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# Welfare Considerations in Aquatic Animals

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Public interest in animal welfare issues has increased steadily over recent years. The ease of access to information via the internet allows people to do home research on whatever topic interests them. A quick scan of the internet on "animal welfare" and it's easy to see that animal welfare pressure groups predominate in the top twenty or thirty documents regardless of the search engine used. The information provided varies from peer-reviewed science, through empirical comment (positive or negative) to the blatantly untrue. Many societal groups are now becoming increasingly interested in animal welfare and not just that of animals seen as being the most appealing. Animal welfare pressure groups have highlighted recreational fishing as a welfare concern for a number of years. Recently public interest has been piqued by such previously unconsidered animals as the rock lobster. The message is clear; animal welfare is important; it must be considered by all sectors using animals; welfare-friendly management systems must be in place and those systems must be progressive and transparent to engender faith in the users of animals. There is an obligation on all individuals to treat the animals in their care humanely and with respect. This includes aquatic animals such as fish, molluscs and crustaceans.

In Australia each State or Territory enacts its own legislation with regard to animal welfare. Most States and Territories include fish within their animal welfare legislation, the exception being South Australia. Recent reviews of legislation in New South Wales, Victoria, the Northern Territory and the Australian Capital Territory have included crustaceans in the animal welfare legislation. Generally speaking crustaceans, where covered, are protected in their use for food preparation and transport for the restaurant trade, whilst fish are also protected in their use for research and teaching. Fish are afforded protection as a vertebrate under the Australian Code of Practice for the Care and Use of Animals for Scientific Purposes. This code of practice is enacted under law according to State or Territory legislation, and in South Australia most institutions also have a requirement that the Animal Ethics Committee approves all research involving vertebrates.

It is not just in the scientific and educational fields that the welfare of aquatic animals is coming under scrutiny. The field of aquaculture is also starting to develop formalised codes of practice and transparent audit schemes to demonstrate a high standard of animal welfare. It is commonplace now in the Northern Hemisphere for the major retail chains to insist that the primary producers growing fish for their supermarkets adhere to detailed codes of practice. These codes of practice cover the whole life cycle of the fish from egg to harvest and include for example:

- stocking rates in hatchery tanks;
- light levels in hatchery buildings;
- water flow rate through tanks;
- dissolved gas concentrations permissible (oxygen and carbon dioxide);
- feeding standards and feed quality;
- handling and grading protocols and training;
- biosecurity of hatchery facilities;
- transport techniques including monitoring;
- regular health monitoring;
- veterinary health plan with regular veterinary input;
- vaccination techniques;
- sea pen stocking density;
- minimum water flow rates;
- net cleanliness;
- feeding systems;
- daily stock inspection;
- methods of treating in sea pens;
- grading and movement protocols;
- crowding limits; and
- humane slaughter techniques.

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These therefore represent detailed comprehensive documents that fish farmers need to adhere to. In addition the European Commission is working on codes of practice for aquaculture to maintain animal welfare standards across the European Community. The Office International des Epizooties (OIE), the animal equivalent of the World Health Organisation, has also started the process of setting up a working group to examine the welfare of aquaculture animals. An internationally accepted set of welfare standards for aquatic animals reared in captivity is expected to result from this working group, and it will certainly take input from a wide range of sources.

It is not only retailers, the European Commission and the OIE that are looking seriously at aquatic animal welfare. Here in Australia the Aquatic Animal Health Committee (AAHC), a federal committee consisting of aquatic animal health experts, policy developers and representatives from aquaculture, commercial and recreational fishing, is looking at the importance of an overarching welfare framework for fish grown in farms.

Other non-governmental organisations are examining the welfare of fish; in 1992 a report on "The Welfare of Farmed Fish" (Lymbery, 1992) was published by Compassion in World Farming. This was followed up by the publication of their report "In Too Deep" (Lymbery, 2002) in 2002. An individual described as an "international animal welfare consultant" wrote both reports. No qualifications or details of his or her experience were indicated to confirm this statement. The report was widely condemned by aquaculture bodies as being out of date and factually inaccurate, although it did succeed in being highly emotive: the press launch in Britain involved a personality sitting in a bathtub to illustrate the average amount of water available to each fish at their quoted stocking densities. A very memorable image when it is considered that the salmon farming Code of Practice clearly stated that fish occupied only 2% of the total volume of water available in the pen, and that each fish has freedom to move through the whole pen and is not restricted to a bathtub of water.

