

Methods of Marking and Identification for Dogs and Cats

To successfully implement sterilization or population control programs, a means to identify animals that are part of the program or that have received treatment is required. Many organizations involved in dog and cat welfare face the challenge of humanely and effectively identifying individual animals, and some organizations have engaged in evaluation of different identification options.¹ There are diverse scenarios in which marking and identification of dogs and cats is desirable, and these different situations would have unique requirements for:

- the amount and type of information that must be conveyed by the mark
- the duration of the mark
- the visibility of the mark
- the number of animals that must be marked
- the expense of the technology
- the degree of handling or restraint required to create the mark
- the degree of handling or restraint required to detect the mark

The ideal combination of these factors that might be appropriate for one application might not be useful for another. For example, a marking system to identify owned animals that have been treated with a specific sterilant or contraceptive might incorporate individualized information, such as owner name and address, while a marking system to identify unowned animals that have been treated might require a simple color-coded tag or collar to indicate membership in the treated population. Similarly, marking to enable tracking of animals in a study of population dynamics might require more detailed information or higher technology (such as GPS tracking) than other types of studies.

This report summarizes methods currently in use to mark animals, including livestock, wild populations, and laboratory animals. It is organized by method, and generally from the least to the most invasive approaches. Pain is included as a category, but assessing pain in animals is a difficult question.² Only methods applicable to dogs and cats are included (ie, methods specific to birds such as wing banding, or to marine mammals such as web tags, will not be discussed).

1. Observation of natural markings, including photography

For some animal species that may be difficult to capture or to which it is difficult to apply a mark, careful observation and record keeping, frequently combined with photography, have provided a means to identify and track individuals in the field. The approach has been successfully applied to marine mammals including whales,³ orcas, and dolphins,⁴ and terrestrial mammals including wild horses,⁵ and has the advantage of being completely non-invasive and not altering the appearance of the animal, which in some cases may alter the interaction of an animal with other

¹ Identification methods for dogs and cats. World Society for the Protection of Animals, Companion & Working Animals Unit.

² Guidelines for pain and distress in laboratory animals: responsibilities, recognition and alleviation. (http://oacu.od.nih.gov/ARAC/documents/Pain_and_Distress.pdf, accessed November 23, 2012).

³ WhaleNet (<http://whale.wheelock.edu>, accessed December 3, 2012).

⁴ The use of photo-identification in dolphin research. Copyright © 2007 DOLPHIN RESEARCH CENTER. (http://www.dolphins.org/marineed_photoid.php, accessed July 17, 2012).

⁵ Kirkpatrick JF and Turner A. Achieving population goals in a long-lived wildlife species (*Equus caballus*) with contraception. *Wildlife Research*. 2008. 35:513-519.

animals in its environment. However, the approach is limited to animals that have distinctive individual markings, requires that the animal be observed under specific conditions (such as daylight, and in a location where an observer or camera is able to detect the marking of interest), and requires extensive record-keeping of drawings and/or photographs that may not be easily computerized or scaled up for use with a large number of animals. Some scientists are pioneering the use of sophisticated computer-based image analysis to expedite the identification of individuals contained within a population database,⁶ and a program to assist in matching photos of stray dogs has been developed.⁷ Although no physical contact with the animal is required, the need to be close enough to the animal to make an observation may be intrusive in some cases. Technology such as cameras with zoom lenses can facilitate observation from a distance. On a smaller-scale, photographic sampling through monitoring of feeding stations in feral cat colonies was found to be an accurate way to measure population size and identify certain individual cats.⁸

For application to large-scale dog and cat sterilization programs, this method has the disadvantage that it would not be obvious to a casual observer whether an animal is part of a program and has been sterilized. A monitor would need access to a database of animals to look up an individual based on appearance to determine if it has been treated.

Used in – species including whales, dolphins, orcas, horses, small-scale study in cats

Invasiveness – none

Pain – none

Danger to animal – none, though animal may be distressed if observer needs to approach closely (for example, in a boat when trying to observe marine mammals)

Skill required to apply – careful note taking, some type of referencing system to organize and access the images

Skill required to read – careful observation, an indexed referencing system to allow an observer to look up the marking and match the current observation with earlier observations

Information that can be conveyed – would require access to database or referencing system to find information about the individual (ie recognition that an animal has been sterilized would not be immediate but would require finding the animal in the reference)

Duration – potentially lifelong

Visibility – depends on the animal; for cats and dogs, it probably would be very difficult to differentiate similar animals

Expense/scale – not easy to scale up with respect to referencing and indexing the data

Handling to apply – in theory, handling is not necessary if the traits are easily visible

Handling to detect – in theory, handling is not necessary

2. Collars

Neck collars are commonly worn by owned dogs and cats, and are generally recognized in the United States and other parts of the world as a sign that an animal is owned and being cared

⁶ Kehtarnavaz N, Peddigari V, Chandan C, Syed W, Hilman G, and Wursig B. Photo-identification of humpback and gray whales using affine moment invariants. In: Image Analysis: 13th Scandinavian Conference, Scia 2003, Halmstad, Sweden, June/July 2003 Proceedings. Springer-Verlag Berlin, Germany. Page 109.

⁷ Conservation Research. (<http://www.conservationresearch.co.uk/straydog/straydog.html>, accessed December 3, 2012).

