Unit 19: Understand Ecological Concepts and Application

Unit code: A/600/9180

QCF Level 3: BTEC National

Credit value: 10

Guided learning hours: 60

Aim and purpose

This unit aims to introduce learners to the skills and knowledge needed for ecological concepts and application, and how these can be applied in practice. It is designed for learners in centre-based settings looking to progress into the sector or onto further/higher education.

The learner will investigate the theoretical concepts of ecology, and consider the practical applications of these concepts in the field. They will plan and carry out ecological surveys of plants and animals and develop their understanding of the behaviour and relationships these reveal.

Unit introduction

It is important that people who are in a position to influence the management of the countryside have a sound knowledge of the scientific concepts underpinning their management strategies. This unit will enable learners to gain an understanding of the biology affecting species and their evolution, and a thorough knowledge of how to carry out surveys and interpret the results.

Learners will have the opportunity to explore the concept of life history strategies for a variety of organisms and the associated behaviours. This will give learners a deeper understanding of how species interact, which is necessary when applying effective conservation techniques.

Learners will also study population dynamics in more detail and the factors that affect species populations. The concept of island biogeography is central to understanding population dynamics at this level and will enable learners to relate habitat changes to population changes, and further understand how populations are influenced by human impact on the landscape.

Learners will also gain practical skills in planning and carrying out surveys of both plant and animal species, which are essential for those working within the countryside and environmental sector.

Learning outcomes

On completion of this unit a learner should:

1 Understand the principles of behavioural ecology for life history strategies

2 Understand the principles of population dynamics at the levels of island biogeography and metapopulations

3 Be able to plan and carry out ecological surveys for plants

4 Be able to plan and carry out ecological surveys for animals.

Unit content

1 Understand the principles of behavioural ecology for life history strategies

Aspects of behaviour: parental investment in offspring; territoriality and resource defence; monogamous/polygamous/polyandrous mating systems (mate guarding, cooperative breeding and social behaviour, optimal foraging); underpinning evolutionary theory; applications; effective foraging ability; predator/prey relationships

Relationships: parental investment per offspring eg numerous/fewer, small/large, energetically 'cheap'/well provisioned; r K concepts; parent- offspring conflict

2 Understand the principles of population dynamics at the levels of island biogeography and metapopulations

Population dynamics: island biogeography; the ecology of metapopulations, metapopulation cycle (colonisation, establishment, local extinction, recolonisation) eg butterfly populations, pond-dependent species; sources and sinks; habitat fragmentation; biotic and abiotic requirements; influence of human activities eg agriculture, industry, deforestation; influence of natural events eg floods, storms, geological processes

3 Be able to plan and carry out ecological surveys for plants

Surveying: planning (methods, resources, timescales, survey objectives); selection of appropriate techniques for target species; National Vegetation Classification (NVC) to include detailed investigation of NVC communities eg woodlands, grasslands, heathlands, moorlands, coastal communities; transect methods; quadrat methods; species identification (using guides and keys); sources of error (in surveying, species identification, calculations, results analysis); health and safety

4 Be able to plan and carry out ecological surveys for animals

Surveying: planning (methods, resources, timescales, survey objectives); selection of appropriate techniques for target species eg pit fall traps, kick nets; transect methods; quadrat methods; species identification (using guides and keys); sources of error (in surveying, species identification, calculations, results analysis); health and safety

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 explain aspects of behaviour that influence reproductive success [IE]	**M1** compare factors affecting reproductive success in different species	**D1** discuss factors which influence the survival of a species
P2 evaluate relationships between parental investment and breeding systems [IE]		
P3 explain the metapopulation cycle with reference to selected examples [IE]	**M2** discuss the biotic and abiotic factors that influence metapopulations	
P4 assess how habitat fragmentation might lead to local extinction		
P5 plan surveying of a given NVC community [IE, EP]	**M3** explain how results are derived from an NVC survey	**D2** evaluate an ecological survey methodology and analyse the data collected.
P6 carry out surveying of a given NVC community [TW, SM]		
P7 state the potential sources of error		
P8 plan surveying of a given animal or animal species group [IE, EP]	**M4** explain the purposes of an ecological survey.	
P9 carry out surveying of a given animal or animal species group [TW, SM]		
P10 state the potential sources of error.		