What this illustrates is that there is an increasing awareness of the welfare of aquatic animals, especially fish. The general public either can seek out material from a myriad of information sources, or it may be physically presented to them in a high profile manner. Recently there has been media interest in research in the United Kingdom that suggests fish feel pain in their lips. Media networks and animal welfare pressure groups immediately picked this up, the inference being that fishing induces pain in the fish hooked. It is important therefore that any users of aquatic animals are aware of this increasing perception of the importance of aquatic animal welfare, and have husbandry systems that are best practice, take strenuous efforts to ensure that welfare is monitored, and constantly endeavour to progress and improve upon their current management systems.

**The debate continues: Do fish feel pain?**

The proponents for and against fish feeling pain are almost equal in numbers. The fundamental difficulty in determining conclusively whether fish do or do not feel pain lies in our inability to know what a fish is experiencing. A review of the internet will reveal a preponderance of sites dedicated to spreading the message that fish feel pain in the same ways as humans do. These sites generally have several quotes reported to be from scientists experienced in the field of aquatic animals. A review of these sites is important to gather all the available information for or against the hypothesis that fish feel pain. A problem arises however when a scientist is quoted, without a reference being given. A thorough literature search usually fails to locate a scientific paper on the subject by the quoted scientist. Being unable to read the context in which the quote was originally made makes it difficult to assess to what degree the opinion is accurately represented or based on scientific evidence rather than empirical experience. The question "is animal pain the same as human pain?" has been asked and discussed previously, including during the 1990 conference of ACCART (Australian Council on the Care of Animals in Research and Teaching). It seems likely that the quality of sensation experiences in animals is not the same as in humans, but neither is it necessarily a prerequisite that it be so to be significant.

Numerous studies on nociception have been carried out in a number of species, and it is clear that there are well-developed sensory systems capable of responding to aversive stimuli throughout the animal kingdom. The examples of learned or adaptive behaviour has been cited as indicative of pain response in animals; however, a review of experiments carried out in this field suggest that these adaptive behaviours are most likely to be motor programs designed to respond to sign stimuli with a pre-wired motor sequence. The existence therefore of pre-wired adaptive behavioural units may well mean that problem-solving behaviours may not necessarily indicate awareness. Many of these responses can occur without complex experiences, even in humans. Differences in human and animal experience are likely to relate to differences in the design and complexity of the central nervous systems (Molony, 1992); however, a fixation on the prefrontal association cortex as being the only anatomical area of the central nervous system capable of experience or awareness is questionable (Divac, 1990). The presumed mechanised process involved in habituation and learned adaptive responses does not rule out the possible role of consciousness in other behaviours (Griffin, 1981).

**Websites on the awareness of pain in fish**

University of Edinburgh Animal Welfare Research Group:
*www.vet.ed.ac.uk/animalwelfare/Fish%20pain/fish%20pain.htm*

The Fisheries Society of the British Isles:
*www.le.ac.uk/biology/fsbi/*

*Head-to-head: Feelings of fish.* BBC News (UK Edition).
*http://news.bbc.co.uk/1/hi/sci/tech/2988501.stm*

Narrowing the debate to the area of fish likewise narrows the field of available refereed scientific papers. Two such papers currently frame the two sides of the debate. Rose (2002) presented a detailed scientific review on the subject based on literature review and philosophical argument, in which he argues that the projection onto fish, by humans, of the ability to feel pain is invalid. He argues that this is anthropomorphism and has no place in the debate. Rose relates the function of the central nervous system to its anatomy, and indicates that fish lack the anatomical structures that make conscious appreciation of noxious stimuli likely. The human neocortex, or prefrontal association cortex, is vital in the experience of aversive stimuli (i.e. pain) beyond the simple nociceptive, or reflex, response. This approach supposes that other less complex regions are incapable of allowing consciousness. Rose supports this conclusion stating that it is unlikely that there are alternate, functionally uncommitted systems that could meet the requirements for generation of consciousness, namely an exceptionally highly interconnected network involving cortex, thalamus and nonsensory cortical mass. The responses seen in fish, Rose argues, are effective escape and avoidance responses to noxious stimuli, but without the possibility of higher awareness. He theorises that a response to opiates does not necessarily indicate pain sensation, but can be explained through the action of the opiates at lower nervous levels to reduce nociceptive responsiveness. The emotional responsiveness of humans, Rose states, is highly dependent on such limbic structures as the septal region and the amygdala. Whilst fish have anatomically similar structures, this homology cannot be taken to indicate that emotional response and pain experience is the same in fish and humans; instead the emotional response to noxious stimuli is heavily dependent on the association of the amygdala with the pre-frontal cortex, a structure lacking homology in the fish brain. In addition the cingulate gyrus, a structure that has been linked to the emotional aversiveness of pain, has not been identified in fish. Rose once again points out that no functional equivalency is established merely by neuroanatomical homology; however, one crux of his argument is that the absence of anatomical similarity with regard to the neocortex is highly suggestive of a lack of awareness in fish, and that a lack of awareness therefore renders pain sensation impossible.

