

Marking amphibians, reptiles and marine mammals: animal welfare, practicalities and public perceptions in New Zealand

David J Mellor, Ngaio J Beausoleil, Kevin J Stafford



Published by
Department of Conservation
PO Box 10-420
Wellington, New Zealand

Cover photo: Female sea lion with brand satellite transmitter (shoulder), time-depth recorder (mid-back) and VHF transmitter (hip) temporarily glued to the fur. She also has plastic flipper tags as does her pup.

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ISBN 0-478-22563-6

In the interests of forest conservation, DOC Science Publishing supports paperless electronic publishing. When printing, recycled paper is used wherever possible.

This report was prepared for publication by DOC Science Publishing, Science & Research Unit; editing by Sue Hallas and design/layout by Ruth Munro. Publication was approved by the Manager, Science & Research Unit, Science Technology and Information Services, Department of Conservation, Wellington.

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Introduction

Identification of wildlife aids biological study and conservation management and, usually, the most reliable approach is to apply an artificial mark. Marking can affect the animals involved through the act of marking itself, the wearing of the mark and the procedures required for observing the mark. Adverse effects may be evident immediately or appear long after the procedure is performed, and may have implications for animal welfare, ecological balance, the value of the information obtained and public support for wildlife research.

In terms of animal welfare, virtually all marking methods require capture, which is stressful¹ to wild animals. Many methods also involve tissue damage and therefore cause pain. Persistent infection or protracted healing may extend the period of pain and change an animal's behaviour and energy use. Moreover, after healing, wearing the mark may alter an animal's appearance, social interactions, other behaviours and survival. Repeated capture and handling for re-identification can cause persistent low-level stress, which may make marked animals more vulnerable to the effects of other natural stressors.

The adverse effects of marking may extend beyond the individual animal to include disruptions to populations or interactions between species and, thereby, disturbances to ecological balance. For instance, marking may restrict an animal's movement or feeding, alter predator-prey relationships, disrupt breeding or social interactions or alter distribution or migration patterns.

Each marking method has its own advantages and disadvantages. Scientists need to weigh up the anticipated benefits of the research with the probable adverse consequences of marking for

¹ Stress represents physiological responses to significant challenges, which can be emotional and/or physical. They elicit well-documented 'fight-or-flight' responses and changes that help to deal with possible injuries. Externally observable signs of stress include aggression, struggling or freezing behaviours, abnormal postures, vocalisation or its absence, impaired grooming, altered activity patterns, shivering, altered breathing, change in skin colour and body temperature change. The associated physiological responses may be measured.

individual animals, populations and ecosystems, because such negative effects would compromise the quality of the data collected. If a mark is lost or illegible, or if the data collected are inappropriate or are corrupted by marking, reduced animal welfare and other negative effects will have occurred without redeeming benefit. Application of the General Safeguards, as outlined below, together with those safeguards specific to each method, should help to maximise the benefits of marking programmes.

Wildlife managers or researchers who consider using a new marking method, or the application of an existing method to a new population, must first conduct an evaluation of the effects of the method itself on individual animals, the population or ecosystem. Such preliminary studies will help to determine the appropriate welfare safeguards, and give an indication of the reliability of the data obtained from that particular marked population.



Hector's dolphin (*Cephalorhynchus hectori*). PHOTO: © STEVE DAWSON, OTAGO UNIVERSITY.



Public perceptions and support

Public support for government-funded wildlife research is crucial. There will always be some people who object to interfering with wildlife in any way, and others who object to inflicting pain or stress on any wild animal. However, the majority of interested people appreciate the role of marking in wildlife biology and conservation, and it is to those people that scientists must demonstrate that the chosen methods are both suitable and humane.

Marking methods that appear to seriously harm animal welfare are likely to be unacceptable to the public. This applies in particular to methods that markedly change the appearance of the animal, obviously cause pain and/or stress, grossly alter behaviour or cause death. It is these types of negative effects that lead to public disquiet about wildlife marking. However, there is often a disparity between the *real* and *perceived* effects of marking on animal welfare. Methods that appear to the public to cause serious welfare problems, but in fact do not, may be more appropriate than other methods that are mistakenly considered to be benign. Therefore, it is critical that the public be informed about the benefits, risks and safeguards associated with each marking method used in New Zealand.