⁸ Masters Thesis, Kimberly Byrd Subacz, Auburn University, Impact assessment of a trap-neuter-return program on selected features of Auburn, Alabama feral cat colonies.

for. In this way, the collar itself can be a marker. By incorporating color-coding or other patterning, a collar can indicate the year in which, or method by which, an animal has been treated. Collars can also be modified to communicate additional information, such as by numbering, barcoding, or the attachment of tags. In the United States, many state and local laws require that dogs and cats wear collars with tags specifying that the animals have been vaccinated against rabies. Collars can also be outfitted with radio transmitters, which have been used to track dogs⁹ and cats,¹⁰ as well as large animals including lions¹¹, and GPS-enabled to allow real-time tracking¹² and monitoring of activity levels.¹³

Collars can be made from a variety of materials, and are relatively inexpensive to produce in large numbers. However, collars are not a permanent means to mark a dog or cat, and can endanger unowned animals that are not the subject of regular supervision to identify and treat problems related to the collar. A special consideration for the use of collars with juvenile animals is that as the animal may outgrow the collar. Collars can cause skin irritation, and can be snagged on items in the environment or can trap an animal's jaw or leg if the animal tries to get the collar off. In one study, 2 of 23 cats fitted with tracking collars died soon after release due to collar strangulation.¹⁴ For this reason, breakaway collars are frequently used for owned cats, further reducing the persistence of the collar as a means of identification. A study of 3 different collar types (plastic buckle, breakaway plastic buckle, and elastic stretch safety) found breakaway plastic buckle collars were most likely to be lost over the 6-month study period.¹⁵ In this study, all three types of collars were found to be safe when carefully fitted and monitored by the owner: only 3.3% of the 538 cats in the study withdrew from the study because their collar had caught on an object (0, 0, 3 cats in the plastic buckle group, the breakaway plastic buckle group, or the elastic stretch safety group respectively), in their mouth (2, 4, 4 cats respectively), or on their forelimb (1, 3, 1 cats respectively).

Used in – many species including dogs, cats, and larger animals such as lions, bears

Invasiveness – none

Pain – none

Danger to animal – potential for collar to irritate the skin or become caught on items in the environment, and for animal to get leg or jaw trapped in the collar while trying to remove it, potential for animal to outgrow collar

Skill required to apply – none, except the ability to safely handle the animal and the knowledge of how to properly apply collar with respect to tightness

⁹ Wildlife Materials, Inc: Transmitter Collars. (<http://wildlifematerials.com/dog/products/transmitters.php>, accessed July 17, 2012). Unique Distributors: Tracking Systems for Dogs (<http://uniquedistributors.com/radiotracking.html>, accessed July 17, 2012).

¹⁰ Masters Thesis, Kimberly Byrd Subacz, Auburn University, Impact assessment of a trap-neuter-return program on selected features of Auburn, Alabama feral cat colonies.

¹¹ Predator Conservation Trust: Radio Tracking of Wildlife (<http://www.predatorconservation.com/radiotracking.htm>, accessed July 17, 2012).

¹² Securus Inc: Spotlight GPS Pet Locator (<http://www.spotlightgps.com/tracking.aspx>, accessed August 5, 2012).

¹³ Johnson K. 'Smart Collar' in the works to manage wildlife better. *New York Times*. August 29, 2011. (<http://www.nytimes.com/2011/08/30/us/30collars.html>, accessed July 17, 2012).

¹⁴ Masters Thesis, Kimberly Byrd Subacz, Auburn University, Impact assessment of a trap-neuter-return program on selected features of Auburn, Alabama feral cat colonies.

¹⁵ Lord LK, Griffin B, Slater MR, Levy JK. Evaluation of collars and microchips for visual and permanent identification of pet cats. *J Am Vet Med Assoc*. 2010; 237(4):387-394.

Skill required to read – none. Visible enough to be useful to the general public to recognize an animal that has been neutered.

Information that can be conveyed – yes/no information – has this animal been treated. With color-coding, can add information such as year animal was treated, or method by which treated (eg red for surgical sterilization, yellow for non-surgical, etc). Addition of tags (color-coded or imprinted) can allow for more detailed information.

Duration – not permanent. Ability to track an animal with GPS-enabled collars will depend on battery type; rechargeable batteries can provide 5 to 7 days of continuous tracking between charges,^{16,17} while lithium batteries can last up to 16,000 hours.¹⁸

Visibility – high

Expense/scale – relatively inexpensive for regular collars; GPS collars cost about \$150, including enrollment in a recovery service. Easy to scale up; companies can manufacture custom collars.

Handling to apply – need to capture and restrain animal to apply collar. Anesthesia not required, but collar could be applied at time of surgery if animal is treated with surgery.

Handling to detect – none, unless imprinted tags are used that must be viewed up close

3. Leg bands

Leg bands, often made from metal or rigid materials, are typically used to identify and track birds,¹⁹ but flexible leg bands are available for goats,²⁰ and reflective leg bands made from an elastic material are available for dogs as a safety measure when walking at night.²¹ The reflective leg bands are not intended for long-term use, but for the duration of a walk. For dogs and cats where the foot may not be much larger in diameter than the leg, it may be difficult to maintain leg bands for long periods of time.

Used in – species including birds, goats, dogs

Invasiveness – none

Pain – none

Danger to animal – potential for tissue damage and/or infection if a rigid material is used long-term with mammals; potential for skin irritation; potential for animal to scratch at band and inflict injury; potential for band to snag on item in the environment; potential for juvenile animal to outgrow band

Skill required to apply – none, except the ability to safely handle the animal and the knowledge of how to properly apply band with respect to tightness

Skill required to read – none. Visible enough to be useful to the general public to recognize an animal that has been neutered.

Information that can be conveyed – similar to collar – yes/no information – has this animal been treated. With color-coding, can add information such as year animal was treated, or

¹⁶ Retriva Dog Tracking (http://www.retrievatracking.com/tracking_anti_theft_dog_collar.aspx, accessed Nov 23, 2012).

