Guidelines for the identification of birds in research

Authors:

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Frode Bergan, Torbjørn Endal, Francois M. Lambert, Ana Maria Acosta Roa, Steinar Snartland, Ronny Steen, Øyvind Steifetten, Marianne Sødring & Tomas Aarvak.

The groupwork was compiled into one document by Adrian Smith, Norecopa (www.norecopa.no). Norecopa offers this compilation as a service to researchers, but does not necessarily endorse its content.

Introduction

Individual birds may be caught and marked in order to carry out research in a wide range of fields including behavioural ecology, population ecology, genetics, medicine (disease vectors), conservation biology and evolutionary biology. Studies on habitat selection, survival, reproductive success, population viability, dispersal, migration, mate choice, avian influenza and climate change are all often dependent on samples with birds that can be individually recognized or followed. A number of alternative marking techniques exist and it is essential that the most suitable method is identified. The following criteria must be addressed before a method is chosen:

- How large sample size is needed – will it be possible to catch enough individuals?
- The method should be quick and easy to apply
- How long must the method last?
- Must the bird be caught again? Can the bird be identified from a distance?
- Will the markings fade?
- Are the colours distinguishable? Are the observers colour blind?
- How will the method affect the animal: will it harm the bird or affect its behaviour? Will it make the bird more susceptible to predation?

In general, great care must be taken to avoid the method affecting not only survival and longevity, but also the animal's behaviour in such way that the scientific results can be biased. If possible, studies should be undertaken to measure the effect of the marking method, especially if there is any doubt. For example, coloured marking techniques can affect choice of mate in birds, where some colours are more preferred than others. In studies of mate choice, the effect of the colour marking must be investigated. Coloured neck bands can increase visibility and thereby lead to increased predation and mortality. In rare circumstances, neck bands can also be heavily iced, leading to increased mortality. Neck

bands, leg and wing bands can get entangled in vegetation or human waste, such as fish nets and lines, which may lead to starvation and death.

Before a researcher decides which marking methods to be used, the type of experiment must be thoroughly planned in order to refine the procedures for observation, catching, marking and release. The aim should be to avoid exposing each individual bird to any unnecessary pain, suffering, stress or injury.

Before the bird can be marked, it must be caught. There are several different ways to capture birds for marking, including:

- baited traps where the birds are lured into a trap with food.
- net traps where birds are lured to an area with food. Once the birds are in the selected area, a net is shot out over them.
- mist nets with a very fine mesh that birds fly into.

Once the bird has been caught, there are a number of things a researcher must consider before deciding on a marking technique. Birds should always be treated with special care due to their size and fearful nature. There are various ways of calming birds, such as the use of a hood, dark cage, a cotton bag, a piece of soft cloth wrapped around the birds head and body, or medical sedation (this should be the last option). When caught, the researcher should pay special attention to the most vulnerable and vital parts of the bird: the legs, neck, eyes and wings. After marking the bird with the chosen identification method, it should be released without any physical harm and with as little stress as possible.

Choice of identification method

There are many different methods for identifying birds in a study. Each method may not fit every type of bird experiment, therefore the researcher must weigh the pros and cons of each method prior to deciding which to use.

First, the type of bird to be studied must be taken into account as marking methods that may be well suited for one type of bird may not be appropriate for other types of birds, for example waterfowl in regular contact with water. Secondly, the researcher must consider the age of the bird at the time of marking, since a young bird may not be fully developed and will therefore continue growing after marking, which can result in harm to the bird if the marking technique does not take this into account. Furthermore, the researcher should use an appropriate marking technique for the size of the bird. For example, small passerines may not be able to handle the weight of a radio transmitter that a larger bird such as a falcon or hawk can handle.

Secondly, the researcher should consider the type of marking suitable for the experiment in terms of data collection. For example, if birds are to be observed from a distance only, the method should be such that it will disappear after some time, or be of a type that will not

affect the bird once the experiment is over. For experiments where recapture is necessary for data collection, other methods of marking may be used after recapture.

Thirdly, it is important to avoid any markings that may have a negative impact on the bird. The method must not have adverse effects on the bird's behaviour, physiology, survival, reproduction or general welfare, and should not be a source of discomfort or hindrance. Researchers should take special care when choosing the colour of bands, tags or neck collars, since some colours, in particular those similar to the birds plumage colour used for social signaling, may adversely affect the bird. For a list of criteria that the researcher should be aware of, and try to meet, when choosing a marking method, see Marion and Shamis (1977).

Before starting a specific project it is advisable to carry out an extensive literature search when the study species has been chosen. It is likely that others have already experience of the effectiveness of various marking methods in the species in question. Contact with these researchers will help to avoid already known pitfalls.