PLTS: This summary references where applicable in the pass criteria, in the square brackets, the elements of the personal, learning and thinking skills. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

Delivery of this unit will involve practical assessments, written assessment, visits to suitable collections and will link to work experience placements.

Tutors delivering this unit have opportunities to use as wide a range of techniques as possible. Lectures, discussions, seminar presentations, site visits, supervised landscape practicals, internet and/or library-based research and the use of personal and/or industrial experience would all be suitable.

Work placements should be monitored regularly in order to ensure the quality of the learning experience. It would be beneficial if learners and supervisors were made aware of the requirements of this unit before any work-related activities are undertaken so that naturally occurring evidence can be collected at the time. For example, learners may have the opportunity to carry out botanical and animal surveys and they should ask for observation records and/or witness statements to be provided as evidence of this. Guidance on the use of observation records and witness statements is provided on the Edexcel website.

Whichever delivery methods are used, it is essential that tutors stress the importance of ecological and animal welfare, sound environmental management and the need to manage the resource using legal methods.

Health and safety issues must be stressed and reinforced regularly and risk assessments must be undertaken before any practical activities.

Evolutionary theory underpins behavioural ecology and learners should ensure they make this link. Wherever possible, the examples used to illustrate concepts should relate to the conservation status of the organism in its particular habitat. There is often a close relationship between life history strategies and how common or rare a species is. This can be related to the conservation problems of particular species, and links to the practical applications of behavioural ecology.

While the concepts of island biogeography and metapopulation are theoretical, they can be related directly to numerous realistic problems in species conservation, highlighting the issues of habitat fragmentation, connectivity within landscapes and the size of nature reserves. Given suitable landscapes, it should be possible to illustrate this, at least in part, by landscape-based practical exercises. These should be based on basic information on species habitats and dispersal capacity. The practical application of this material can be explored further by considering the role of human development in habitat fragmentation.

The planning of surveys will need to be introduced in the classroom but there should be opportunities for practical work, for example learners practising species identification and survey techniques in the field before the main survey. While botanical surveys will only be feasible in the summer and early autumn terms, the survey of some animal groups can be carried out in winter and spring. Exposure to species in the field is essential for learners.

A crucial element of ecological survey is species identification but, given the sheer numbers of species that may be encountered even just in the UK, it is not practicable to cover all taxonomic groups in detail. A more workable approach would be to develop learners' skills in identification techniques, rather than bulk learning of individual species, and to encourage them to develop specialisms in taxonomic groups that are small enough to be manageable.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives an indication of the volume of learning it would take the average learner to achieve the learning outcomes. It is indicative and is one way of achieving the credit value.

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Introduction and overview of the unit.
Assignment 1: Reproduction and Breeding (P1, P2, M1) Introduction to the assignment brief.
Classroom activity: different reproductive behaviours and strategies.
Links between parental investment and breeding systems for a range of different species, factors affecting reproductive success.
Research: reproductive strategies in different species.
Production of report or presentation.
Evaluation and assessment.
Assignment 2: Population and Extinction (P3, P4, M2, D1) Introduction to the assignment.
Classroom activity: metapopulation cycle using examples, biotic and abiotic factors.
Habitat fragmentation: its causes, examples in practice.
Research: factors influencing species survival.
Production of report or presentation.
Evaluation and assessment.
Assignment 3: Surveying Plants Using NVC (P5, P6, P7, M3) Introduction to the assignment brief.
Classroom activity: including classification keys and NVC guides.
Practise using survey techniques.
Production of survey plan(s): aspects to consider, setting survey objectives, planning equipment, planning survey methods.
Carry out surveys, collate results and use NVC to classify.
Evaluation and assessment.
Assignment 4: Surveying Animals (P8, P9, P10, M4, D2) Introduction to the assignment brief.
Theory: types of survey for different animal species, terrestrial and aquatic.
Field survey of animals.
Collation of results.
Statistical analysis of data.
Preparation of report or presentation.
Evaluation and assessment.

