Home Office

NON-TECHNICAL SUMMARY

The costs of flight

Project duration

5 years 0 months

Project purpose

- (a) Basic research
- (d) Protection of the natural environment in the interests of the health or welfare of man or animals.
- (e) Research aimed at preserving the species of animal subjected to regulated procedures as part of the programme of work.

Key words

Flight, Energetics

Retrospective assessment

> The Secretary of State has determined that a retrospective assessment of this licence is not required.

Objectives and benefits

Description of the project's objectives, for example the scientific unknowns or clinical or scientific needs it's addressing.

What's the aim of this project?

The airspace used by birds in flight is changing. This is because wind speeds themselves are changing, and so too is the ground that the wind moves over with humans encroaching more into the aerial habitat as we build structrues from turbines to skyscrapers. We therefore need to understand how birds are affected by air currents. Factors such as wind affect the costs of flight, but it is difficult to predict how, as there is still uncertainty over the energy required to fly. This project will develop new methods to estimate the energy expended during flight in still air (simulated by a wind tunnel) and in the wild, where airflows are highly dynamic. This will be achieved using miniaturised tags attached to birds' backs to quantify how often and how hard birds flap their wings. The project will also estimate how these measurements are affected by the tag itself. Overall, this will provide completely new insight into how much energy birds expend during flight and how this changes with the weather.

Potential benefits likely to derive from the project, for example how science might be advanced or how humans, animals or the environment might benefit - these could be short-term benefits within the duration of the project or long-term benefits that accrue after the project has finished.

What are the potential benefits that will derive from this project?

An improved understanding of how much energy is used during flight is needed for a wide range of issues that include fundamental biology (e.g. how flight costs vary across birds with different body sizes and body shapes) and applied questions, such as how much extra energy will a certain species have to spend in order to divert its flight path round a wind farm. The results from this project will feed into both, by providing new estimates of the energy expended in still air, and the means to quantify the energy expended by birds flying in the wild depending on where and when they chose to fly.

Species and numbers of animals expected to be used

What types and approximate numbers of animals will you use over the course of this project?

The project will involve up to ~ 20 homing pigeons (Columba livia), which will be flown over the duration of the project (5 years).

Predicted harms

Typical procedures done to animals, for example injections or surgical procedures, including duration of the experiment and number of procedures.

In the context of what you propose to do to the animals, what are the expected adverse effects and the likely/expected level of severity? What will happen to the animals at the end?

This project involves flying the pigeons in a wind tunnel. This is perfectly safe as birds will not be able to access any of the moving parts and an observer will be present during all flights to ensure that birds do not damage themselves by flying against the wall of the tunnel. While individual flights will be short (~20 mins) birds may become tired in the period when their flight muscles are increasing. Training flights will therefore be very short to begin with and increase as training progresses. Miniature loggers

will be attached to birds for the flights and these loggers will be attached in a way that minimizes any possible feather damage. The loggers will be a very small percentage of the bird's mass but this may still increase flight costs. We will use tests to measure how much extra energy it requires to fly with loggers. Measurements of energy use will require measurements of the carbon dioxide, which will involve training birds to fly with a mask on for short periods (~10 minutes), and measuring carbon dioxide and oxygen levels while birds rest. Birds will continue to be housed at the establishment after the end of the project.

Replacement

State why you need to use animals and why you cannot use non-animal alternatives.

The premise of the study is to provide new insight into the costs of flight. This is necessary because previous estimates have been heavily influenced by the methods used, and data gained from laboratory trials do not agree with data gathered from birds flying in the wild, as has already been confirmed by a literature review. We therefore need new experimental data and new methods to understand why this is.

Computer modelling is the only type of non-animal alternative for this work, as it can be used to predict the energetic consequences of a bird chosing flight path a over flight path b, and opting to fly faster or slower, for instance. In order to have any confidence in these simulations, we need to compare the results with the decisions made by real birds . We will know that we have a robust framework for predicting animal movement, and how this is affected by the physical environment, when these two approaches produce the same results. Nonetheless, the literature will be continually reviewed in order to keep up with latest developments and the possibility of any further reduction in the use of animals.

Reduction

Explain how you will assure the use of minimum numbers of animals.

The following steps will be taken to ensure the appropriate number of animals is used, commensurate with good experimental design. This will ensure that the research will be publishable according to the ARRIVE guidelines:

- Extensive training will be undertaken to ensure that study animals are fit, accustomed to the wind tunnel and experimental procedures. This will also ensure that the signal to noise ratio is maximised.
- Preliminary work will be undertaken to establish how long birds need to be flown for.
- The final numbers of birds used in wind tunnel trials will reflect (1) the need for statistical power. Previous studies have shown that the variation in flight costs is very low between individuals compared to the variation caused by flight speed. Most previous studies have used between 5 and 10 individuals. Comparisons of flight costs will be made in relation to speed, with statistical models controlling for mass and sex of birds. (2) The proportion of the initial flight team that take

well to training. Research at other institutions indicates that around 2/3 of all birds will end up flying well in a wind tunnel after training. Around 15 birds will undergo initial training.

- Final protocols will involve the simultaneous collection of multiple data types. This will reduce the number of overall trials.

Project personnel include researchers with substantial statistical expertise who will be consulted to refine the experimental design and ensure that the minimum number of animals used is commensurate with the ability to achieve statistical power.

Refinement

Explain the choice of species and why the animal model(s) you will use are the most refined, having regard to the objectives. Explain the general measures you will take to minimise welfare costs (harms) to the animals.

The welfare of the animals will be prioritized during all procedures and steps will be taken to enrich their living conditions, including the provision of an external aviary, where they can be outside the loft without being at risk of predation. Predator scaring measures will be considered if there is evidence that predators are being attracted to the loft.

Flying birds in a wind tunnel is the only way of ensuring that they experience controlled conditions. This is necessary in order to provide baseline measurements of the costs of flight, before expanding the project to assess how these vary in the wild. Methods of training birds will be reviewed before training commences. Procedures that train birds with positive associations will be favoured. An observer will be present during all flights in order to (i) monitor the bird for signs of stress or exhaustion (ii) stop the trials where such signs are observed, or in the unlikely event that a bird becomes injured/ is behaving in such a way that it might make injury likely. An emergency stop button will be located within easy reach of the observer. Flight durations will be increased from a matter of seconds during the early stages of training.

Protocols will be refined to keep handling of animals to a minimum.

Tagging is now a widespread method of quantifying the movements of wild animals and this project will also provide valuable data on the costs of flying with tags.

Animal models will be refined by regular review and critical appraisal of work during the course of the licence to ensure that they remain the most refined from an animal welfare point of view and to obtain the maximum scientific output for the minimum animal suffering.