South Africa Schools' Booklet 2017

Dinokeng & Sodwana

Contents

1. Project Overview and Research Objectives

Research Sites

South Africa is the best place in the world if you want to learn about how to make wildlife conservation work financially. Income from game management and ecotourism revenue has meant that there is an ever expanding network of game reserves that also benefit much other wildlife besides the game species. For the 2017 season there is the choice of options for school groups. For the terrestrial component, our school groups can visit Balule Game Reserve, Dinokeng Game Reserve or Gondwana Game Reserve. This booklet will focus on the expedition involving a week in a low veld reserve – **Dinokeng** - followed by a week diving at **Sodwana.** Note there are other sites on the map of research sites in South Africa (Figure 1) where other school groups or university students are helping with related studies in other reserves.

Figure 1. Location of the terrestrial research sites – Balule Game Reserve, Dinokeng Game Reserve and Gondwana Game Reserve - and the marine camp - Sodwana Bay.

Terrestrial Research Aims

One interesting point is the contrasting financial models used for these three Big 5 reserves. **Dinokeng Reserve** is an example of where a local government sees an opportunity to develop an income stream for local communities whilst creating a wildlife corridor and existing property owners gain a benefit from the development. **Balule Reserve** is an example of where private landowners adjacent to existing successful National Parks see more income to be made from converting their land to a wildlife reserve and getting the fence between them and the National Park removed to their outer boundaries. **Gondwana Reserve** is an example of where adjacent cattle and game ranchers put together a potential reserve, fenced it and introduced game. Funding comes from setting aside 2 X 50ha areas where individuals can buy a 1ha plot, build a house/lodge for their own use and have traversing rights across the whole reserve.
Given all this investment in wildlife management in enclosed reserves in South Africa, a whole series of management practices have grown up on which decisions are made. Some of these approaches seem to be making assumptions that are not borne out in practice. Examples include:

- Fynbos vegetation has zero carrying capacity for herbivores.
- Setting stocking rates for herbivores based on look up tables linked to rainfall levels or using a computer programme to calculate amount of foliage based on standard tree shapes, gives accurate stocking levels. In practice developing techniques to actually measure the amount of foliage available for browsers for individual reserves may give more accurate data.
- Elephants damage vegetation and massively reduce the availability of forage for other species so should be stocked at no more than 0.35 animals per km^2. In practice they may keep the savannah from converting to woodland where most of the forage is then out of reach of the other herbivores and by knocking over trees make additional forage available to those species only feeding below 2m height.
- Direct counts by helicopter are necessary to get accurate counts of game numbers, whereas DISTANCE based transect surveys provide a much more cost effective method and also allow species that cannot be counted from the air, such as Nyala, to also be estimated.

The overall objective of the Opwall surveys in South Africa, which are run in conjunction with WEI, is to develop a manual of best practices for wildlife conservation reserve managers based on the latest scientific data and the results of some of these research projects across the high veld, low veld and fynbos vegetation communities.

2. Itinerary

One week in Dinokeng Reserve followed by a week dive training or diving if already qualified at Sodwana Bay. This expedition will start in the Balule reserve, near Hoedspruit and finish in Sodwana Bay. International flights will need to be arranged into Johannesburg airport by Friday at 0800hrs and out of Johannesburg airport on Friday after 2000hrs. Internal travel will be costed by the Opwall travel section once the flights have been arranged to ensure transfers to Balule from the airport at the start of the expedition and back from Sodwana Bay to Johannesburg airport at the end of the expedition.

On this option the students will complete an African Wildlife Management course in the first week. In the second week there are different options depending on your dive experience. If the students are already dive trained or only wish to snorkel during this week, then they will be completing an Indian Ocean reef ecology course.