Methods

Leg rings

For laboratory studies, metal rings with numbers and plastic rings in different colours provide an easy way for individual bird identification. For field studies, ringing may be a good alternative depending on the design of the study. If recapture is necessary for blood sampling or other measurements, the bands can easily be read when the bird is captured. However, for studies that do not require recapture, ringing may not be the best marking choice as both metal and plastic rings may be too small to read from a distance. In field studies of larger birds where recapture is not required, the ring may be large enough to enable the numbers or colour of the ring to be read using binoculars from a distance. When choosing this method of identification, the researcher must be take the bird's age into consideration, so that ring fitted to juvenile birds allow for subsequent growth. In addition, the ring must be correctly fitted to the animal (not too tightly or loosely).

Every country has a central ringing office that issues metal rings with an address and a unique serial number. In Europe, all ringing schemes are coordinated by EURING (www.euring.org). In Norway, when marking with rings (both metal and coloured rings), these must be ordered from Stavanger Museum (www.stavanger.museum.no), which oversees both banding and reporting of ringing. Routines for the use of coloured rings are also managed by the Museum to avoid confusion with other ringers' colour codes. All ringing must be registered with the Norwegian Directorate for Nature Management (Direktoratet for Naturforvaltning) which can issue three different type of licences; A, B or C. Type A licences certify the bearer for all types of bird ringing, as well as trapping and netting. A type B licence allows the holder to mark the nestlings, but for trapping birds, a person with a type A licence must be present. Type C licence are usually issued for research projects, where the holder of the licence intends to study one specific area or one species. Each licence is valid for one year and may

be revoked. Every licensed bird ringer must submit an annual report, and failure to do so results in revocation of the licence. Other methods of bird identification do not require a licence.

The bird is uniquely marked on a leg, but must in most cases be recaught to ensure positive identification. Skilled bird observers with high quality telescopes or photographic equipment are able to read these at a distance. When ringing the bird, it is important to avoid putting the ring on upside down. Metal rings are made of aluminum or stainless steel alloy. Stainless steel is used for birds in contact with salt water or similar environment that make aluminum rings corrode away. Some species such as crows and parrots are able to destroy aluminum rings and in these cases stainless steel rings must be used. All ringing offices maintain lists with ring type and size for individual bird species. In some species males and females differ in size, necessitating different ring sizes. In some species, the legs of juveniles are not fully developed at the appropriate time of ringing and other techniques must be used or the ring must be tailormade.

Colour ring types are also in use. *Celluloid springy rings* of various colours are used on small birds, while *Darvic PVC* is used for bigger ones. Colour rings are most often put on in unique combinations to allow individual identification. Most rings are cemented or sealed to avoid ring loss. Colour rings can last from a few years to a lifetime. It is advisable to ring the bird with a unique metal ring in order to assess colour ring/flag loss and retention rates. Alternatively, coloured sticky tape (glued) around the metal ring can be used, though it tends to last only a few weeks or months.

Neck collars

This form of marking is often used with waterfowl, as foot rings may be difficult to see in birds that spend most of their time with their feet under water. These have often different colours with a unique combination of letters and numbers, which enables identification at a long distance. Researchers using neck collars must ensure that the collar is correctly fitted to the animal to avoid damage.

Wing tags

A brightly-coloured tag with letters and/or numbers is affixed to the bird's wing feathers, allowing for easy identification from a distance. The wing tag will fall off once the bird moults, and recapture is therefore unnecessary.

Dyes

Marking an animal with dyes could be a good method of identifying individual birds in both field and laboratory studies. Dyes can be applied to the feathers, skin, beak, or feet, but should be used sparingly. The researcher must take into account the affect that the dyes may have on the bird's behaviour and the behaviour of the bird's conspecifics. The type of dye to be used depends not only on the birds studied but also on the study itself. For example, for studies involving waterfowl, the dye used should be waterproof, and for long-term studies the dye must be able to withstand the elements. Most importantly, the researcher must ensure that the

dye is non-toxic. UV-dyes are an alternative to visible dyes, but marked birds have to be recaptured for data collection.

Feathers are not easy to colour, but dye has been used extensively, especially on colonial waterbirds. Tatto inks, using cattle-marking sticks, non-lead paints, picric acid, Rhodamine B and Malachite green have been used on light coloured feathers. These are relatively short lasting and suffer from methodological problems (Fair *et al*., 2010). Aerial and ground spraying of fluorescent particles has been used to mass-mark birds in roosts and nesting colonies, and this is retained for several months or until moult. Dyeing methods do not allow for a large number of individuals to be uniquely identified.

Microchips (transponders)

Passive integrated transponder (PIT) tags are electronic devices encased in glass or resin that do not transmit constant signals but respond to an external scanner. The PIT tag is very small and is injected subcutaneously. They are cheap and easy to use, but the scanner must be within 10-20cm of the animal in order for the tag to be read.This method allows for permanent marking of a bird, but requires recapture to read the chip. PIT tags are reliable and do not, in most cases, cause any harmful side-effects to the bird's physiology, anatomy or behaviour.

