Red or Grey: Using Citizen Science for Conservation Monitoring

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Red Squirrel Conservation

The distribution and abundance of the red squirrel (*Scuirus vulgaris*) in the UK has declined since the introduction of the invasive eastern grey squirrel (*Scuirus carolinesis*) over a century ago. In red squirrel conservation areas, it is vital that existing populations are carefully monitored and any grey incursions are swiftly detected.

To do this effectively requires considerable monitoring effort, requiring both reliable detection methods and manpower. Volunteer groups in and around conservation areas assist funded projects to conduct surveys and monitoring, typically using hair tubes and camera traps. Both methods require some judgement to distinguish between squirrel species.

This study aims to compare the effectiveness of remote camera traps and hair tubes in producing reliable data of both red and grey squirrels, which volunteers can utilise without the need for in-depth training or expertise.

Body size and pelage colour cannot be used as the sole indicator of species identification

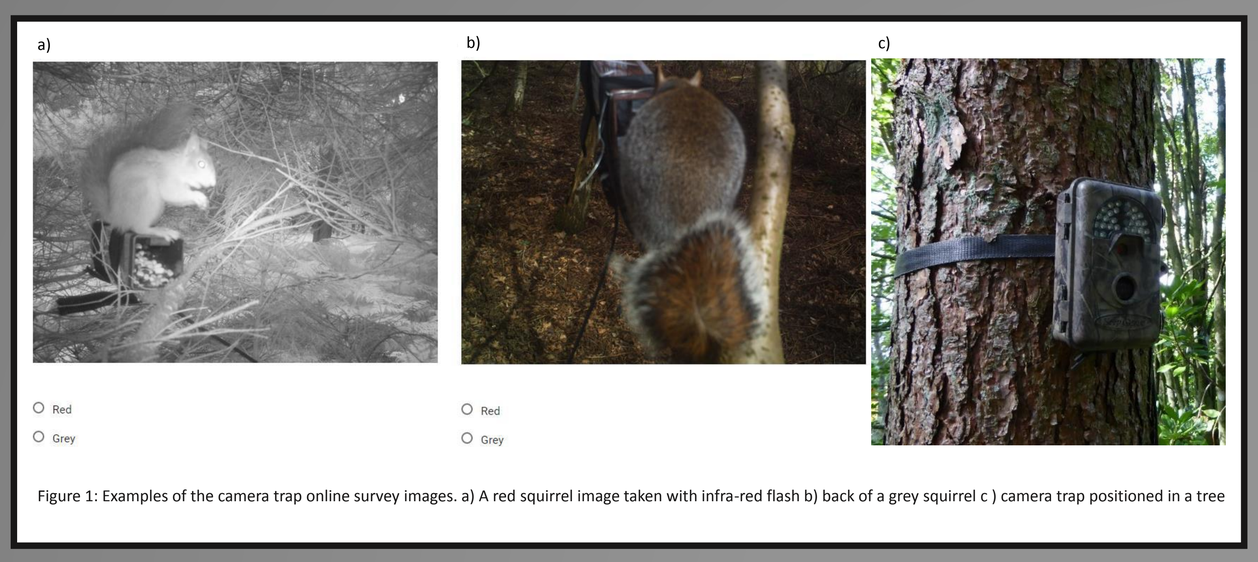

Figure 1: Examples of the camera trap online survey images. a) A red squirrel image taken with infra-red flash b) back of a grey squirrel c) camera trap positioned in a tree

Research Questions:

- How do common monitoring methods compare for species identification?
- Do people need a lot of experience to successfully distinguish between the two species using these methods?
- Is one species more distinguishable than the other?

We used online questionnaires to assess the ability of the public, trained volunteers and squirrel experts to classify red and grey squirrels from images from camera traps and from hair samples (with and without microscopes) from hair tubes.

Camera Traps

Camera traps (Figure 1c), often placed facing a baited feeding station, are an increasingly popular tool as they provide an unobtrusive means of collecting data whilst retaining a permanent digital data and time stamped record of the species at a particular location. Images however can be difficult to interpret as cameras can sometimes produce poor quality images, which may be presented as black and white (1a) if the infra-red flash is activated in low lighted woodlands, further inhibiting identification.

All 444 survey participants were better at identifying red squirrels (Figure 3: 88% correct) than grey (81% correct) ($\chi^2 = 140.695$, df = 1, $p < 0.001$). However, there was a difference in ability to correctly identify the squirrels based on the level of training received. Experts (n=) correctly classified 94% of all images compared to 79% of the public (n=) ($\chi^2 = 280.273$, df = 2, $p < 0.001$; Figure 3).

In our survey the public were not given information on the distinguishing features of reds and greys before participating indicating training can improve identification. With online platforms such as *zooniverse.org* for analysis of images camera traps offer the opportunity to engage with armchair enthusiast as citizen scientists.

Figure 2. Examples of hair sample images used in the hair tube surveys. a) baited hair tube b) Non-microscopic red tail c) microscopic red nape with tightly packed medulla cells d) Non-microscopic grey nape, hairs have three discrete bands e) Microscopic grey tail where medulla cells are more widely spaced.

Hair Tubes

Baited hair tubes (Figure 2a) or feeder boxes are the most widely used approaches to monitoring squirrels. When a visiting squirrel places its head in the tube or box to feed, a sample of hair from the nape of the neck is deposited onto an adhesive pad affixed to the inside. Identification of squirrel species can then be made by visual inspection, which may require further analysis using microscopy. Our survey contained 24 images of red and grey squirrels, some of which were magnified (x 100) through a microscope.