Assessment

For P1, learners must explain aspects of behaviour that impact on reproductive success. Learners should demonstrate their knowledge of the relationship between behaviour and reproductive success. This will include primary reproductive behaviour, but can also include aspects such as effective foraging ability and territorial defence. Evidence could take the form of a pictorial presentation with notes, an annotated poster or a written assignment.

For P2, learners must evaluate the relationships between parental investment and breeding systems. Learners should refer to the basic r and K concepts of parental investment per offspring, for example numerous, small, energetically 'cheap' offspring as opposed to fewer, larger, well-provisioned offspring. This should also be related to the variations in mating systems and differing parental investment between males and females. Evidence could be similar to that suggested for P1.

For P3, learners must explain the metapopulation cycle with reference to selected examples. Tutors should identify the examples or agree them through discussion with learners. Learners should describe the basic process of colonisation, establishment, local extinction and recolonisation in the metapopulation cycle. This concept is best approached through case studies or examples, such as butterfly populations or species dependent on ponds where the 'patchy' nature of the correct habitat can be illustrated easily.

For P4, learners must assess how habitat fragmentation might lead to local extinction. They should extend the metapopulation idea, explaining how human activities can cause the isolation of small groups of a species, which then fail because of a lack of recolonisation sources. Evidence could be similar to that suggested for P1.

For P5, P6, P7, learners must plan and carry out a survey of a given NVC community and state the potential sources of error. They should be able to survey a defined NVC community and present the results. This could use whatever plant communities are locally relevant and take the form of a practical group exercise, using transect or quadrat methods, and tabulating the results collected by the group in a written report.

For P8, P9, P10, learners must plan and carry out a survey of a given animal or animal species group and state the potential sources of error. This may be simple presence or absence, or a more detailed mark-recapture exercise. Evidence could be the same as suggested for P5, P6 and P7.

For M1, learners are required to compare factors affecting reproductive success in different species, which is likely to be an extension of P1 and P2. Learners need to show their understanding of the relative success of different reproductive strategies for different species. Assessment could be similar to that suggested for P1.

For M2, learners must discuss the biotic and abiotic factors that influence metapopulations. They should discuss natural landscape processes such as plant succession, cycles of erosion and deposition, and the climate that will affect habitats and, therefore, the metapopulation of the species being considered. Evidence could be similar to that suggested for P1.

For M3, learners need to explain how results are derived from an NVC survey, ie how the survey results are interpreted to lead to a classification of the vegetation community. Evidence may be an extension of the survey report created for P5, P6 and P7.

For M4, learners must explain the purpose of an ecological survey. This could be based on their survey undertaken as part of this unit. This could be assessed directly by the tutor during practical activities. If this format is used, suitable evidence from guided activities would be observation records completed by the learner and the tutor, accompanied by appropriate work logs or other relevant learner notes.

For D1 learners need to build on the evidence created for M1 and M2 to discuss the factors which influence the survival of a species. This should include a consideration of how some species become threatened or extinct and how others adapt and survive. Evidence could be in the form of a verbal or written report.

For D2 learners must evaluate an ecological survey methodology and analyse the data collected. This could be based on the surveys conducted as part of the unit. They should show that they understand the limitations of the survey to the extent that they can distinguish precisely what conclusions can, and cannot, be drawn.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, M1	Reproduction and Breeding	As a trainee ecology surveying officer it is essential that you understand the principles of ecology before you take to the field. Part 1 of your training requires you to understand breeding and reproduction. Create an illustrated report comparing factors which affect reproductive success in different species. This should include aspects of behaviour, parental investment and breeding systems.	Illustrated report.
P3, P4, M2, D1	Population and Extinction	Part 2 of your training requires that you understand how plant and animal populations change and the factors that influence this change. Create a PowerPoint presentation which explains factors that cause some species to survive and others to become extinct.	PowerPoint presentation.
P5, P6, P7, M3	Surveying Plants Using NVC	Now you have the relevant theoretical knowledge, you have to carry out a plant survey of a particular area. Plan and carry out an NVC survey. In your report include potential sources of error, and how the NVC system is used to classify plant communities.	Observation records. Survey report.
P8,P9, P10, M4, D2	Surveying Animals	This assignment requires you to put your planning into practice and conduct an animal survey for a specified area. Plan and carry out the survey using appropriate methods. In your report include potential sources of error, and explain the purposes of an ecological survey.	Observation records. Survey report.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit has particular links with:

Level 2	Level 3
Undertaking Ecological Surveys and Techniques	Understanding Organism Identification

Essential resources

Learners should have access to a range of semi-natural habitats in the local area and permission to carry out habitat surveys. They will also need relevant fieldwork equipment, including identification guides, quadrats and tape measures, Longworth traps and/or invertebrate sampling equipment.

Employer engagement and vocational contexts

Opportunities for employer engagement and vocational contexts are limited and will need careful negotiation to ensure a meaningful experience for learners. The National Trust and other conservation organisations may provide opportunities for survey work. Most local authorities will have conservation officers who conduct surveys. Larger development organisations may also provide opportunities for ecological impact surveys before development. Additionally, consultant ecologists may provide limited but valuable experience.

Indicative reading for learners

Textbooks

Begon M and Mortimer M – *Population Ecology: A Unified Study of Animals and Plants, Second Edition* (Wiley Blackwell, 1996) ISBN 0632034785

Chapman J and Reiss M – *Ecology: Principles and Applications, Second edition* (Cambridge University Press, 1998) ISBN 0521588022

Gosling L and Sutherland W – *Behaviour and Conservation* (Cambridge University Press, 2000) ISBN 0521665396

Krebs J and Davies N – *Introduction to Behavioural Ecology* (Wiley Blackwell, 1993) ISBN 0632035463

Krebs J and Davies N – *Behavioural Ecology: An Evolutionary Approach, Fourth Edition* (Wiley Blackwell Publishers, 1997) ISBN 086542731 3

Rodwell J S – *National Vegetation Classification: User's Handbook* (Joint Nature Conservation Committee (JNCC), 2006) ISBN 186107574X

Sutherland W – *Ecological Census Techniques: A Handbook, second edition* (Cambridge University Press, 2006) ISBN 0521606365

Website

www.jncc.gov.uk	Joint Nature Conservation Committee

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are ...
Independent enquirers	evaluating aspects of plant and animal behaviour that might influence reproduction analysing information to determine relationships between parental investment and breeding systems planning plant and animal surveys
Team workers	collaborating with others to collect survey data
Self-managers	organising priorities, time and resources to conduct an ecological survey
Effective participators	proposing a sequence of steps needed to carry out plant and animal surveys.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are ...
Independent enquirers	examining survey methods and data for sources of error
Creative thinkers	generating ideas concerning plant and animal relationships
Reflective learners	feeding back on survey methods and identifying sources of error
Team workers	collaborating with others when surveying environments
Self-managers	managing time and resources when surveying environments
Effective participators	proposing practical ways forward.

Functional Skills – Level 2

Skill	When learners are ...
ICT – Use ICT systems	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	
Use ICT to effectively plan work and evaluate the effectiveness of the ICT system they have used	
Manage information storage to enable efficient retrieval	creating databases of survey data and plant and animal keys
Follow and understand the need for safety and security practices	
Troubleshoot	correcting errors in database operations
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	using NVC databases
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: • text and tables • images • numbers • records	entering survey data to produce analytical graphs, tables and diagrams
Bring together information to suit content and purpose	producing an analysis of survey data
Present information in ways that are fit for purpose and audience	
Evaluate the selection and use of ICT tools and facilities used to present information	
Select and use ICT to communicate and exchange information safely, responsibly and effectively including storage of messages and contact lists	
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	applying analytical statistical techniques to survey data
Identify the situation or problem and the mathematical methods needed to tackle it	

Skill	When learners are ...
Select and apply a range of skills to find solutions	
Use appropriate checking procedures and evaluate their effectiveness at each stage	checking survey results are both valid and reliable
Interpret and communicate solutions to practical problems in familiar and unfamiliar routine contexts and situations	
Draw conclusions and provide mathematical justifications	
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	investigating plant and animal populations, relationships and behavioural ecology
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	presenting the results of ecological surveys.