In the research context, all animal use in New Zealand must be approved by an Animal Ethics Committee (AEC). The law² requires that each AEC include, in addition to its scientific and technical members, a lay member (usually nominated by a local authority), an animal welfare advocate (usually nominated by the Royal New Zealand Society for the Prevention of Cruelty to Animals) and an independent veterinarian (nominated by the New Zealand Veterinary Association). These latter three members act as watchdogs on behalf of animals, and effectively represent the public interest. The members of the AEC must balance the anticipated value of the research against the pain and stress likely to be caused to the animals involved, and, in the case of marking, must decide whether the method is acceptable for the species and the research planned.

² Animal Welfare Act 1999.

There may be conservation and management activities involving marking that do not require formal approval from an AEC. We recommend that all marking methods used in such contexts, whether invasive or not, be assessed generically, preferably by each organisation's AEC. We also recommend that guidelines be drawn up for conservation managers, which include comprehensive species- and population-specific analyses of the practical and animal welfare advantages and disadvantages of each method, the safeguards, possible sources of public disquiet and the value of the information gained. They should be reviewed regularly and updated in the light of field experience and new research findings.

Public discontent with wildlife marking usually occurs when procedures are undertaken without the public being informed. Public perception of the degree of harm to welfare, whether accurate or not, must be considered if support for wildlife research is to continue. Most people respond positively to clear descriptions of project details and, especially, to the knowledge that measures have been put in place to safeguard animal welfare. Therefore, when animals are marked using a painful or stressful method, the following important steps should help to reduce public disquiet.

1. The public should be provided with the justification for the marking programme and the method chosen and a careful explanation of the benefits and general and specific safeguards employed.
2. Marking should be carried out only by knowledgeable and proficient personnel.
3. Anaesthesia and/or pain control should be used where appropriate.
4. Wounds should be treated appropriately.
5. The effects of marking should be monitored, untoward effects noted and, when necessary, remedial actions taken.
6. The outcomes of the research should be made public.

Another issue to consider is the extent of public access to the study site. If members of the public are unlikely to encounter marked animals, researchers may be more confident when

applying highly visible marks. In areas of high public access, the use of such methods may be unsuitable. However, it is important to remember that public perceptions of welfare problems may not accurately reflect actual problems, and methods which appear benign to the casual observer, may in fact cause serious harm. Nevertheless, an informed public will be less likely to respond negatively to encounters with marked wildlife.

Finally, it is imperative that information about wildlife marking be displayed in the most appropriate location. Where members of the public are likely to encounter marked animals, information about specific marking programmes should be prominently displayed or be readily available. Forewarning the public about the benefits and disadvantages, and the safeguards taken to minimise these disadvantages, will help to reduce public concern.

This booklet focuses on animal welfare impacts, practicalities and public perceptions associated with a range of methods used to mark wildlife found in and around New Zealand, in particular amphibians, reptiles and marine mammals. Further information about the methods discussed here is provided in the companion DOC publication *Methods for marking New Zealand wildlife: amphibians, reptiles and marine mammals* (2004).

Female sea lion with brand, white flipper tags and telemetry equipment (satellite transmitter, shoulder; time-depth recorder, mid-back; VHF transmitter, hip) temporarily glued to the fur. PHOTO: ©

PADRAIG DUIGNAN, MASSEY UNIVERSITY.



Why and how we mark animals



Reasons for marking animals include:

- To identify individuals or groups of animals in order to study demographics, behaviour, ecology and other aspects of the lives of wild animals
- To estimate population size and to determine rates of survival, reproduction and recruitment within specific populations
- To determine the ranges and distributions of individuals, populations or species
- To identify particular stocks and rates of stock mixing (This kind of information is used extensively to monitor populations undergoing conservation management.)
- To identify individual animals for behavioural studies
- To develop and verify aging techniques and to ascertain growth rates in individual animals

The methods described below have been classified according to mark durability, rather than ranked by their potential to cause animal welfare problems, for several reasons. The ranking of methods on animal welfare grounds would be complicated and subjective, and we do not believe that enough information exists at the present time to classify marking methods on welfare grounds alone. In addition, the potential welfare problems would differ according to species, the environment and other factors. Finally, wildlife practitioners, for whom this report is primarily written, will want to focus on the method first and then consider the associated animal welfare implications. Therefore, the methods outlined in this report are broadly categorised as *temporary*, *semi-permanent* and *permanent* (Table 1).