Overall the 101 people who participated in the online survey did not find one species easier to determine by examination of the hair image. There was however a significant difference in the proportion of correct responses between the public, volunteers and experts ($\chi^2 = 48.129$, df = 2, $p < 0.001$; Figure 4). The experts and the public contributed to the largest difference with the experts achieving 17% more correct hair identifications than the public. Participants were less accurate at identifying hairs magnified by microscopy – indicating a potential training requirement to identify the key features.

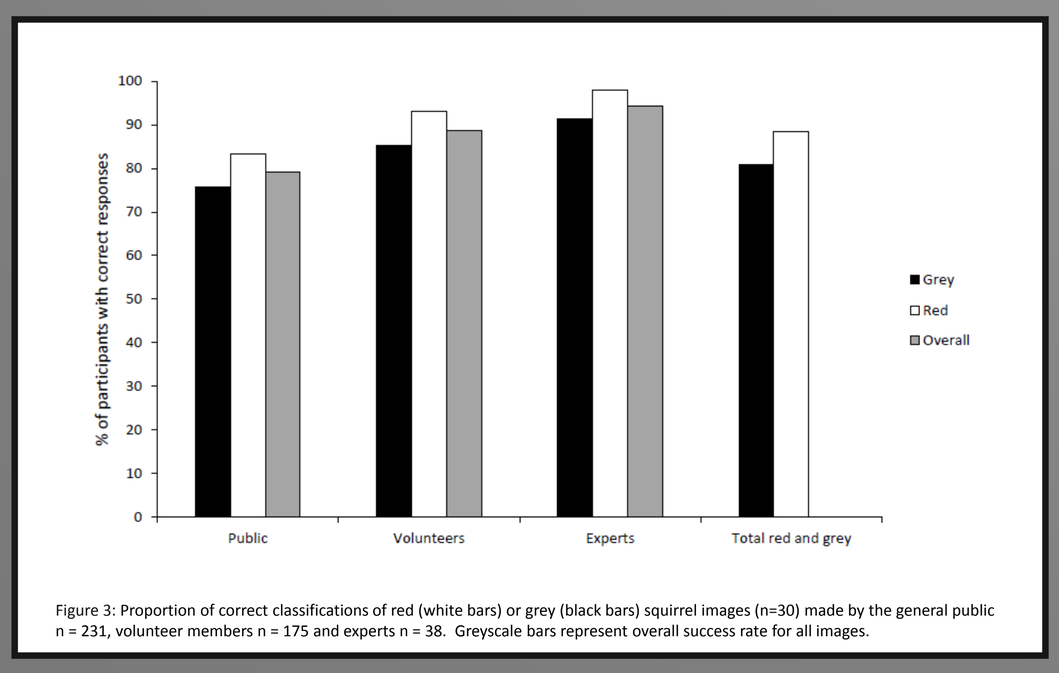

Figure 3: Proportion of correct classifications of red (white bars) or grey (black bars) squirrel images (n=30) made by the general public n = 231, volunteer members n = 175 and experts n = 38. Greyscale bars represent overall success rate for all images.

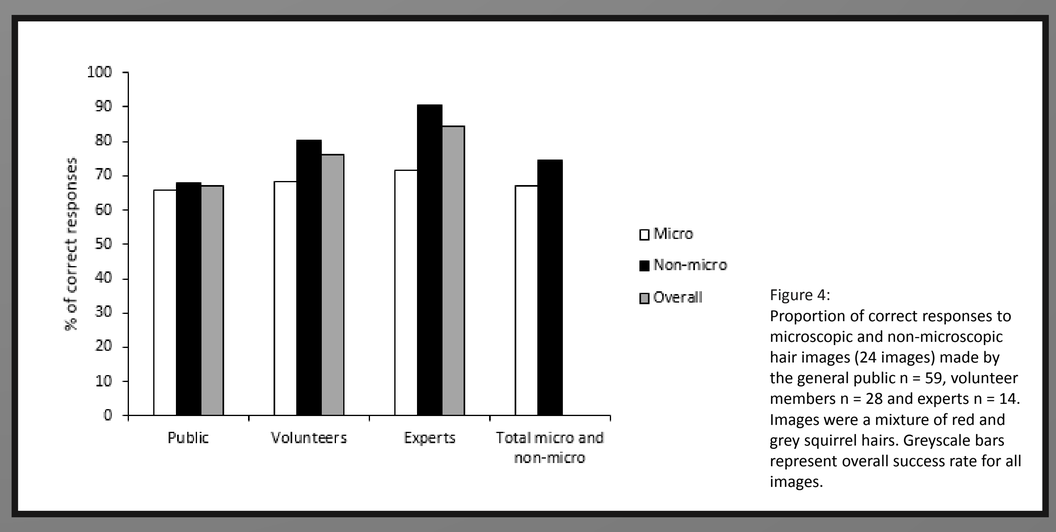

Figure 4:
Proportion of correct responses to microscopic and non-microscopic hair images (24 images) made by the general public n = 59, volunteer members n = 28 and experts n = 14. Images were a mixture of red and grey squirrel hairs. Greyscale bars represent overall success rate for all images.

Citizen Science plays a very important role in the future of squirrel conservation. Camera traps, although more expensive to set up and maintain, produce a digital record that can be quickly and easily verified by experts. This helpful in the detection of grey squirrel incursions. Hair tubes, although resulting in a lower correct classification rate in our survey, followed a very similar trend indicating that with appropriate training the general public can become competent citizen scientists. Comparing both monitoring methods, 83% of camera trap images were identified correctly, significantly more than hair sample images which received 72% of correct responses ($\chi^2 = 151.831$, df = 2, $p < 0.001$).

We recommend that volunteer groups continue to recruit new volunteers and train them in species identification, particularly in defining characteristics of the grey squirrel, to assist in squirrel monitoring and conservation.