¹⁷ Securus Inc: GPS Pet Locator FAQs (<http://www.spotlightgps.com/gps-pet-tracking/pet-tracking-devices-faqs.aspx>, accessed November 23, 2012).

¹⁸ LL Electronics Dog Tracking Collar (<http://www.radiotracking.com/dogs.html>, accessed Nov 23, 2012).

¹⁹ Migration Research Foundation: Methods, Banding/Tagging (<http://www.migrationresearch.org/methods/banding.html>, accessed July 17, 2012).

²⁰ Caprine Supply: Nylon Leg Bands (<http://www.caprinesupply.com/products/goat-management/i-d-products/nylon-leg-bands.html>, accessed July 17, 2012).

²¹ Foster and Smith, Inc: Bright Steps Leg Bands (http://www.drsfostersmith.com/product/prod_display.cfm?pcatid=22413, accessed July 17, 2012).

method by which treated (eg red for surgical sterilization, yellow for non-surgical, etc). Bands can also be imprinted with numbers or text or a barcode to communicate additional information.

Duration – Years for birds. Uncertain how long they can be worn by goats, cats or dogs; flexible bands are likely to be chewed off or otherwise removed by an animal, while less-flexible bands are more likely to cause tissue damage if worn long term.

Visibility – high

Expense/scale – easy to scale up; companies can manufacture custom bands

Handling to apply – need to capture and restrain animal to apply band

Handling to detect – none, unless band must be viewed at close range to read imprinted information

4. Iris and retinal scanning

Retinal scanning and iris scanning are noninvasive means of uniquely identifying an animal. Iris scanning is currently available for horses, and images may be linked to a registry to help identify lost horses, and to a horse's medical records.²² For horses, iris imaging is preferred to retinal scanning for identification because the retinal vessels are small.²³ Studies applying retinal scan technology to cows²⁴ and dogs²⁵ have determined that this technology would be a feasible way to identify individual animals. Retinal imagers for cattle and sheep are commercially available,²⁶ and retinal images are required for 4-H ruminant animals entered at the Indiana State Fair. The Fort Collins, Colorado company, Optibrand, sells a ClearView® Optical Imaging System for veterinary use in dogs and cats, and a seemingly similar product, the ClearView ID system, for in-the-field acquisition of livestock retinal images. The ClearView Optical Imaging System is a hand-held device that is held close to the face of the animal, and images are sent directly to a computer.²⁷

Used in – horses, livestock (a feasibility study was conducted in dogs, but no reports of subsequent use in dogs were identified)

Invasiveness – none

Pain – none

Danger to animal – none

Skill required to apply – need a scanner, and must register image in a database. Horse iris scans are acquired from a distance of 12-14 inches. Retinal imaging of livestock requires that the animal be restrained in a squeeze chute or calf cradle.

Skill required to read – need a scanner and access to the database to identify a registered animal

²² Global Animal Management Inc: eyeD

(<http://www.veteyed.com/?gclid=CMiwn5eTg7ECFc2A7QodMUE7Aw>, accessed July 17, 2012).

²³ DVM Newsmagazine: Iris scan technology for horses

(<http://veterinarynews.dvm360.com/dvm/article/articleDetail.jsp?id=715258&sk=&date=&pageID=3>, accessed July 17 2012).

²⁴ Allen A, Golden B, Taylor M, Patterson D, Henricksen D, Skuce R. Evaluation of retinal imaging technology for the biometric identification of bovine animals in Northern Ireland. *Livestock Science*. 2008. 116(1):42-52.

²⁵ Gionfriddo JR, Lee AC, Precht TA, Powell CC, Marren KK, Radecki SV. Evaluation of retinal images for identifying individual dogs. *Am J Vet Res*. 2006 Dec;67(12):2042-5.

²⁶ Optibrand Ltd. LLC: Livestock Applications (<http://www.optibrand.com/applications/>, accessed July 17, 2012).

²⁷ ClearView introduction video. (http://www.optibrand.com/vetdiagnostics/clearview_introduction.html, accessed August 5, 2012).

Information that can be conveyed – the unique image can be linked to a database in which any information can be stored, such as address, medical records, etc

Duration – lifelong

Visibility – none

Expense/scale – scanners cost approximately \$2600. For horse iris scanning, an animal and its associated iris image can be assigned a 15-digit alphanumeric ID number and registered with a service that would maintain the animal's information for approximately \$100 a year.

Handling to apply – would need to restrain the animal to acquire the image; horse iris images are captured from a distance of 12 to 14 inches from the eye. The OptiReader® retinal scanner captures and stores an image of cattle retinal patterns in less than 15 seconds; the ClearView Optical Imaging System, used for veterinary diagnostics rather than ID, is held about an inch from the face of a dog or cat.

Handling to detect – would need to restrain the animal to acquire the image, as above

5. Paint

Paint has been used to mark a variety of animals, from paint or ink applied by hand to keep track of farm animals over a short period,²⁸ to paint balls used to mark bears that wander into campgrounds or other populated areas. This method can be useful during a concentrated campaign to indicate which animals had been treated. A pilot study of the use of xylene-based paint pens in marking side-blotched lizards (*Uta stansburiana*) suggested a dose-related, adverse effect of using the pens and cautioned that “field biologists should avoid using these paints for marking lizards or other animals”.²⁹ Material safety data sheets (MSDS) for some paint markers and spray paints marketed as non toxic indicate the paint should not be ingested, and list exposure hazards for people handling the products,³⁰ so care should be taken in selecting a product.

Used in – many species including pigs, sheep, cattle, horses, bears

Invasiveness – minor; paint can be absorbed through skin or ingested if animal licks paint

Pain – assumed to be none. Delivery by paint spray or paint ball may be painful; care should be taken to avoid getting paint in eyes.