Leg flags

Small plastic flags are often used in combination with coloured rings. Leg flags can be used alone with different combinations of letters and numbers for identification from distance.

Patagial flags

A plastic flap is pinned on the upside of the wing by a stainless steel pin through the patagium and held in place with a nylon washer. The tags can have different colour, letters and numbers. It is commonly used in vultures and raptors, but is not recommended for diving birds or small species.

Nasal marks

A plastic flap (disc or saddle) is fixed on the upper beak by a pin through the nostrils. It is commonly used in ducks where neck bands/collars or leg bands cannot be used. The use of nasal marks is controversial and have been the subject of several studies (see Regehr & Rodway 2003).

Biometric methods

On rare occasions, biometric methods can be used. For some large birds of prey, such as buzzards, the colour patterns of the wings observed from beneath are characteristic for each individual of that species. The chosen method should be quick and easy, and the researcher should be able to easily distinguish the markings of one bird from that of the other birds in the study.

Radio and satellite tracking

Marking birds with radio transmitters is a very good way of gathering information about the birds being studied, but before this method is chosen, the researcher must consider any potentially negative consequence of using transmitters. This technique is successful for larger birds, but for smaller birds, the weight of a transmitter may be too heavy and consequently have adverse effect on the bird's behaviour by for instance hindering flight, disrupting mating, or preventing feeding. The way the transmitter is attached to the bird (glue, harness, sutures) is also important for the animal's welfare, and must be taken into consideration. An extensive literature search specific to the species in question is paramount to avoid particular problems and to identify good solutions. Avian species vary considerably in their ability to be equipped and how they are affected.

Radio- and satellite transmitters are particularly useful in studies of home-range, time budgets, habitat selection and migration (Kenward, 2000).

Conventional radio transmitters transmit pulsed signals in the Land Mobile Band mostly at 138-174MHz, though this varies between countries. These transmitters can be tracked actively by handheld receivers from land or air, or passively by stationary receivers put out where it is likely that the birds will appear. They are useful as such as they occur in size as small as 0.5g and last for a few days up till a few weeks. Larger models usually last longer since it is the size of the battery that determines the transmitter size.

Satellite transmitters (PTTs) come in many sizes, but are still being limited by the size of the battery package, the smallest currently being a PTT powered by a solar cell weighing 5g. These are tracked through the Doppler effect of the PTTs signal by polar orbiting satellites and the accuracy varies from ±150 to ±10-15km. PTTs weighing 22g and upwards have GPS capability and give accurate positions down to ±5m. For larger animals devices with inboard GPS use the GSM-system to transmit data, but these are still too large to be utilized on birds. These devices are very useful for bird species roaming within open landscape, but seems to have very limited use for forest dwelling species.

Attachment techniques vary, from backpacks, tail mounts, neck collars and implants.

Data loggers

Geo locators or data loggers are revolutionizing the research on migration in birds (see for example http://www.birdtracker.co.uk/). Geo locators can be as small as 1g and can be attached to most bird species. They does not transmit data (a few larger models can transmit on very short distance) so the bird must be retrapped to retrieve the data. The logger can collect data for 1-3 years about activity, light intensity, and some have a salt water switch making it possible to tell if the bird is on water or not. The light intensity together with time of day is enough to calculate a position on Earth with an accuracy of ±150km.

Isotopes and other internal markers

Ingestion of coloured plastic articles or radioactive isotopes such as P^{32} in bait can be used to study movements of individuals. It depends on the location of faeces and cannot be utilized to mark uniquely a larger number of individuals.

Other methods

There are other methods for marking birds, but some of these may cause harm to the bird, as they are considered to be more painful. These include, but are not limited to, feather clipping, toenail clipping, removal of tissue, tattooing and freeze branding.

Licences

In order to catch and mark birds in Norway, permission must be acquired from the Directorate for Nature Management (Direktoratet for Naturforvaltning, www.dirnat.no), according to the national legislation:

- Forskrift om innfanging og innsamling av vilt for vitenskapelige eller andre særlige formål (http://www.lovdata.no/for/sf/md/td-20030314-0349-001.html#3).
- Lov om forvaltning av naturens mangfold (naturmangfoldloven) (http://www.lovdata.no/all/tl-20090619-100-003.html#23).

Before starting a project using coloured rings/leg flags/neck collars, the following must be observed:

- Obtain permission from your ringing central to colour-ring birds.
- Obtain permission from the agreed international *Colour Ring-coordinators* for the colours and codes to be used. In case of no coordinator, you must contact others working with the species/or web admin at (www.cr-birding.be)
- Send project details to be added to the *European colour-ring Birding* website (www.cr-birding.be).
- Regular reports must be made to the field-observer and the national ringing central.

References & recommended reading

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