For each method, this booklet lists the inherent *advantages* and *disadvantages*, the *safeguards* taken to help to minimise disadvantages relevant to animal welfare, and the method's *acceptability*, in terms of practicality, biological function and animal welfare, and to the public. In addition, a list of General Safeguards which apply to all marking methods has been included, and must be referred to and followed by all personnel working with wildlife.

Forest gecko.
PHOTO: C. ROBERTSON.

TABLE 1. IDENTIFICATION METHODS.

TEMPORARY	SEMI-PERMANENT	PERMANENT
Paints or dyes Streamers, adhesive tapes, trailing devices Hair/fur removal Fluorescent powders Radioisotope marking	Tags Neck collars, harnesses, bands Nocturnal lights Telemetry (radio, satellite, bio) and archival data recorders	Hot, freeze or chemical branding Tattooing Passive integrated transponders (PIT) Visible implant fluorescent elastomer tags (VIE) Tissue removal: ear notching; toe, disc and web clipping Vital stains Using natural markings

Overloaded tuatara:
(Sphenodon punctatus) male,
 showing identification markings and with a radio transmitter attached, Stephens Island, July 1977.
 PHOTO: DON NEWMAN.



Chevron skink
(Oligosoma bomalonotum) with transmitter. This photo, taken in 2000, shows the much smaller size of transmitters now used.
 PHOTO: KERI NELSON.





General safeguards for marking wildlife

1. It must be demonstrated that marking is necessary to achieve the proposed research objectives.
2. The purposes and benefits of the method chosen must be sufficient to justify its adverse effects.
3. Devices and methods must be selected carefully. Where there is a choice, choose a device that has a size, weight and configuration appropriate for the animal's species, size, behaviour and habitat (i.e. a device that minimises any adverse effects on the animal).
4. Methods must meet the precise objectives of the study in terms of data required, study duration, recognition proximity (close/distant) and specificity (individual/group).
5. Only experienced and/or well-trained personnel who are proficient in the method should carry out marking.
6. Personnel should assess marking procedures which are new, or new to the particular population, on captive individuals or allied species before attempting to mark wild populations.
7. Since any handling may cause short-term stress, use gentle and minimal handling, and for the shortest time possible.
8. If the adverse effects of a method are not known, the literature must be reviewed or laboratory assessments made to discover these and measures must be taken to minimise them.
9. Accidental injury during marking should be treated and, if sufficiently serious, the animal should be euthanised.
10. Personnel must minimise the transmission of infectious diseases and parasites between animals during the marking procedure.
11. Marker-induced distortions of survival, reproductive success, behaviour and interactions between conspecifics and with other species need to be assessed and measures devised to minimise them. Data analysis must take account of such effects.
12. Wherever possible, monitor the health and welfare of marked animals.
13. Marking should not compromise conservation strategies for endangered or threatened species (e.g. kill methods or those that adversely affect reproduction should not be used), nor should it adversely affect the ecological balance or the environment.



Temporary methods

Temporary identification methods are those that are required to last for only a short time relative to the life span of the animal (Table 2). They tend to be readily visible from a distance, because of their contrasting colours and bold characters and symbols. Temporary marks are often used if more permanent methods of identification are expected to adversely affect the animal's welfare, or if no other options are viable.

TABLE 2. TEMPORARY IDENTIFICATION METHODS¹.

METHOD	SPEED OF APPLICATION	COMPLEXITY	COST
Paints and dyes	Fast	Low	Low
Streamers, adhesive tapes, trailing devices	Intermediate-Fast, depending on method	Low-Intermediate, depending on method	Low
Hair/fur removal	Fast	Low	Low
Fluorescent powders	Fast	Low	Low
Radioisotope marking	Slow-Fast, depending on attachment method, vehicle, isotope	Intermediate-High, depending on attachment method, vehicle, isotope	Intermediate-High, depending on attachment method, vehicle, isotope

¹ Ranks in columns (e.g. slow, intermediate and fast) are qualitative, comparative scores for the parameter listed for the methods in the table.



Clipping seal pup. PHOTO: PADDY RYAN.

