



Section 4. Ecology and Ecosystems

In this section you will learn:

- What the typical year for an Irish Bat is like.
- How to identify different bat species through morphology.
- Methods used to record and capture bats
- The implications of green energies for bats and their environment.

FUN FACT: The scientific name for bats is Chiroptera. What does this mean?



4.1 All About Bats

Bats are mammals. They are warm blooded and covered in fur and give birth to one pup a year. There are more than 1,200 species of bat worldwide. They can vary greatly in size from the tiny Bumblebee Bat (Kitti's hog-nosed bat) found in Thailand and Burma to the larger fruit bats found in the Tropics. Nine species of bat are resident in Ireland.



FUN FACT: The Royal Botanical gardens in Sydney Australia is home to huge number of Flying Foxes



Bats are amazingly important to our Ecosystems. There are a vast number of plants that depend on bats for pollination and seed dispersal. All of the Irish bats are insectivores i.e. their diet consists only of insects. Amazingly, one tiny bat can eat over 1000 insects per night making them very important for pest control.



A group of bats is called a colony and they live in roosts. When choosing a roost, they will want to be comfortable, safe, and warm and near a food source. Although many bats in Ireland will live near a river/canal lined with deciduous trees, a good number will also live in man-made structures such as buildings and bridges. It is thought that they hibernate through the colder winter months so they seek hibernation roots where they will not be disturbed.



A Year in the Life of an Irish Bat	
January/February/March	Bats are in hibernation. Their metabolism slows down to conserve energy. They are living off fat reserves.
April/May/June	As the weather gets warmer the bats start to emerge from their hibernation roots at night to forage for food. Female bats will begin their search for a suitable nursery roost in which they will give birth. Males roost either in small groups or on their own.
Late June/July	Females give birth to one pup which they suckle. They can recognize their pup by smell and sound.
August	The pups are now 6-7 weeks old and can echolocate and feed independently. Females leave the maternity roosts. Bats will move to mating roosts.
September	The start of mating season. The bats are also consuming a large amount of insects to build up fat stores for winter
October	Bats are seeking suitable hibernation roosts
November/December	Bats are in hibernation.




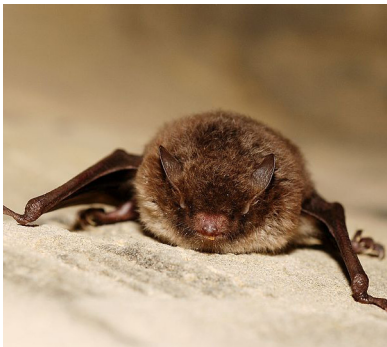





FUN FACT: The French for bat is chauve-souris – bald mouse!.



4.2 Identification of Bat Species



9 species of bat resident in Ireland

<p>Common Pipistrelle</p>  <p>Licensed under Creative Commons Attribution-Share Alike 3.0 via Wikimedia Commons.</p>	<p>Soprano Pipistrelle</p>  <p>Photo by Evgeniy Yakhontov - Licensed under Creative Commons Attribution-Share Alike 3.0 via Wikimedia Commons.</p>	<p>Brown Long Eared</p>  <p>Licensed under Creative Commons Attribution-Share Alike 3.0 via Wikimedia Commons</p>
<p>Daubenton's</p>  <p>"Myotis daubentoni01" by Gilles San Martin from Namur, Belgium - Myotis daubentoni. Licensed under Creative Commons Attribution-Share Alike 2.0 via Wikimedia Commons</p>	<p>Natterer's</p>  <p>Photo by Armin Kübelbeck. Licensed under Creative Commons Attribution-Share Alike 3.0 via Wikimedia Commons.</p>	<p>Lesser Horseshoe</p>  <p>Photo by Lylambda. Licensed under Creative Commons Attribution-Share Alike 3.0 via Wikimedia Commons</p>
<p>Whiskered</p>  <p>icensed under Creative Commons Attribution-Share Alike 3.0 via Wikimedia Commons</p>	<p>Leisler's</p>  <p>Photo by Manuel Werner. Licensed under Creative Commons Attribution-Share Alike 3.0 via Wikimedia Commons</p>	<p>Nathusius's Pipistrelle</p>  <p>Photo by Mnolf. Licensed under Creative Commons Attribution-Share Alike 3.0 via Wikimedia Commons.</p>

4.2 Identification of Bat Species



4.2 Identification Of Bat Species Through Morphology

Scientists will use keys to identify species but they can actually gather a lot of information from an initial visual inspection. For example;

- Horseshoe Bats have a very distinctive horseshoe shaped nose so this helps to rule out other species.
- The Brown Long Eared Bat is the only Irish bat to have ears joined over the head.
- The tragus shape is particularly useful for identifying Myotis species.