Research objectives, activities and schedule at Dinokeng Reserve

The Dinokeng Reserve is an 18,500 ha reserve in the high veld just north of Pretoria that provides a unique approach to wildlife conservation, which if successful, may offer a way in which wildlife corridors can be established and funded in Africa across landscapes with multiple previous uses. Much of the wealth of South Africa is concentrated around Johannesburg and Pretoria, yet just 50km north lies a large impoverished local community. In the early part of the century, the government of Gauteng province provided economic development support to these communities, by the creation of a large wildlife reserve to hold the big 5 (lion, leopard, elephant, buffalo and rhino) across what had been a landscape of game farms, traditional farms and small holdings. The government funded the fencing of the whole area and fenced around each of the buildings within the newly created reserve areas. The whole area was then stocked with game species and the owners of the land given traversing rights across the reserve. Thus instead of having large areas with animals fenced in, it is those living in the area of the reserve that are fenced out! This initiative been very successful and has allowed the creation of a number of tourism related businesses by the previous landowners and employment for local community members. Indeed so successful has it been that the area of the reserve is continuing to expand as additional landowners opt to join in the scheme. This approach may provide a model for how wildlife corridors linking existing conservation areas can be created and funded, so is a crucial project to study. WEI and Operation Wallacea have been appointed to provide data on a range of research outputs to provide data to answer the following questions:

1. How are elephant impacting the vegetation?
2. Is the stocking density of the various herbivores correct for the browsing available?
3. What are the recruitment levels and condition factors for each of the large game species?
4. How do species such as elephant, lion, cheetah and white rhino utilise the habitats available?
5. Using camera trapping in conjunction with Panthera, how are the populations of leopard, caracal, brown hyena and other nocturnal species being affected by the reserve?
6. How are the bird communities changing?
7. What species of herpetofauna are found in the reserve?

The students will complete two days of bush skills training and four days helping with biodiversity research and after that will be working on the surveys needed to answer the research questions. To answer research question 1 a network of 40 X 1ha permanently marked plots selected randomly from within 3 bands of distance from water sources have been selected and the students will be involved in completing assessments on the Walker scale of the level of damage caused by elephants to each bush or tree within that plot.

To answer question 2 data need to be collected on available forage for browsers. Carrying capacity of an area for browsers is normally assessed from look up tables related to rainfall levels or from measurement of trees and using the BEVCOL programme to estimate the volume of forage from the tree and shrub dimensions input. Both of these methods make significant and often difficult to justify assumptions. So it is proposed to measure the quantity of forage available within the reserve in a height of up to 2m, during July when leaf biomass should be approaching its' lowest level. In other words if there is sufficient forage available at this time of year then the carrying capacity for browsers will not have been reached and indeed there may be spare capacity for introduction of additional browsers. A 20m x 20m square will be positioned adjacent to the vegetation plots on the north, south, east or west sides (the side will be chosen randomly). The volunteers on the project will then remove all the leaves and petioles from within the first 2m height in these 20m x 20m squares. Where it is considered the thickness of the bushes is so great that the inner

leaves could not be browsed by the various species these will be left. The leaves collected will be separated into two bags (i.e. those below 1m and those collected from 1 – 2m). In addition there are some tree species that are only consumed by particular species, so these will be collected separately. Likewise there are some tree and shrub species that are unpalatable to all browsers, so these will not be collected. The total weight of leaves and petioles in each of the categories will then be weighed and dried so that the calorific value can be measured at a later date. The daily calorific value and weight of forage required to maintain condition and the height of browsing is known for each of the browsing species so these data can then be used in combination with the forage weight and calorific value available in the winter months to estimate the carrying capacity of browsers.

To answer questions 3 & 4 vehicle based large mammal transects will be used to cover the network of trails within the reserve. The GPS location of the vehicle for each large mammal sighting will be noted, the distance to the animal using a range finder and the species, age (adult, juvenile) and condition recorded. Bird species noted along the transect will also be recorded. In addition, radio collars have been fitted to a number of the elephants, rhinos, lion, cheetah and buffalo in the reserve. The position of as many of these animals as possible needs to be recorded on a daily basis where possible using radio telemetry. The GPS location of each animal then needs to be identified.