SHORT-TERM STRESS	INFLUENCE OF OPERATOR	VISIBILITY	APPROPRIATE SPECIES
Low: some handling	Low	High	Terrestrial and marine mammals, reptiles, invertebrates
Low-Intermediate, depending on method	Intermediate	High	Birds, marine and terrestrial mammals, reptiles, amphibians
Intermediate, because of handling, machine noise, vibration	Low	Moderate-High	Haired/furred terrestrial mammals, pinnipeds
Low: handling	Low	Moderate-High depending on vegetation, ambient light	Small nocturnal mammals, reptiles, invertebrates
Low-High, depending on attachment method, vehicle, isotope	High	Low	Small or nocturnal terrestrial mammals, reptiles, amphibians, invertebrates

PAINTS OR DYES

Pigmented compounds such as paints and dyes are used to temporarily mark a wide variety of animals (Table 2). Paint can be applied to the surface of the integument or hair, and is usually lost over time through wear, skin sloughing or hair shedding. The durability of paint marks is dependent on the animal's environment and behaviour, as well as characteristics of the paint itself. Dyes and bleaches tend to produce longer-lasting changes when applied to hair or fur. Dyes impregnate the hair with colour, whereas bleaches remove pigment; the durability of marks made by dyes and bleaches depends mainly on hair shedding, but some dyes also fade.

Advantages

- Commonly available, versatile, cost-effective, quick and easy to apply
- Readily visible to observers at a distance
- Do not usually alter the behaviour of the marked animal
- Dyes and bleaches are useful for marking the hair of pinnipeds because of the durability of the marks in water

Disadvantages

- May be absorbed through the skin or ingested during grooming, and some paints/dyes may be toxic
- May increase the visibility of study animals to human observers and to predators or prey
- May cause marked animals to be treated differently by conspecifics
- The physical presence of paint or solvents may affect the animal's behaviour, e.g. by increasing the time spent grooming

Safeguards

- Adhere to the General Safeguards listed on page 13
- Choose non-toxic paints, dyes, solvents and bleaches

- Paint use is not advised on thickly furred animals, as fur clumping and/or matting can cause fur loss or skin problems, and such animals often remove (and ingest) paint quickly by grooming

Acceptability

- *Practicality*: High, because of their versatility, visibility, low cost and ease of application.
- *Biological and welfare acceptability*: High, provided all safeguards are followed, owing to the temporary nature of the mark, low stress associated with application, low physiological cost of wearing the mark and generally minimal effect on behaviour and survivorship.
- *Public perceptions*: Generally neutral or positive, unless marks make animals more visible to predators or prey, alter social interactions or cause toxic effects.

ATTACHED STREAMERS, ADHESIVE TAPES OR TRAILING DEVICES

Streamers and coloured or reflective tapes have been attached to a variety of animals in order to increase their visibility for a short time (Table 2). In addition, trailing devices (e.g. spools of thread) can be used to track animals over short distances or periods of time. Streamers or tapes are chosen to contrast with the natural colour or texture of the animal, and are generally attached to the integument or hair using non-toxic glue. Mark durability depends on the material, method of attachment, environment and habits of the animal.

Advantages

- Commonly available, versatile, cost-effective and often easy to apply (excluding marine mammals)
- Readily visible to the observer at a distance
- Marks attached with glue eventually fall off

Disadvantages

- Difficulty with attachment and retention of marks in marine mammals due to water friction
- The physical presence of the mark may affect the animal's behaviour: for example, the animal may vigorously and/or persistently attempt to rid itself of the device, which could result in stress or injury
- Marks, especially trailing devices, may cause the animal to become entangled in the device or snagged on features of the environment, which can lead to injury or death
- May increase visibility of study animals to human observers and to predators or prey
- May cause marked animals to be treated differently by conspecifics
- Lost marks may harm other animals by entanglement or ingestion
- Invasive anchorage of marks in tissue (e.g. in cetaceans) usually causes tissue trauma and pain

Safeguards

- Adhere to the General Safeguards listed on page 13
- Select non-toxic glue
- Select marks that minimise untoward behavioural responses, entanglement and snagging
- Marks or trailing devices that will not degrade or drop off the animal must be removed
- Consider using biodegradable materials or retrieving lost marks that may be hazardous to other animals
- For invasive tissue anchorage, use appropriate restraint, anaesthetic, anti-septic and measures of pain control

Acceptability

- *Practicality*: High, because of their visibility, low cost and relative ease of application (excluding cetaceans).
- *Biological and welfare acceptability*: High, provided all safeguards are followed, owing to the temporary nature and eventual disengagement of most marks. Exceptions include

devices that alter behaviour or cause entanglement, pain and/or tissue trauma.