Danger to animal – potential of animal to ingest paint when grooming. In some cases, changing the color of an animal may affect its interactions with other animals in its environment, for example, by making it more difficult to utilize camouflage.

Skill required to apply – in some cases the animal can be painted from a distance (ie pump spray guns or paintballs³¹), but in many cases, the person applying the paint may need to be able to safely handle the animal, and possibly restrain or sedate the animal if a specific pattern or location is desired

Skill required to read – none. Visible enough to be useful to the general public to recognize an animal that has been neutered.

²⁸ Alibaba.com: Animal Marking Paint (<http://www.alibaba.com/showroom/animal-marking-paint.html>, accessed July 17, 2012).

²⁹ Boone JL, LaRue EA. Effects of marking *Uta stansburiana* (Sauria:Phrynosomatidae) with xylene-based paint. *Herpetological Review*. 1999. 30:33-34.

³⁰ LA-CO® Markal® All-Weather Quik Shot® Spray Paint Livestock Marker MSDS, Revision date January 8, 2009. LA-CO Markal All-Weather PaintStik. Revision date September 13, 2010.

³¹ New York State Department of Environmental Conservation: High Peaks Black Bear Study (<http://www.dec.ny.gov/animals/7219.html>, accessed July 17, 2012). Nelson Paint Company: The Inventor and Innovator of Paintball (<http://www.nelsonpaintball.com/about.html>, accessed July 17, 2012).

Information that can be conveyed –yes/no information regarding whether this animal has been treated. Could potentially paint a number or symbol for additional information tracking.

Duration – brief: weeks – mainly useful for short-term studies of population/migration

Visibility – high

Expense/scale – easy to scale up; paint brands and stencils can be purchased to make it easier to apply numbers and letters³²

Handling to apply – likely would need to capture and restrain animal to apply paint

Handling to detect – none

6. DNA profiling

DNA profiling allows accurate identification of an individual. DNA profiling is available to verify the pedigrees of animals, including cats and dogs.³³ In Petah Tikva, Israel, officials are trying to compile a DNA bank of the city's dogs, and to compare samples from droppings to identify owners who are not cleaning up after their pets,³⁴ and a similar PooPrints program is being used by apartment complexes in the United States.³⁵ Though not a visible mark, a DNA profile, if maintained in a registry or database, provides a way to absolutely identify an individual.

Used in – many species, used in dogs, cats, and livestock to prove pedigree, and in wildlife and PooPrints programs to verify the presence of a specific individual by DNA typing animals' leavings

Invasiveness – none to moderate – can obtain sample from feces, a cheek swab, or blood draw

Pain – none to minimal

Danger to animal – none

Skill required to apply – none if fur collected; need to safely handle and restrain the animal if cheek swab is taken

Skill required to read – would need to re-do the DNA analysis of an animal and check it against some registry to identify the animal, so requires skilled operators, high tech equipment, and time

Information that can be conveyed – a DNA fingerprint can identify an individual if compared against a prior sample. A database can link the DNA fingerprint to detailed information.

Duration – lifelong

Visibility – none

Expense/scale – retail price for PooPrints, \$29.95 to register a dog, \$10 for a collection kit, and \$49.95 for analysis and matching. Wholesale cost may be less.

Handling to apply – need to capture animal to collect initial sample

Handling to detect – in most scenarios would need to recapture animal (exception would be typing of feces to identify presence of individuals in the environment)

7. Microchips

³² L & H Branding Irons: Paint Branders (<http://www.lhbrandingirons.com/branders/paint.asp>, accessed July 17, 2012).

³³ Animal DNA Laboratory: Cat DNA Fingerprinting (http://www.animalsdna.com/web/page/feline_dna_profile, accessed July 17, 2012). The Kennel Club: DNA Profiling (<http://www.thekennelclub.org.uk/item/463/>, accessed July 17, 2012).

³⁴ Skloot R. The dog-poop DNA bank. *The New York Times*. December 12, 2008.

³⁵ Palmer K. Sleuthing out a doggie whodunnit. *Minneapolis Star Tribune*. December 5, 2011.

Microchips are passive radio-frequency identification (RFID) devices that are commonly used by shelters and owners to track dogs and cats. There are three microchip frequencies in the United States: 125 kHz, 128 kHz, and 134.2 kHz. The 134.2 kHz frequency is the ISO (International Standards Organization) standard and is the primary frequency used worldwide. In this frequency band (120-140 kHz), the range for passive detection is typically 10 cm.³⁶ Scanners have been developed that can read each of the different types of chips, and there are universal scanners that are able to read or detect any of these chips in a dog or cat.³⁷ The chip encodes a number that must be registered with a service³⁸ to retrieve information about the animal bearing the chip.

Used in – species including livestock, dogs, cats, horses

Invasiveness – moderate – chip implant is injected under the skin with a pre-loaded implanter

Pain – minimal, similar to vaccination

Danger to animal – none

Skill required to apply – safely handle and restrain animal; familiarity with use of implanter

Skill required to read – must have a microchip reader to detect and decode the chip, must have proper technique to locate implanted chip, must have access to the registry maintained by the company for commercially available chips

Information that can be conveyed – whatever information is contained within the registry database, which can include name and address of owner, medical history, and more

Duration – lifelong, though the chip can migrate from the original injection site

Visibility – none – requires scanner to detect

Expense/scale – approximately \$15 to \$60 to have a private or shelter veterinarian implant the chip and to register the animal. HomeAgain chips, preloaded in a syringe and purchased in bulk, cost about \$9.50 each.