It is also very helpful to determine how big the bat is by using callipers to measure the head and body in mm and also to measure the forearm (elbow to wrist) in mm. Using keys and combining the morphology of bats with their echolocation calls help to identify unknown species by a process of elimination .



Callipers for taking measurements

There are some excellent keys available of the following websites which give a fantastic amount of information about bat identification:



http://www.batconservationireland.org/pubs/reports/Leaflet_I_BatsinIreland.pdf

<http://www.batconservationireland.org/> Irish bats in Flight

<http://www.bats.org.uk> Identification of British bats – Michael Walker, South Nottinghamshire Bat Group.




STUDENT TASK

Below are some pictures of Bats. You would use this simple key provided, to identify who is who ?

1	Are my ears joined over my head?	Yes	Brown Long Eared Bat
		No	Go to question 2
2	Does my wingspan range start at 190mm?	Yes	Soprano Pipistrelle
		No	Go to question 3
3	Do I have a distinctive horseshoe shaped nose?	Yes	Lesser Horseshoe

Here are some measurements we have already made from collected bat specimens. Use the key above to work out who is who!

	<p>Ears joined over head Head and body length 37-48mm Wingspan 230-285</p> <p>Answer</p> <hr/>
---	--



STUDENT TASK (cont...)



Ears not joined over head
Head and body length 35 -45mm
Wingspan 200-250

Answer



Ears not joined over head
Head and body length 35-45mm
Wingspan 190-250

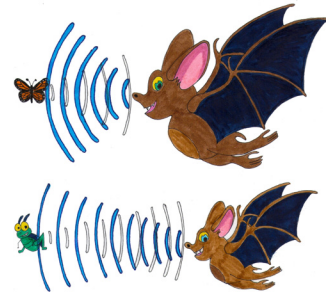
Answer

4.3 Methods Used to Record Bats



4.3 Methods Used To Record Bats.

Bats have a very unique ability. They can echolocate. They build up an image of their surroundings using high frequency calls. Echolocation is individual to each species and although some of the social calls that bats make can be picked up by the human ear, their echolocation calls are completely inaudible to human hearing. Therefore, it is necessary to use bat detectors to pick up their calls. There are several types of detector available, ranging from basic and inexpensive through highly technical and very expensive. An amateur bat enthusiast is likely to use a Heterodyne Tuneable Detector. The detectors have an ultrasonic microscope and by adjusting the tuning frequency, different calls become audible. Bats will sweep through frequencies so if the detector is set at 45 kHz, it will pick up the calls from many bat species.



Many scientists are trying to understand how bats use sound to 'see' their environment. Below is a link to a research laboratory at the university of Bristol. Here you can find what a bat sounds like through a bat detector. Echolocation calls are mostly used by bats to find food and to find a roost. It is possible to tell most different species of bat apart by listening to and analysing their echolocation calls? Can you find and listen to all of our Irish bat species? Can you hear the difference?



University of Bristol: Echolocation calls of British bats

<http://www.bristol.ac.uk/biology/research/behaviour/batlab/downloads/echolocation/>



Other detectors that are used are the Frequency Division Detector, Time Expansion detectors and the Full Spectrum Real Time Sampling Detectors. The calls can be recorded and are analysed by software to help identify species. Check out the following website for more information:



Bat Conservation Trust: Time expansion detectors

http://bats.org.uk/pages/bat_detectors.html#TE



4.4 What To Expect From A Bat Walk

Safety First! Bats are nocturnal. This means that a 'bat walk' will take place at night. A responsible adult should be present at all times. There are often guided bat walks that take place so check out the local information in your area. Bats like to forage near slow running water where there will be lots of insects. A canal or a slow running river lined with deciduous trees is the perfect spot for bats at dinner time.