- *Public perceptions:* Generally neutral or positive if the benefits and safeguards are explained. Negative perceptions would occur with entanglement, snagging (e.g. finding dead snagged animals), premature death and/or aberrant behaviour. Invasive attachment of marks would be of particular concern to the public.

HAIR/FUR REMOVAL

In those animals with sufficient hair/fur (Table 2), it can be removed by shearing, clipping or with chemical depilatory pastes to create identifying marks. Groups or individuals may be identified by using combinations of different numbers and/or mark locations.

Advantages

- Using clippers, hair removal is cost-effective, easy to achieve and usually painless
- Marks are usually highly visible, especially if the under-fur is a contrasting colour
- Can be combined with paint or dye to increase visibility or the number of animals individually marked

Disadvantages

- Only animals with sufficient hair/fur can be marked
- Limited application in small animals
- Marks last only until the next moult
- Handling may be protracted and therefore stressful, especially if accompanied by machine noise and vibration
- May increase visibility of study animals to human observers and to predators or prey
- May cause marked animals to be treated differently by conspecifics
- Chemical depilatory pastes may cause painful or stressful skin irritations
- Extensive hair removal may result in hypothermia or sunburn

Safeguards

- Adhere to the General Safeguards listed on page 13
- Extensive hair removal should be avoided
- Assess the welfare impacts of depilatory agents before use
- If hair/fur removal is combined with other methods (e.g. paints or dyes) apply their safeguards too

Acceptability

- *Practicality*: High, because of its visibility, low cost and relative ease of application.
- *Biological and welfare acceptability*: High, provided all safeguards are followed, owing to non-invasive application, temporary nature, low physiological cost of wearing the mark and generally minimal effect on behaviour, reproduction and survivorship. However, protracted handling accompanied by machine noise and vibration, or skin irritation due to chemical application, may adversely affect animal welfare.
- *Public perceptions*: Generally neutral or positive. Skin irritation (by chemical depilatories), sunburn, debilitating hypothermia and/or extensive hair/fur removal would generate significant public concern.

FLUORESCENT POWDERS

Nocturnal animals can be identified by dusting them with fluorescent powder. The released animal leaves a trail of fluorescence that can be detected in the dark using ultraviolet (UV) lamps. The animal and the trail are detectable for a few nights after dusting. This method is most useful in small mammals, as their fur helps retention of the powder, but it has also been used to track reptiles (Table 2).

Advantages

- Allows tracking and identification at night
- Powder is easy to apply, cost-effective and relatively easy to detect (with UV lamps)
- Information can be gathered immediately or over the next few nights

- Particularly useful for assessing movement patterns, and home range and habitat use

Disadvantages

- Data must be gathered within a few nights, owing to powder loss through environmental contact and grooming
- Trail detection is hindered by vegetation cover, precipitation and high ambient light intensity
- May be absorbed through the skin or ingested during grooming, and some powders may be toxic
- Powder may influence heat absorption in reptiles
- Marked animals are often very conspicuous during the day owing to the brightness of the powder, which may affect predator-prey and/or intraspecific interactions
- Marked animals may be more conspicuous at night if predators, prey and/or conspecifics can detect fluorescence
- The physical presence and/or taste of the powder may affect the animal's behaviour, e.g. by increasing time spent grooming

Safeguards

- Adhere to the General Safeguards listed on page 13
- Choose non-toxic powders
- Do not apply powders to animals that are normally active during the day, to minimise effects on predator-prey and intraspecific interactions
- Apply powder only to ventral and lateral parts of the animal, to minimise effects on heat absorption

Acceptability

- *Practicality*: High, because of the visibility of marked animals at night (under UV light), low cost and ease of application.
- *Biological and welfare acceptability*: Moderate, provided all safeguards are followed. The mark is short-lived, wearing it carries a low physiological cost and, generally, effects on behaviour, reproduction and survivorship are low. However, bright powders may make marked animals more conspicuous

during the day, or at night if predators, prey or conspecifics can detect fluorescence.