Handling to apply – need to capture and restrain the animal

Handling to detect – need to capture and restrain the animal

8. Freeze branding

Freeze branding is an alternative to hot branding that is used to mark livestock.^{39,40} A cold iron is applied to the skin and alters the cells that produce hair pigment, resulting in white hair. Longer application can permanently destroy hair-producing cells, resulting in a bald spot that more resembles a hot brand. The metal branding iron is supercooled, usually in a mixture of dry ice and methanol or liquid nitrogen, and applied to shaved and washed skin. Since animal-to-animal variation in the appearance of the brand is greater than with hot branding, the Oklahoma Cattlemen's Association recommends that hot and not cold branding be used for ownership

³⁶ Recknagel S. Low-frequency RFID in a nutshell. Texas Instruments. Application Report SWRA284 - September 2011.

(<http://www.ti.com/general/docs/lit/getliterature.tsp?literatureNumber=swra284&fileType=pdf>, accessed November 23, 2012).

³⁷ How does microchipping work? (http://microchipregistry.foundanimals.org/help_and_faq.php, accessed December 3, 2012).

³⁸ AVID: Saving Pets (<http://www.avidid.com/pets/index.html>, accessed July 17, 2012). American Kennel Club: Pet Recovery Services (<http://www.akccar.org/recovery/>, accessed July 17, 2012).

³⁹ Utah Department of Agriculture and Food: Freeze Branding (<http://ag.utah.gov/divisions/animal/brands/freeze.html>, accessed July 17, 2012).

⁴⁰ Freeze Branding (agr.wa.gov/FoodAnimal/Livestock/docs/Freeze_Irons.pdf, accessed November 23, 2012).

purposes,⁴¹ but studies indicate freeze branding causes less discomfort to cattle than hot branding⁴² and freeze brands are legal marks of ownership in states including Oklahoma, Washington, and Utah.

The Royal Society for the Prevention of Cruelty to Animals commissioned a report in 2010 that concluded that, when a visible means of identification is required or desired to prevent theft, freeze branding is preferable to hot branding for horses and ponies.⁴³ The technique has been used on the ears⁴⁴ or flanks of hunting dogs, and its utility in marking bats has been studied.⁴⁵ In the bat study, no anesthesia was used, and some discomfort was observed while the brand was applied, but no longer-term problems were described.

Used in – species including livestock, dogs, small mammals including mice and bats

Invasiveness – moderate; melanocytes in skin are destroyed.

Pain – studies indicate discomfort is less than hot branding but greater than sham branding;⁴⁶ the cold of the iron is thought to have a numbing effect; skin swells and scabs over after branding; discomfort possible during healing.

Danger to animal – low; freeze branding rarely results in infection

Skill required to apply – requires proper training to correctly create brand, animal must be restrained, if brand is applied for too long it can cause scabbing or tissue necrosis and the new skin that grows may contain melanocytes (producing colored hair instead of white) resulting in an indistinct brand

Skill required to read – none

Information that can be conveyed – symbol to say animal treated, or number to mark individual animal

Duration – lifelong

Visibility – high, though a pattern may be difficult to detect in a long-haired animal, and animals with white hair or fur will require longer application of the freeze brand to generate a bald spot resembling a hot brand

Expense/scale – special equipment and the ability to maintain dry ice are required. Freeze branding irons for livestock cost from \$32 for small standard numbers and letters to \$200 for larger irons or custom designs.⁴⁷ The cost was \$0.28 per bat in a study of freeze branding bats⁴⁸

Handling to apply – would need to capture and restrain animal

Handling to detect – none on short-haired animals; the brand can be difficult to read on long-haired animals or under winter coat

⁴¹ Livestock Branding in Oklahoma, Oklahoma Cooperative Extension Service ANSI-3255.

⁴² Schwartzkopf-Genswein KS, Stookey JM, Welford R. Behavior of cattle during hot-iron and freeze branding and the effects on subsequent handling ease. *J Anim Sci.* 1997. 75:2064-2072.

⁴³ RSPCA: Science Group Review of 2011. March 2012

(<http://www.rspca.org.uk/ImageLocator/LocateAsset?asset=document&assetId=1232728895850&mode=prd>).

⁴⁴ CoonDawgs.com: Freeze Branding 101 (<http://www.coondawgs.com/freezebrand.html>), accessed July 17, 2012).

⁴⁵ Sherwin RE, Haymond S, Stricklan D, Olsen R. Freeze-branding to permanently mark bats. *Wildlife Society Bulletin.* 2002. 30(1):97-100.

⁴⁶ Schwartzkopf-Genswein KS, Stookey JM, Welford R. Behavior of cattle during hot-iron and freeze branding and the effects on subsequent handling ease. *J Anim Sci.* 1997. 75:2064-2072.

⁴⁷ L & H Branding Irons: Freeze Branders (<http://www.lhbrandingirons.com/branders/freeze.asp>, accessed July 17, 2012).

⁴⁸ Sherwin RE, Haymond S, Stricklan D, Olsen R. Freeze-branding to permanently mark bats. *Wildlife Society Bulletin.* 2002. 30(1):97-100.

9. Hot branding

Hot branding is a common way to mark livestock. If done correctly, hot branding is considered safe, and a recent publication found that horses experienced equal distress from hot branding and microchip implantation.⁴⁹ However, hot branding is considered by many to be painful and dangerous since incorrect branding can lead to open sores that can become infected, and the hot branding of horses has been banned for animal welfare reasons in Denmark and Scotland and is under debate in Germany.