Although it will be possible to see the bats without equipment, in order to hear them you will need a detector (the basic models retail at around €50). A torch is also a good asset.

FUN FACT: The Daubenton's Bat is also called the Water Bat. It skims the water in search of prey which it catches with its large feet.



By tuning the detector to different frequencies, it is possible to pick up different calls. At 25kHz, you can hear a Leisler's Bat. This is the biggest Irish Bat and is usually seen just after sunset. As the night progresses, adjusting the detector to a frequency of 45kHz will pick up the Common Pipistrelle at 55kHz, the Soprano Pipistrelle. These are Ireland's two smallest bats and have very fast and convoluted flight patterns. The Daubenton's Bat, also known as the Water Bat, can also be picked up at 45kHz but it will be spotted skimming the water looking for insects.

FUN FACT: Bats can navigate in complete darkness using Echolocation.



The following websites are packed full of information and it is also possible to hear recorded bat calls:




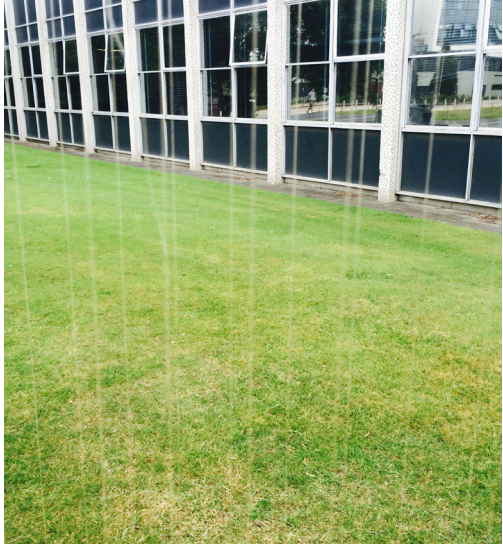
<http://www.bats.org.uk>
<http://www.batconservationireland.org/>

4.5 Methods for Capturing Bats



4.5 Methods For Capturing Bats

Sometimes, scientists have to capture bats. It is important that this is done with minimal distress for the bats. These tiny creatures are a protected species in Ireland so a special licence is required to catch and handle them.

	
<p>MIST NET: This is a mesh of nylon that is suspended between two poles. The net is very delicate and care must be taken when unfolding and folding the net to avoid a mass of tangles occurring.</p>	<p>HARP TRAP: This consists of layers of 'harp strings' suspended from poles</p>



4.6 The Implications Of Green Energies For Bats And Their Environment.

In Ireland, bats mainly live in man-made structures and deciduous woodlands. Loss of habitat is a huge and ongoing issue and loss of roosts may be as a result of timber treatment, tree felling, disturbances by other animals (such as cats) and water pollution, to name but a few.

FUN FACT: Bats can fly. While other mammals glide, bats are capable of true and continued flight.



In more recent times, the use of green energy, most notably wind-farms, has had an impact on bats. Below is a website that describes some of the problems that bats face in relation to wind-farms. This is a start for you to explore this idea more.



USGS: Bat Fatalities at Wind Turbines
<https://www.fort.usgs.gov/science-feature/96>

STUDENT TASK

In pairs/groups, discuss how wind-farms could affect bats and write your ideas in the box below:

With regards to the turbines, it is thought that bats may die or become injured in 2 ways. Firstly, by direct collision of the bat with the blades of the turbine. Secondly, there is a pocket of low pressure just behind the blade. If the bat gets caught in this pocket, it is thought that the change in pressure will result in haemorrhaging (bleeding heavily) of the lungs, similar to what divers may experience with decompression sickness (the bends).

Currently in Ireland, scientists are studying bats to find out where and when they roost. The data will be used to identify areas of the country that bats do not frequent making them suitable for windfarms.

Student Task Suggestions

- Create a poster based on some aspect of this chapter and present your poster to the class.
- Create a presentation or on the affects of windfarms on bats in Ireland to present to your class.



Conclusions

To truly understand how the world works it is important to study our world using all of the scientific tools available. By completing this transition year syllabus you have learnt, cell biology, genetics, field biology, ecology, bioinformatics and phylogenetics. You have also learnt about the diversity, uniqueness and wonder of the most fascinating mammals the bats. By integrating all of these different scientific approaches you are now in a position to delve deeper into the mysteries of life on this planet. We hope to see you all in UCD first year where you will learn more skills to explore these mysterys further. Well done!