To answer question 5 a network of 80 camera traps will have been positioned prior to the start of the season to monitor for Leopard, Caracal and other nocturnal species such as Brown Hyena, using a network of camera traps at a series of sites around South Africa. The cameras need the data downloading and the batteries changing each week. These data will be analysed to give numbers of sightings per trap hour of the target species and in subsequent years to monitor whether the populations are increasing or decreasing.

To answer questions 6 & 7, the students will be walking 1km transects designed to cover as much of the reserve as possible. The start position would be identified from a GPS location and the direction of travel from a bearing. Along each transect the surveyor will record all bird species seen or heard. At the end of the transect the team would turn round and retrace their steps but actively searching for herpetofauna species.

The volunteers will be divided up into groups of a maximum of nine and each will spend half of each day in the large fenced area of the camps having briefings and lectures. The other half of each day will be spent in the bush in vehicles or on foot in groups of nine with an armed guard and a FGASA qualified guide for each group. Thus some of the students will spend the morning in camp with briefings and lectures followed by the afternoon in the bush, whilst the rest will spend the morning in the bush and the afternoon on briefings and lectures, alternating each day.

Accommodation will be in shared rooms or large tents in a fenced compound. There will be hot showers and toilets on site and electrical power at all times. Note the group will spend half their time in the field and half the time back at their base completing the Africa Wildlife Management course and analysing camera trap images.

Table 1. Indicative timetable for the week at Dinokeng Reserve. Note there may be changes depending on fitness of students, group sizes and numbers, weather conditions or operational problems.

Day	Group 1	Group 2
Fri eve	Introduction to camp and safety rules	Introduction to camp and safety rules
Sat am	Lecture 1 – An introduction to Africa's Biodiversity Workshop 1 – Effects of fire on biodiversity	Vehicle based field visit with briefings about species encountered and safety when encountering these animals
Sat pm	Vehicle based field visit with briefings about species encountered and safety when encountering these animals	Lecture 1 – An introduction to Africa's Biodiversity Workshop 1 – Effects of fire on biodiversity
Sat eve	Lecture on small and potentially dangerous species – spiders snakes and scorpions	Lecture on small and potentially dangerous species – spiders snakes and scorpions
Sun am	First field trek with armed guard to learn about safety issues and approaching game species. Change cards and batteries in camera traps	Lecture 2 – South African Birds Workshop 2 – Bird identification and practical survey skills
Sun pm	Lecture 2 – South African Birds Workshop 2 – Bird identification and practical survey skills	First field trek with armed guard to learn about safety issues and approaching game species. Change cards and batteries in camera traps
Sun eve	Analysis of camera trap images	Analysis of camera trap images
Mon am	Walking transect for birds and herpetofauna and change cards and batteries in camera traps	Lecture 3 – The herbivores of South Africa Workshop 3 – Calculating density estimates and carrying capacities
Mon pm	Lecture 3 – The herbivores of South Africa Workshop 3 – Calculating density estimates and carrying capacities	Large mammal surveys by vehicle
Mon eve	Analysis of camera trap images	Analysis of camera trap images
Tue am	Lecture 4 – The predators of South Africa Workshop 4 – Problems with managing closed populations	Walking transect for birds and herpetofauna and change cards and batteries in camera traps
Tue pm	Large mammal surveys by vehicle	Lecture 4 – The predators of South Africa Workshop 4 – Problems with managing closed populations
Tue eve	Analysis of camera trap images	Analysis of camera trap images
Wed am	Measuring vegetation impact of elephants	Lecture 5 – The elephant Workshop 5 – Reducing human-animal conflict
Wed pm	Lecture 5 – The elephant Workshop 5 – Reducing human-animal conflict	Assessing herbivore carrying capacity
Wed eve	Analysis of camera trap images	Analysis of camera trap images
Thur am	Lecture 6 – African conservation and wildlife management Workshop 6 – Consumptive vs non-consumptive reserve management	Measuring vegetation impact of elephants
Thur pm	Assessing herbivore carrying capacity	Lecture 6 – African conservation and wildlife management Workshop 6 – Consumptive vs non-consumptive reserve management
Thur eve	Analysis of camera trap images	Analysis of camera trap images
Friday	Transfer to Sodwana Bay or Gondwana	Transfer to Sodwana Bay or Gondwana

African Wildlife Management Course

During the time in camp during the first week, the students will be completing an African Wildlife Management Course that will have direct relevance to the research they are helping with in the field. Each sessions starts with a 40 – 45 minute lecture and the rest of the time is then spent on a workshop aimed at reinforcing elements of the lectures and applying the knowledge to practical South African examples.