- *Public perceptions:* Generally neutral or positive if the purposes and safeguards are properly explained. However, the difference between fluorescent powders and radioactive materials should be clarified to avoid confusion and negative public reactions.

RADIOISOTOPE MARKING

Radioactive material can be applied in various ways in order to study small, camouflaged, retiring or nocturnal animals, which would otherwise be difficult to study (Table 2). Each radioactive isotope has an energy emission profile that allows detection and can cause tissue damage (radio-toxicity). The choice of radioisotope depends on availability, type of radiation emitted, radio-toxicity, half-life of the isotope, distance of detection required and the length of the study. Radioactive material can be incorporated into externally attached wires, pins, capsules or tags, or attached to leg bands, collars or harnesses (see below). Radioisotopes can also be implanted into the body with a needle, which often requires an anaesthetic. Inert implanted radioisotopes are not metabolically active, and are not incorporated into the tissues. Metabolisable radioisotopes can be implanted in the same manner as inert tags, or by forced or natural feeding. These marks are incorporated into the tissues by the metabolic processes of the body. Metabolically active radioisotopes can be passed on to offspring and may be voided in urine and faeces, thereby allowing the study of movement and dispersal of labelled animals, as well as their reproductive success.

Advantages

- Enable researchers to study the movement, behaviour, social interactions, home ranges, migration, predator-prey interactions and other features of animals which are otherwise difficult to study
- Wide variety of materials and attachment methods allows application to a range of species

- Allow tracking of labelled animals for long periods without direct interference by the researcher
- Radioactive marks cannot be detected by the labelled animal or its conspecifics, predators or prey

Disadvantages

- Non-target predators may become labelled by consuming radioactive prey. Other non-target animals may become labelled by uptake of radioisotopes lost to the environment
- The environment itself may become contaminated
- Identification of individual animals is not possible
- Exposure to radioactive material may be hazardous to researchers and members of the public
- Methods are expensive (equipment, safety precautions, special training, licences and permits) and laborious (preparation and handling of radioactive material)
- Tissue damage due to radiation may seriously debilitate or kill the labelled animal
- The behaviour of labelled animals may be seriously affected by radio-toxic effects, thereby invalidating behavioural data
- Handling and radioisotope introduction may cause stress, pain and/or infection (in the case of implanted marks)
- Recapture for tag recovery may be necessary to avoid environmental contamination or minimise radio-toxicity, thereby increasing the handling stress experienced by labelled animals
- Other disadvantages may be related to external methods of attachment (see Tags and Neck collars, harnesses or bands)

Safeguards

- Adhere to the General Safeguards listed on page 13
- If possible, use alternative methods for identifying or tracking animals
- Carefully choose the radioisotope based on the detection distance required, length of study, radioisotope half-life, emission profile and radio-toxicity

- Limit the animal's exposure to the radioactive material by retrieving the label and using shields (e.g. capsules for inert implantations)
- Monitor labelled animals for any symptoms of radio-toxicity and remove the label, or humanely kill the animals, when any such symptoms are detected
- Remove all external attachment devices from the animals at the end of the study
- Retrieve any radioactive material lost to the environment
- Follow all legal and institutional safety precautions

Acceptability

- *Practicality*: Poor to moderate; only justifiable when safer, less complex, less laborious and less expensive alternatives cannot be used.
- *Biological and welfare acceptability*: Poor to moderate, even when all safeguards are followed, as all radioactive materials have the potential to cause radio-toxic effects that could impact negatively on the health, behaviour and survivorship of labelled and non-target animals, and contaminate the environment.
- *Public perceptions*: Most likely to be strongly negative, especially if labelled and non-target animals suffer debilitating or fatal radio-toxic effects, or if this were only suspected to be the case. The public would also view the possibility of environmental radioactive contamination most unfavourably.

Goldstripe gecko
(*Hoplodactylus
chrysosireticus*),
Taranaki. *Top*: with
temporary markings
using xylene-free silver
ink pen; *bottom*:
without markings.

PHOTOS:
HALEMA JAMIESON.