Olivia Derwin, Clare Lamont, Joanna Kacprzyk, Emma Teeling and all members of BatLab.



Acknowledgements

We would like to extend our sincere gratitude to Professor Emma Teeling and Dr. Joanna Kacprzyk for the opportunity to work in the Bat Lab this summer and their help with editing the content of this book. Special thanks to the following who offered great assistance and endless patience at every turn: Dr. Nga Lao, Dr. Carlotta Sacchi, Graham Hughes, Una Nealon and Zixia Huang. Many thanks to Richard Dawson who very kindly created hand drawings per our requests which were used in both the book and the blogs. Peter Lang also deserves recognition for excellent graphic design and the web development involved in the Science for Schools programme. This project would not have been possible without funding from Science Foundation Ireland- Discover, UCD Earth Institute, UCD College of Science, and European Research Council to whom we are very grateful.

Oliva Derwin and Clare Lamont.

Bibliography

“A Rapid PCR based Assay for identification of Cryptic *Myotis* spp”. E.Boston *et al*

“The status of the cryptic bat species *Myotis Mystacinus* and *Myotis Brandii* in Ireland”, E.Boston *et al* “Genome analysis reveals insights into the Brandt’s Bat *Myotis Brandii*” (Nature Communications) “Bat Conservation Ireland Leaflet No. 1”- Bats in Ireland

“Irish Bats in Flight”-Bat Conservation Ireland

“Identification of British Bats” - Michael Walker, South Nottinghamshire Bat Group “Phylogenetic Trees Made Easy” Barry G. Hall

“Campbell Biology” Pearson.

“Phylogeny for the faint heart: A Tutorial”-Sandra L Baidauf.

“DNA for Real: Learning about PCR in science workshops” Anna Joliffe.

“Phenol-Chloroform Extraction” P. Zumbo, Weill Cornell Medical College, Laboratory of Christopher E. Mason PH.D

Photo Credit

Cover photograph by Dr. Sebastien Puechmaille.



Useful weblinks



Genetics and Evolution.

<http://www.yourgenome.org>
<http://ed.ted.com/lessons/how-to-sequence-the-human-genome-mark-j-kiel>
<http://learn.genetics.utah.edu>
<http://ed.ted.com/lessons/the-twisting-tale-of-dna-judith-hauck>
<http://unlockinglifescode.org>
<http://www.youtube.com/watch?v=QY9LZ5tt-QE&sns=em>
<http://www.statedclearly.com>
<http://evolution.berkeley.edu>
<http://www.bozemanscience.com>
<http://m.youtube.com/watch?v=H6lrUUDboZo>
<http://www.bbc.co.uk/darwi>
<http://www.bbc.co.uk/science/0/22941835>

Bat Material

<http://youtu.be/3BtbS9JC8x8> (great irish bat clip)
<http://www.eurobats.org>
<http://www.csiro.au/Outcomes/Environment/Biodiversity/Spectacled-Flying-Fox/Bat-facts.aspx>
http://news.nationalgeographic.com/news/2005/01/0127_050127_bats_2.html
<http://www.csiro.au/Portals/Media/2011/Bat-immunity-key-to-controlling-deadly-viruses.aspx>
<http://www.batconservationireland.org/>
<http://www.thewildclassroom.com/bats/videos.html>
<http://www.arkive.org/daubentons-bat/myotis-daubentonii/video-00.html>
<http://www.nhm.ac.uk/nature-online/life/mammals/bats/session2/index.html>
<http://www.rte.ie/radio/mooneygoeswild/factsheets/bat/>
<http://www.bats.org.uk>

PCR

<http://m.youtube.com/watch?v=NYIT3f-MZ5o&sns=em>
<http://m.youtube.com/watch?sns=em&v=2KoLnIwoZKU>
<http://www.ncbi.nlm.nih.gov/genome/probe/doc/TechPCR.shtml>
<http://www.abpischools.org.uk/page/modules/pcr/index.cfm> (PCR for Schools)

Sequencing

<http://blast.ncbi.nlm.nih.gov/Blast.cgi>
<http://www.ebi.ac.uk/Tools/msa/clustalo/>