Lecture 1: An introduction to Africa's biodiversity
This lecture will outline the term 'biodiversity' and what this can mean in different situations to different groups of people. Students will also learn about the biodiversity of Africa and how humans, latitude and other gradients affect biodiversity.

Workshop 1: Effects of fire on biodiversity
Different fire regime case studies will be presented to the students which they will discuss and compare best method. The practical activity will be an exercise where students are given example vegetation data from savannah plots and asked to determine for each data set, which herbivores would be utilising the grazing/browsing, the fire loads and whether or not burning would be beneficial.

Keywords
- Biodiversity
- Biogeography
- Fire
- Succession

Lecture 2: South African birds: how we name, identify and survey their numbers and distribution
This lecture briefly looks at the importance of taxonomy and its role in conservation. It then looks in more detail at the identification of local birds and how survey work is carried out.

Workshop 2: Students will learn 10 of the commonest bird calls likely to be encountered on the surveys. In addition they will be taught how to use a GPS to plot routes and range finders to estimate distances will be demonstrated and the students will have to complete a test course using only GPS and estimating distances of target objects.

Keywords
- Classification; Taxonomy; Binomial system; Dichotomous Keys
- Identification

Lecture 3: Adaptation: the herbivores of South Africa
This lecture will give an overview of Africa's main ecosystems and how herbivores are adapted for survival. There will also be a brief description of Kruger National Park and its importance in conservation. The lecture will concentrate on the mammalian herbivores and their ecology, behaviour and identification.

Workshop 3: The requirements in terms of browse or grazing amounts, minimum herd sizes and distance from water that each of the species routinely feeds will be discussed for each of the main ruminant (buffalo, impala, kudu, wildebeest, nyala, giraffe and other antelope species) and non-ruminant (zebra, elephant, rhino, hippo, bush pig, warthog) herbivore species. Students will be given stock density data and asked to estimate what percentage of the browse and grazing capacity was being utilised and what mix of additional browsers and grazers could be added to the reserve.

Keywords

- Ecology; Habitat; Niche; Abiotic; Biotic
- Biome; Ecosystems;
- Adaptation
- Populations; Competition; Interspecific; Intraspecific; Predator Prey; density dependent; independent.
- Behaviour / nutrition

Lecture 4: Adaption: the predators of South Africa.
This lecture will look at the role of the main predators and how they are adapted for survival. In particular the ecology of lions, cheetah and leopards will be looked at in detail.

Workshop 4: A film on hunting techniques in a savannah environment will be shown. Why reserves are fenced in South Africa and the problems associated with managing closed populations. Determining how many and what types of predators (lion, cheetah, hyena, leopard etc) should be introduced to control the growth of populations.

Keywords

- Ecology; Habitat; Niche; Abiotic; Biotic
- Biome; Ecosystems;
- Adaptation
- Populations; Competition; Interspecific; Intraspecific; Predator Prey; density dependent; independent.
- Behaviour

Lecture 5: Africa's iconic animal: the Elephant
This lecture looks at the ecology and behaviour of the world's largest land mammal. It also considers the role of this iconic animal in tourism and other problems such as the ivory trade and control of elephant populations.

Workshop 5: How do we define a damage causing animal and who should take responsibility? A hypothetical example will be given of a human wildlife conflict situation and the students will be asked how to best reduce the impacts.

Keywords

- Conservation, Sustainability
- Tourism, trophy hunting, population control, poaching, CITES
- Damage-causing; compensation
- Behaviour

Lecture 6: African conservation and wildlife management
This lecture compares and contrasts between the consumptive use of game and non-consumptive use of game on game reserves through ecotourism. This lecture will include case studies on the sustainability of hunting and intensive breeding industries.