Used in – primarily in livestock including cattle, horses

Invasiveness – moderate; involves burning the skin with a hot iron to remove all hair and leave a mark in the shape of the metal applied

Pain – high; anesthesia is typically not used, and discomfort may occur during healing

Danger to animal – infection can occur if a branding iron is too hot and damages the skin, or if the branding iron is too cool and is applied to the skin for a long period of time

Skill required to apply – safely handle and restrain the animal

Skill required to read – none

Information that can be conveyed – symbol to say animal treated, or number to mark individual animal

Duration – lifelong

Visibility – high in short-haired animals; low in long-haired animals

Expense/scale – An electric hot-branding iron for characters smaller than 4” costs about \$100⁵⁰ while fire-heated irons cost from \$50 to \$250 depending on the size and number of characters. Portable propane brand heaters cost about \$250.

Handling to apply – animal must be restrained

Handling to detect – none on short-haired animals; brand can be difficult to read on long-haired animals or under winter coat

10. Tattoos

Tattoos have been used in dogs and cats. Animals can be tattooed with a number that is registered with a service,⁵¹ or a letter or symbol on the abdomen, ear, thigh, or inside the lip or cheek. Ear tattoos are often applied using tattoo pliers (also called a tattoo machine or tattoo gun on some websites), which consist of a clamp with needle-like projections; ink is applied to the area to be tattooed and the clamp is squeezed on the ear and the needles pierce the skin. Ink is then rubbed over the small punctures and will remain in the skin once it heals. Tattoo pens (hand-held vibrating needles containing tattoo ink, also called tattoo guns on some websites) are often used on rabbit ears and to tattoo dogs on the abdomen or thigh. In some shelters, tattoo ink is incorporated into the incision after spay surgery of cats and dogs, to make it obvious on visual inspection that an animal has been spayed. Tattooing with a tattoo pen on the abdomen is said to be pain free and require no anesthesia by some pro-tattoo

⁴⁹ Erber R, Wulf M, Becker-Birck M, et al. Physiological and behavioural responses of young horses to hot branding and microchip implantation. *Vet J.* 2012. 191(2):171-175.

⁵⁰ L & H Branding Irons: Electric Branders (<http://www.lhbrandingirons.com/branders/electric.asp>, accessed July 17, 2012).

⁵¹ Tattoo-A-Pet (<http://www.tattoo-a-pet.com/>, accessed July 17, 2012). National Dog Registry: Welcome to NDR! (<http://www.nationaldogregistry.com>, accessed July 17, 2012).

organizations,⁵² though most other sources state that anesthesia or heavy sedation is required to allow the practitioner to work with a stationary animal. According to an article from the UC Davis School of Veterinary Medicine, tattooing has not remained a popular method of identification because tattoos can become difficult to read over time and tattoo registries have not been stable.⁵³ Ark Sciences, the company behind Zeuterin, the non-surgical sterilant for male dogs, recommends that treated dogs be marked with a “z” tattoo on the upper inner thigh while the dog is under sedation for the Zeuterin treatment.⁵⁴

Used in – dogs, cats, cattle, bears

Invasiveness – moderate; involves injecting ink under the skin; tattoo pens inject the ink 1/32 of an inch under the skin

Pain – depends on the size of tattoo and method of application; vibrating tattoo pens are said to cause less discomfort than ear clamps, but tattooing with a pen takes longer the vibration and noise can be distressing to the animal.

Danger to animal – there can be a risk of infection

Skill required to apply – requires a person properly trained to apply the tattoo, and the animal will need to be safely restrained and possibly sedated or anesthetized. Difficulty may vary with complexity of mark and method of application.

Skill required to read – none, but in cats and dogs tattoo likely would not be visible unless one were very close to or handling the animal. Difficulty of reading may depend on tattoo placement (e.g. ear vs. inner thigh); dogs may not want to be rolled onto their backs as would be necessary to read a tattoo on the abdomen. Interpretation of tattoo will require reader familiarity with codes or marks in use in that locale.

Information that can be conveyed – a symbol can be used to indicate that an animal has been treated and the method of sterilization, or a number could be used to mark an individual animal, time of treatment, program administering the treatment, etc.

Duration – lifelong

Visibility – low – need to be close to animal to see tattoo (exception may be inner-ear tattoos on up-eared animals such as cats and some dogs), and in some cases the tattoo may not be visible once fur grows back

Expense/scale – requires specialized equipment; a tattoo machine for dog ears and a set of letters costs around \$230,⁵⁵ while a tattoo pen is about \$50.⁵⁶

Handling to apply – would need to capture, restrain, and typically sedate or anesthetize animal

Handling to detect – depending on location of tattoo, no handling may be required or may need to capture and restrain the animal

11. Ear tags

Ear tags are commonly used in agricultural and wildlife settings to identify animals. The tags come in a large variety of sizes, materials, and colors. Tags have the advantage of being easily

⁵² National Dog Registry; The National Dog Registry Tattoo Does Not Hurt Your Pet (<http://www.nationaldogregistry.com/nopain.html>, assessed August 5, 2012).

⁵³ UC Davis School of Veterinary Medicine, Program for Companion Animals: Provide Identification and Prepare for Possible Disasters (<http://www.vetmed.ucdavis.edu/ccab/identi~1.htm#Tattoos>, accessed July 17, 2012).

⁵⁴ Ark Sciences Zinc Neutering video. (<http://www.youtube.com/watch?v=xfD6xDxB57s>, accessed August 5, 2012).

⁵⁵ All K-9 Inc: Ear Tattoo Machine (<http://www.allk-9.com/ear-tattoo-machine-p-393.html>, accessed July 17, 2012).

