---|---|---|---|---|
| Tuesday evening | Welcome to Kasiba camp briefing, health and safety briefing | | | |
| Wednesday | Bathymetric & water quality team | Fisheries team | Benthic survey team | Ecotourism and culture team |
| Wednesday evening | Lecture 1: African Rift Valley Ecology and Evolution course - Adaptive radiation | | | |
| Thursday | Ecotourism and culture team | Bathymetric & water quality team | Fisheries team | Benthic survey team |
| Thursday evening | Lecture 2: African Rift Valley Ecology and Evolution – Species formation | | | |
| Friday | Benthic survey team | Ecotourism and culture team | Bathymetric & water quality team | Fisheries team |
| Friday evening | Lecture 3: African Rift Valley Ecology and Evolution – Species concepts and tests | | | |
| Saturday | Fisheries team | Benthic survey team | Ecotourism and culture team | Bathymetric & water quality team |
| Saturday evening | Lecture 4: African Rift Valley Ecology and Evolution – Invasive species and hybridisation | | | |
| Sunday | Transfer to Maru Lake Research Centre, Malawi | | | |
| Sunday evening | Welcome to Maru Lake Research Centre camp, health & safety briefing and completion of PADI documentation | | | |

| | | | |
|---|---|---|---|
| Monday | PADI Open Water dive training course | Dive trained group helping on lake and fish landing surveys | Snorkel group helping with lake and fish landing surveys |
| Monday evening | Lecture 5: African Rift Valley Ecology and Evolution course - Formation of the African Rift Valley and characteristics of the lakes | | |
| Tuesday | PADI Open Water dive training course | Dive trained group helping on lake and fish landing surveys | Snorkel group helping with lake and fish landing surveys |
| Tuesday evening | Lecture 6: African Rift Valley Ecology and Evolution course - Fishery management of Lake Malawi | | |
| Wednesday | PADI Open Water dive training course | Dive trained group helping on lake and fish landing surveys | Snorkel group helping with lake and fish landing surveys |
| Wednesday evening | Lecture 7: African Rift Valley Ecology and Evolution course - Human evolution in the Rift Valley | | |
| Thursday | PADI Open Water dive training course | Dive trained group helping on lake and fish landing surveys | Snorkel group helping with lake and fish landing surveys |
| Friday | PADI Open Water dive training course | Dive trained group helping on lake and fish landing surveys | Snorkel group helping with lake and fish landing surveys |
| Friday evening | End of dive training and lake research party | | |
| Saturday | Travel to Liwonde National Park | | |
| Sunday | Big game viewing in Liwonde National Park | | |
| | Lecture 8: African Rift Valley Ecology and Evolution course - Management of large game parks | | |
| Monday | Breakfast and expedition finishes | | |

## 4. Academic Benefits

Apart from the most obvious values of going on an expedition such as contributing towards conservation, the physical challenge and adventurous travel, the experience can also benefit a student by increasing their chances of gaining entry to university or being successful in a job application and impressing at interview. This can be achieved in many different ways but it will often depend upon which country and educational system a learner is from. Common to most countries the experience will:

- Enhance their understanding of course syllabuses
- Allow learners to gain specific qualifications such as:
- Research Qualifications e.g. Extended Essays for IB and UK EPQs
- University Course Credits
- Creativity, Action and Service (CAS) for IB
- Universities Award from ASDAN

## 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 many education systems worldwide.

We are able to support the **dissertation essay style** research question; however individual scientific investigations (in which students design and collect their own data) are more difficult to facilitate given the short amount of time students are present on-site.

It is a great 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.

Much of the research they will be able to get involved with is specific to their expedition location. The projects that students will come into contact with range from students helping to collect data through to working and learning alongside the scientists where primary data collection by school students is less practical or more difficult.

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. We have now developed an application system to ensure that the student will be able to realistically undertake such a project, that their choice of topic is appropriate to their expedition site, the science staff 'on-site' are aware of the project and where practical can assist in a constructive way before, during and after their expedition.

For more information visit the Opwall website - http://opwall.com/sixth-form-high-school/independent-research-projects/

## Relevance of their expedition to the syllabus

Specific specifications for Biology, Geography and Environmental Studies have been reviewed for over 10 examination boards from around the world to see how relevant a student's expedition experiences will be when related to what they learn in their classroom. The tables in the appendix section show how this matching works although not all topics are relevant to all sites so have been grey-out.

# 5. Additional Reading

## Books

Terry Stevenson(Author), John Fanshawe(Author), Brian E Small(Illustrator), John Gale(Illustrator) July 2015 **Birds of East Africa** - ISBN-13: 9781408157367 £29.99

Charles Foley(Author), Lara Foley(Author), Alex Lobora(Author), Daniela De Luca(Author), Maurus Msuha(Author), Tim RB Davenport(Author), Sarah M Durant(Author) July 2014 **A field Guide to the larger Mammals of Tanzania** ISBN-13: 9780691161174 £13.97

David Hosking and Martin Withers 2007 **Collins Traveller's Guide - Wildlife of Kenya, Tanzania and Uganda** ISBN-13: 9780007248193 £15.99

Mary Fitzpatrick & Tim Bewer (2012) **Lonely Planet Travel Guide: Tanzania** 2012 ISBN-13: 9781741792829 £16.99

Andreas Spreinat (1995) **Lake Malawi Cichlids from Tanzania** ISBN: 3931328007 £12.99

George W Barlow (2002) **The Cichlid Fishes: Nature's Grand Experiment in Evolution** ISBN: 0738205281 £11.99

Jos Snoeks (2004) **The Cichlid Diversity of Lake Malawi/Nyasa/Niassa: Identification, Distribution and Taxonomy** ISBN: 0966825586

## Articles

Barley, S. (2009) Kenya's lions could vanish within 10 years. New Scientist Online available at http://www.newscientist.com/article/dn17648-kenyas-lions-could-vanish-within-10-years.html

Maslin, M (2013) How Climate Change and Plate Tectonics Shaped Human Evolution
A new study links the emergence of new hominid species, expanding brain capacity and early human migration with the appearance of deep freshwater lakes. The Conversation on November 14, 2013
https://theconversation.com/how-a-changing-landscape-and-climate-shaped-early-humans-19862

## Electronic media

BBC Last Chance to See, Episode 3: Northern White Rhino. Available online at http://www.bbc.co.uk/programmes/b00mvbbx
BBC Life of Mammals, Episode 4: Plant Eaters
BBC Life of Mammals, Episode 5: Meat Eaters
BBC Planet Earth, Episode 7: Great Plains
The Secret Life of Elephants. BBC Video. Available from NHBS - www.nhbs.com/

# Appendix

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

## Table 1: Biology

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

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)

## Table 2: Geography and Environmental Science

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

Table: 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)