The diet of Daubenton's bats (*Myotis daubentonii*) along The Millennium Link canal system in Scotland – a review of potential study methods

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Abstract
This short paper reviews the methods available for studying the diet of Daubenton's bats (*Myotis daubentonii*). Active, passive and aquatic techniques are discussed, together with a brief discussion of methods for analysing the actual diet of the bats. Details of the methods to be used in future surveys are included.

Key words: active, passive, aquatic, surveys

Introduction

The BATS and The Millennium Link (BaTML) project was launched in late 2000 to study the bat populations on and adjacent to the canal network that connects the east coast of Scotland with the west coast. This network, which is comprised of the Forth & Clyde and Union Canals, is undergoing major changes, during a period when they have been completely re-opened to water traffic.

The project, which commenced its survey programme in 2001, was set up primarily to study Daubenton's bats (*Myotis daubentonii*), Soprano pipistrelle (*Pipistrellus pygmaeus*) and Bandit (or Common) pipistrelle (*Pipistrellus pipistrellus*).

One of the key foci of this project is to investigate the diet of Daubenton's bats using the canal network.

Daubenton's bats are medium-sized bats associated with open aquatic habitats. They typically fly close to the water surface and either take their insect prey directly from the surface or just above it. Daubenton's bats are known to travel long distances along watercourses such as canals, however their average range is within circa 6 km of their roost (Bat Conservation Trust, 2003).

Review of Potential Methods

Potential prey items of Daubenton's bats can be split into two categories: aquatic insects associated with the feeding habitat and terrestrial insects associated with the riparian habitat. There are a number of methods and techniques for collecting insects from such habitats, ranging from a simple search in the undergrowth to regular trapping. The techniques covered in this paper can be split into three categories: active collection techniques, passive collection techniques and aquatic techniques.

Active Collection Techniques
Active collection techniques either attract insects to some form of trap, or require the sampler to actively collect invertebrates from the vegetation.

Light trapping
Light traps are typically used to collect moths, however many nocturnal insect species can be attracted to light. The light trap emits an ultraviolet light that is detected by the insect. The insect flies towards the light and then circles the light before hitting a vane and being funnelled into the box below.

Beating
A large canvas sheet, stretched between wooden supports, is held underneath vegetation such as tree branches. The vegetation is shaken or knocked with a stick so that the invertebrates living upon it are dislodged and fall onto the tray where they can be collected.

Sweeping
Sweeping is a useful technique for collecting a wide range of invertebrates. A large, strong net is swept forcefully through long vegetation, which dislodges invertebrates into the net.

Passive Collection Techniques
Passive collection techniques rely on the invertebrates being caught by some form of trap, without the aid of any attractive features. There are several commonly used techniques.

Sticky Traps
Sticky traps are pieces of yellow or blue plastic that have been coated in a sticky, glue-like substance. Strictly these traps should be covered under active collection methods, as the bright yellow/blue colour plays a part in attracting insects to the trap. However, as our main use is to determine what insects are present when bats are active, and therefore at night, the colour is irrelevant. In use, the traps are placed out along the habitat in question and insects are caught on the adhesive, in a similar fashion to traditional flypapers.

Malaise Traps
The design of Malaise traps resembles the shape of a traditional two-man ridge tent. The trap is made of fine netting and is supported by a strong pole and various guy ropes. The insects are collected in a special 'collecting head' comprised of two bottles, which are supported by a metal bracket.

A flying insect hits the central vertical sheet of netting and instinctively flies upward to the light where the pitched roof guides it towards a hole in the netting and the collecting head. The lower bottle of the collecting head contains 70% alcohol, which kills and preserves the insects.

Sugaring
This technique relies upon the fact that many moths and other insects feed on nectar. When foraging, they seek out rich food sources and it is therefore possible to use sugary mixtures to mimic the sweetness of nectar and so hopefully attract the insect. A mixture of sweet/sugary substances is painted onto a number of tree trunks in the survey area at dusk. The trees are then revisited after dark to see what has been attracted.

Aquatic Survey Techniques
As pipistrelle and Daubenton's bats forage above water, it can be useful to investigate what aquatic insects are present in the foraging habitat. There are three methods applicable to aquatic habitats.

Kick Sampling
This method involves disturbing the bed of the river or stream and catching the dislodged invertebrates in a net. The net is held vertically on the bed, downstream of the sampler and the bed of the watercourse is disturbed with a shuffling movement. The invertebrates disturbed by the shuffling motion are washed downstream into the net.

Sweeping
Where the watercourse is too deep to sample by kick sampling (e.g. canals and larger rivers), the invertebrate population can be investigated by sweeping the bankside vegetation. A pond net is swept amongst the stems of submerged and emergent plants and grasses. Invertebrates living on, or amongst these stems are dislodged and collected in the net.

Marginal vegetation along the canal network is often extensive (up to two metres from the bank in summer), making sweeping with a standard pond net difficult, even with a one metre extension fitted. It was initially thought that a two-minute period of sweeping would be sufficient, however, in light of the difficulties encountered during preliminary surveys, it was decided that surveying a predetermined length of bank would be more feasible.

Dredging
To sample the invertebrates present on the bed of a deep watercourse, you can use a net to 'dredge' the bed. The net is dug into the soft sediments of the bed and a sample of this silt and mud is scooped up. When the net is returned to the surface a dipping motion can be used to filter out some of the finer silts. Invertebrates collected are separated from the remaining detritus and identified to the necessary taxonomic precision.

Diet Analysis

Surveys of insects present in or around the canal can only be used to identify the potential prey for Daubenton's bats. To identify the actual diet of any animal it is necessary to either examine the contents of their gut or to analyse their faeces in the hope of identifying the remains of their prey. The legal protection afforded to bats renders the examination of their gut contents impossible. It is however possible to examine their faeces and determine their diet from the arthropod remains therein.

A minimum of 20 faecal pellets are collected from Daubenton's bat roosts on a monthly basis and returned to the laboratory where they are softened and teased apart. Remains of arthropod organisms are separated from the faeces, and then identified to order and, if possible to family.

Discussion

Surveying for potential Daubenton's bat prey could prove quite difficult. There are many methods of sampling the flying insects of an area, however most of these methods either attract specimens to a trap (e.g. light trap or sugaring) or are impractical, as they cannot be employed over water (e.g., sweep netting or Malaise trapping). Possible methods could include: using a suction trap to take insects from near the water surface; devising a

floating insect trap to capture insects on or just above the water surface; or using sticky traps strung across the canal just above the water surface. It is however unlikely that these methods would be feasible due to the nature of the habitat and the possibility that they would interfere with the foraging of bats to some extent.

As a result of preliminary experiments it has been agreed that this study will use the following methods.

Whenever possible, representative samples of droppings from Daubenton's bats will be collected and returned to the laboratory for examination. The remains of arthropod organisms will be separated from the faeces and sorted into orders and, if possible, into families.

To assist with the classification of these remains a Malaise trap will be run at a location adjacent to the canal for a year. The bottle will be changed on a weekly basis and the insects collected will be sorted and identified to family. This will build up a reference collection of insects that can be used to further classify the remains found in the faecal pellets.

In addition to these methods, it is hoped that a limited amount of ad-hoc sampling of the insect fauna may be possible each year. This could consist of light-trapping and sweep netting for insects present during bat surveys or aquatic insect surveys at bat transect locations.

It is thought that these survey techniques will provide sufficient information to identify the diet of Daubenton's bats using the canal network. It is likely that these methods and techniques will however need to be adapted and enhanced throughout the project as different challenges are encountered.

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