⁵⁶ Base Equipment Company: Rabbi-Tatt (<http://www.bassequipment.com/Miscellaneous/Tattoo+Equipment/default.aspx>, accessed July 17, 2012).

visible from a distance, and can be customized by shape or color-coding to communicate additional information such as year treated or type of treatment administered. Insecticide-impregnated ear tags are used in cattle to control the number of horn flies and face flies.⁵⁷ If a number is printed on the tag, the tag could also be used in conjunction with a database to collect information about an individual. As part of the USDA's National Animal Identification System (NAIS), several pilot projects have investigated the use of RFID tags for cattle, where the number on the tag is read with a detector, eliminating transcribing errors from manual records, and overcoming problems with tag reading associated with mud, animal movement, etc. These pilot programs reportedly found the retention date was almost 100% for button-type RFID tags.⁵⁸

Ear tags are used on dogs in Turkey, where stray dogs are collected, vaccinated, and re-released with a yellow ear tag to demonstrate that they have been vaccinated.⁵⁹ In a similar program in Romania, 15,000 dogs have been tagged with numbered, rectangular, plastic ear tags approximately 3.5 cm in length. The dog is anesthetized, the ear is shaved, and topical antiseptic is applied to the area before the tag is inserted. No major infections or substantial cases of irritation have been observed in the Romanian program.⁶⁰ In 1994, the Los Angeles Society for the Prevention of Cruelty to Animals and the Southern California Humane Society offered ear tags as a way to identify lost cats.⁶¹ A study in cats, however, found ear tags and studs have unacceptably high rates of infection, irritation, and tag loss,⁶² and the American Association of Feline Practitioners states that "attempts to use ear studs or ear tags as collar alternatives have been associated with a high rate of infection and loss and are not recommended".⁶³ It does not appear that the potential of ear tags has been extensively studied; it may be that tag geometry, material, and placement can profoundly affect the likelihood of complications and how well the tag serves the purpose intended.⁶⁴ Very tiny ear tags are available for mice and rats,⁶⁵ but in mice, long-term use of ear tags made from a nickel-copper alloy was found to be associated with squamous cell carcinoma.⁶⁶

Used in – many species including mice, cows, sheep, dogs

Invasiveness— high, requires puncturing the ear

⁵⁷ Insecticide-Impregnated Cattle Ear Tags. Lee Townsend, University of Kentucky College of Agriculture. (<http://www.ca.uky.edu/entomology/entfacts/ef505.asp>, accessed August 5, 2012).

⁵⁸ USDA Animal and Plant Health Inspection Service News Release: USDA Releases Report on National Animal Identification System Pilot Projects, May 4, 2007 (http://www.aphis.usda.gov/newsroom/content/2007/05/animal_id_pilot.shtml, accessed July 17, 2012).

⁵⁹ Lonely Planet: Istanbul, Health & Safety (<http://www.lonelyplanet.com/turkey/istanbul/practical-information/health>, accessed July 17, 2012). Sahipsiz Hayvanlari Koruma Dernegi (SHKD) shelter: The Solution to the Istanbul Stray Dog Problem, March 2006. Downloaded from http://www.shkd.org/neuter_and_return.html, July 17, 2012).

⁶⁰ Personal communication, Sara Turetta, Save the Dogs and other Animals.

⁶¹ BRIEFLY: Pets: Ear Tags Offered to Identify Lost Cats. *Los Angeles Times*. September 22, 1994 (http://articles.latimes.com/1994-09-22/news/we-41508_1_ear-tags, accessed July 17, 2012).

⁶² Personal communication, Dr. Julie Levy, Director, Maddie's Shelter Medicine Program, College of Veterinary Medicine, University of Florida.

⁶³ American Association of Feline Practitioners: AAFP Position on Identification of Cats – April 2008 (<http://catvets.com/professionals/guidelines/position/?Id=324>, accessed July 17, 2012).

⁶⁴ Personal communication, John Boone, wildlife biologist, Great Basin Bird Observatory.

⁶⁵ Kent Scientific Corporation: Ear Tags Mouse Rat (https://www.kentscientific.com/products/productView.asp?productID=6237&Mouse_Rat=Animal+Identification&Products=Ear+Tags+Mouse+and+Rat&gclid=CPGtYqQg7ECFUMCQAodr2pWEg, accessed July 17, 2012).

⁶⁶ Baron BW, Langan G, Huo D, Baron JM, Montag A. Squamous cell carcinomas of the skin at ear tag sites in aged FVB/N mice. *Comp Med*. 2005. 55(3):231-235.

Pain – high, groups using ear tags recommend anesthesia

Danger to animal – potential for infection at site of application. Potential for animal to scratch at tag and inflict injury. Potential for tag to snag on item in the environment and inflict injury.

Skill required to apply – must be properly trained to apply the tag safely and in the correct location. Must be able to safely handle the animal, and sedation or anesthesia may be required.

Skill required to read – none. Visible enough to be useful to the general public to recognize an animal that has been neutered. For smaller tags, such as those used in color coding schemes, binoculars can be very useful in making sure the observer is recording the correct information about the tags.⁶⁷

Information that can be conveyed – similar to collar – yes/no information about whether an animal has been treated. With color-coding, or use of multiple tags, can add information such as the year the animal was treated, or method by which the animal was treated (eg red for surgical sterilization, yellow for non-surgical, etc). Also, the tag can incorporate a number to be read, either by sight or by a RFID reader, which would link to a database where information about a specific individual would be maintained.

Duration – some tags fade due to weather and time. In cattle, EZCee ear tags (www.caltaginc.com) are guaranteed to last the lifetime of the animal

Visibility – high

Expense/scale – easy to scale up; companies can manufacture custom tags. Livestock ear tags range from about \$0.18 to \$1.00 each, and RFID tags cost about \$3.50 each. An RFID reader costs between about \$400 to \$1000 dollars depending on size and range.