Workshop 6: A film discussing intensive breeding and hunting (legal) in conservation will be shown. Students will be asked to justify the role of private land owners in the conservation of rare (sable and roan)

and endangered (lion, cheetah, wild dog and rhino) large mammals in South Africa in the context of consumptive and non-consumptive ecotourism.

Keywords

- Ecotourism
- Hunting
- Game breeding
- Conservation

Dive training course at Sodwana Bay

For those students going to Sodwana Bay for their second week, there are three options available; doing a PADI Open Water Dive training course, an Indian Ocean Reef Ecology Course (with the practicals done either by diving or snorkelling – see section 8) or if the students arrive with the theory and pool training elements of the Open Water course already completed (Referrals) then they will spend the first part of the week completing the open water dives and the second part of the week on the Reef Ecology Course.

The PADI Open Water course consists of three different elements of learning; dive theory (knowledge development), confined water dives and open water dives. Each component plays its own role in the students' development to meet the performance requirements and objectives they need to become a qualified diver. Please be aware that as a part of the PADI Open Water Course, all students will be required to complete some basic stamina tests on site. Student divers will need to demonstrate that they can comfortably maintain themselves in water too deep in which to stand by completing a 10-minute swim/float without using any swimming aids. Students will also have students complete a 200m continuous surface swim or a 300 m swim with mask, fins and snorkel.

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

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

Indian Ocean Reef Ecology Course

Table 5 shows an example timetable of the activities that students undertaking the **Indian Ocean Coral Reef Ecology Course** will complete over the week – please note that timetables and activities are liable to change. The practical element of the reef ecology course can be completed by either diving or snorkelling and it has been designed in order to complement the content of the lectures. If students are already qualified divers by the time they arrive on site, they will be required to complete a compulsory check dive with a PADI professional at the start of the course. The Indian Ocean Coral Reef Ecology course covers a range of topics suitable to support A-Level 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 final afternoon at the end of their stay, they will do a small presentation of their findings to the group in as an imaginative way as possible!

Table 2. An indicative timetable for students completing the Indian Ocean Coral Reef Ecology Course. Note that there will be changes to the 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.

Day	Lectures	In-water activities	Land-based activities
Saturday	• The Blue Planet	• Check-out	• Quadrat building
Sunday	• An Introduction to Coral Reefs • Conservation of Coral Reefs	• PADI coral watch • Algae ID	• Turtle talk on the beach • Video analysis
Monday	• The Diversity of Coral Reefs I	• Benthic survey	• Dune walk
Tuesday	• The Diversity of Coral Reefs II	• Invert ID	• Rock pooling
Wednesday	• The Diversity of Coral Reefs III • Mangroves and Seagrass	• Rapid Reef Assessment • Coral ID	• Shark conservation centre • Local fisher talks
Thursday	• The Future of Coral Reefs • Marine Megafauna	• Fish ID	• Assessing a reef on land

Lecture 1: The Blue Planet

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

Lecture 2: An Introduction to Coral Reefs

- Coral biology; growth, development, feeding and reproduction
- Importance of the symbiotic relationship between corals and zooxanthellae
- What are coral reefs and where are they found?
- Introduction to the Indian Ocean

Lecture 3: Conservation of Coral Reefs

- The value of coral reefs
- An introduction to macroalgae
- Competition between macroalgae and hard coral; phase-shifts

- Local threats to coral reefs that stimulate phase-shifts; i. Destructive fishing, ii. Coral mining, iii. Overfishing, iv. Water pollution, v. Coastal development, vi. Disease

Lecture 4: The Diversity of Coral Reefs I
- An introduction to taxonomy
- Classifying a green alga
- Classifying a sea cucumber
- Classifying a parrotfish

Lecture 5: The Diversity of Coral Reefs II
- Coral reef food webs
- Fish herbivory
- Invertebrate herbivory
- Filter feeding
- Predation