Handling to apply – need to capture, restrain and sometimes sedate or anesthetize the animal to apply tag

Handling to detect – none

12. Ear notches

Ear notches are often used to mark laboratory mice and rats. A pattern of notches cut from the left and/or right ear can represent a number, allowing specific individuals to be tracked. Ear notching (done while the animal is under anesthesia) is used by the Tsunami Animal-People Alliance, the Blue Cross of India, and International Welfare Training to mark dogs.⁶⁸ For unowned cats and dogs, however, this method can be less reliable as a means of identification, since the animals may acquire notches in their ears through fighting or other environmental causes. If a set of round-ended pliers and a cauterizer are used to create semi-circular rather than triangular notches, notches may be more easily differentiated from damage due to fighting.

Used in – dogs, mice, rats, pigs

Invasiveness – high, involves removing small parts of the side of the ear

Pain – high, requires anesthesia

Danger to animal – safe

Skill required to apply – need to know the proper place to notch the ear; need to safely restrain and anesthetize the animal

⁶⁷ Personal communication, John Boone, wildlife biologist, Great Basin Bird Observatory.

⁶⁸ Personal communication, Elaine Lissner, Director of Medical Research Programs, Parsemus Foundation.

Skill required to read – less obvious than ear tipping to the untrained individual; may be difficult to see on a long-haired animal. To recognize specific notching patterns would require training.

Information that can be conveyed – yes/no information about whether an animal has been treated, or a pattern of notches can mark an individual animal or encode a number that is associated with other information related to the treatment or campaign/program.

Duration – lifelong, unless the animal injures its ear

Visibility – medium – not as recognizable as ear tipping, and not as visible as a brightly colored tag or collar

Expense/scale – would require anesthesia in cats and dogs; specific ear notching tools or punches are commercially available for \$10 to \$30

Handling to apply – would need to capture, restrain, and anesthetize animal

Handling to detect – none in animals with no or short hair on ears; long-haired animals may need to be handled

13. Ear tipping

Ear tipping is commonly used to mark cats that have been treated as part of a TNR program.⁶⁹ The tip of one ear is surgically removed at the time of spay or neuter surgery. The mark is easy to see, allowing quick recognition of a cat that is new to a colony, and people in the community can learn to recognize these cats as having been sterilized. The cut should be made as straight as possible to differentiate the ear tip from other injuries that feral cats may obtain through fighting.

Used in – feral cat colonies

Invasiveness – high, involves surgically removing part of the ear

Pain – high, requires anesthesia

Danger to animal – safe, rarely requires aftercare, risk of infection

Skill required to apply – skilled veterinarian required to conduct the surgery; must be able to safely restrain and anesthetize the animal

Skill required to read – none, but it can be difficult to differentiate between animals that have had their ear tips removed surgically and those who lost an ear tip in a fight

Information that can be conveyed – the animal has been sterilized

Duration – lifelong

Visibility – high, though not as visible as a brightly colored tag or collar

Expense/scale – requires surgery (though not sutures), anesthesia, and recovery time. Generally the procedure is performed when the animal is under anesthesia for spay/neuter. Expenses would include surgical blades, antibiotic ointment, and veterinary time.

Handling to apply – would need to capture, restrain, and anesthetize animal

Handling to detect – none

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⁶⁹ Alley Cat Rescue: Ear Tipping – A Lifesaver for Feral Cats (<http://www.saveacat.org/eartipping.html>, accessed July 17, 2012).

Table: Summary of marking and identification methods discussed in the report

Method	Type of information	Invasiveness	Pain	Danger to animal	Skill to apply	Skill to detect	Duration	Visibility	Expense	Handling to apply	Handling to detect
Observation/Imaging	Individual	None	None	None	High	High	Lifelong	None	Depends on technology used	None	None
Collars	Individual or population	None	None	Low	Low	None	Low	High	Low	Restrain	None
Leg bands	Individual or population	None	None	Low	Low	None	Low	High	Low	Restrain	None
Iris or retinal scanning	Individual	None	None	None	High	High	Lifelong	None	Cost per animal decreases as volume increases	Restrain	Restrain
Paint	Population	Minor	None	Low	Low	None	Weeks	High	Low	None or restrain	None
DNA profiling	Individual	None to moderate	None to minimal	None	High	High	Lifelong	None	High	None or restrain	None or restrain
Microchips	Individual	Moderate	Minimal	Low	High	Low	Lifelong	None	High	Restrain	Restrain
Freeze branding	Individual or population	Moderate	Moderate	Low	High	None	Lifelong	High	Cost per animal decreases as volume increases	Restrain, sedate	None
Hot branding	Individual or population	Moderate	High	High	High	None	Lifelong	High	Cost per animal decreases as volume increases	Restrain, sedate	None
Tattoo	Individual or population	Moderate	Low to high	Low	High	Medium	Lifelong	Low	Cost per animal decreases as volume increases	Restrain, sometimes sedate	None or restrain
Ear tags	Individual or population	High	High: anesthesia preferred	Low	High	None	Medium	High	Low	Restrain, sedate	None
Ear notches	Individual or population	High	High: requires anesthesia	Low	High	Medium	Lifelong	Medium	Low	Restrain, sedate	None
Ear tipping	Population	High	High: requires anesthesia	Low	High	Low	Lifelong	High	Low	Restrain, sedate	None



Figure 1: Dog with ear tag in Romania, courtesy of Save the Dogs and Other Animals Onlus program, Milano, Italy.



Figure 2: Dog with ear tag in Romania, courtesy of Save the Dogs and Other Animals Onlus program, Milano, Italy.



Picture 3: Freeze brand on the shoulder of a horse, Wikimedia Commons (<http://en.wikipedia.org/wiki/File:LeftShoulderBrand.JPG>, accessed December 5, 2012).