Lecture 6: The Diversity of Coral Reefs III
- An introduction to behaviour
- Parasitism
- Commensalism
- Symbiosis
- Camouflage
- Fish sensory systems

Lecture 7: Mangroves and Seagrass
- Mangrove adaptations
- Seagrass adaptations
- Ecosystem services and functions
- Importance of habitat connectivity
- Threats to mangroves and seagrasses

Lecture 8: The Future of Coral Reefs
- Rising sea surface temperature
- Ocean acidification
- The structure of a reef in 2100
- Conservation management

Lecture 9: Marine Megafauna
- Marine mammals – whales and dolphins
- Eco-tourism
- Elasmobranchs – sharks and rays
- Shark finning

3. 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.

Additional Reading

Allsopp N , Jonathan F Colville , G Anthony Verboom , **Fynbos (2016): Ecology, Evolution, and Conservation of a Megadiverse Region**, Oxford University Press ISBN-13: 9780198777762

Apps P, (2012) **Smither's Mammals Southern Africa** Random House Struick ISBN-13: 9781770079137

Branch, B. (1998) **Field Guide to Snakes and other Reptiles in Southern Africa**. Struik Publishers, Capetown.www.struik.co.za. ISBN 1 86872 040 3

Briggs P, Lizzie Williams (2009) **The AA Guide to South Africa** AA Publishing. *Excellent summary at the start of history and politics*. **ISBN-10:** 0749562366

Carruthers, V. (2008) **The Wildlife of Southern Africa - a field guide to the animals and plants of the region.** Struik Publishers - ISBN-13: 9781770077041

Cillie B, (2009) **The Mammal guide of Southern Africa** Briza Publications ISBN: 1875093451

Esler KJ, Shirley M Pierce , Charl de Villiers (2015) **Fynbos: Ecology and Management** Briza Publications ISBN-13: 9781920217372

King D, Valda Frase (2014) **The Reef Guide: East and South Coasts of Southern** Africa Random House Struick ISBN-13: 9781775840183

Manning J, Colin Paterson-Jones (2008) **Field Guide to Fynbos**, SASOL First Field Guides ISBN-13: 9781770072657

Marais, J (2004) **A complete Guide to the snakes of Southern Africa** New Holland Publishers ISBN: 186872932X

Newmann KB, Faansie Peacock, Vanessa Newman Ralph Boettger (2010) **Newman's Birds of Southern Africa** Random House Struick ISBN-13: 9781770078765

Palgrave K, Meg Palgrave (2001) **Everyone's Guide to Trees of South Africa** Random House Struick ISBN: 1868724891

Paterson-Jones C, John Manning (2007) **Ecoguide: Fynbos** Briza Publications ISBN-13: 9781875093663

RoveroF , Fridolin Zimmermann (2016) **Camera Trapping for Wildlife Research**
Pelagic Publishing ISBN-13: 9781784270483

Sinclair, I, Phil AR Hocke, Warwick Tarboton , Peter G Ryan , Norman Arlott , Peter Hayman (2011) **SASOL Birds of Southern Africa** Random House Struick ISBN-13: 9781770079274

Van Wyck, B, Van Wyck, P & Van Wyck, B. E (2000) Photographic Guide to Trees of Southern Africa. Briza Publications, Pretoria.

Walker, C. (1996) **Signs of the Wild - a field guide to the spoor and signs of the mammals of southern Africa.** Struik Publishers, Capetown.www.struik.co.za. ISBN 1 86825 896 3.

Whyte, I. & Chittenden, H. (2008) **Roberts Bird Guide: Kruger National Park and Adjacent Lowveld: A** Guide to More than 420 Birds in the Region. Jacana Media. SBN-13: 9781770096387

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/
BBC's Africa Documentary

Table 3: Curriculum links

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

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

Topic	Geography, APES and ESS	IB ESS	APES	AQA		CCEA		Edex		OCR		WJEC	
				Geography									
	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; WoodlandBush; 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 warmingCarbon 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												