Rose points out that, regardless of whether the experience of noxious stimuli may be perceived as painful in fish, the receipt of nociceptive stimuli does induce subcortical neuroendocrine and physiological stress responses and that these stress responses can undermine the health and well-being of fish.

Very recently a team of scientists in the United Kingdom published the results of their experiments in which they have claimed that fish do in fact feel pain. The release of this information was greeted with widespread media interest and rejuvenated the animal rights debate regarding fishing as a recreational sport. In her paper, Sneddon (2003) reports that they succeeded in identifying nociceptors on the face and head of rainbow trout. Sneddon injected noxious materials (acetic acid and bee venom) into the lips of rainbow trout to observe the responses, both behavioural and electroneuronal. The results would be judged against certain criteria established prior to the experiment; namely that nociception is a reflex response to noxious stimuli and to suggest pain perception it needed to be shown that any behavioural or physiological responses are not merely reflexive. Ultimately, Sneddon's theory goes, "if a noxious event has sufficient adverse effects on behaviour and physiology in an animal and this experience is painful in humans, then it is likely to be painful in the animal."

Sneddon states that learning experiences (avoidance of electric shock) in fish, and the blocking of this adaptive behaviour by the administration of opiates, indicate that pain perception is likely; however, we have already seen that these are not necessarily reliable criteria to use. During the experiments Sneddon was able to demonstrate an increased respiratory rate in the trial fish, but related this to a physiological response and that it was not necessarily an indicator of pain. However she did report a number of anomalous behaviours in the fish. Some fish were noted to rock from side to side, reminiscent of the stereotypical behaviour noted in other animals, taken to be an indicator of poor welfare, and thought to be performed as comfort behaviour (Gonyou, 1994). Rubbing of the injected area against gravel and sides of the tank was also noted and compared to the human act of rubbing a painful area to lessen the painful sensation. A lack of feeding behaviour following the noxious stimuli was compared to a guarding behaviour, the unwillingness of the fish to utilise a painful part of its body. Unfortunately the paper did not make reference to, or attempt to respond to, the issues raised by Rose in his paper. So whilst the majority of the results presented by Sneddon indicate that reflexive nociception is well developed in the fish, there are some intriguing observations (rocking and lip rubbing) reminiscent of the emotional experience of pain in humans.

Whilst the philosophical and neuroanatomical arguments are thoroughly presented by Rose, the abnormal behaviours reported by Sneddon give pause for thought. It is clear the debate is by no means concluded and that further evidence must be gathered to prove one way or the other. However, as Rose points out, regardless of the presence or absence of the sensation of pain in fish, noxious stimuli will induce physiological and neuroendocrine stress responses that can undermine the welfare of the fish. It is clear, therefore, that responsible users of aquatic animals in science will seek to keep their animals in the best possible conditions both for the sake of the animal, and to limit experimental variability that may be caused by stress responses in the study animals.

**The maintenance of aquatic animals**

It is not my intention to produce a treatise on the husbandry and welfare of the various aquatic animals that may be encountered in a research or teaching scenario, but merely to use this opportunity to highlight some general areas that need to considered when contemplating the use of aquatic animals in science.

1. There are many good textbooks detailing the ideal husbandry conditions for many aquatic animals. It is possible to derive a wealth of useful information from a bookshop or library.
2. Remember to consider what water temperature will be required to keep the animals most comfortable and whether a supply of fresh water, saline water or brackish water will be needed.
3. The simplest systems to use are through-flow systems where there is a constant flow of fresh water into the system. These generally limit the possibility of build-up of toxic waste products (ammonia, nitrite and nitrate) in the system, but heating the large volume of water may be expensive and wasteful.
4. Static water systems, the simple aquarium, make water heating more economical. Oxygenation of the water is usually important, as is a regular change of water to remove those toxic nitrogen compounds.
5. Recirculation systems with biological filtration and partial water replacement combine the benefits of a flow-through system with those of a static water system. They are however potentially problematic to maintain properly and experience is required to keep them running for long periods. They are also more expensive to set up. The biological filter will take 6 to 8 weeks to mature to a point where it is efficiently processing the ammonia wastes.
6. Animals should be checked daily for signs of ill health or discomfort, and appropriate action taken as required. This may consist of consulting an appropriately qualified veterinarian for diagnosis and treatment. The diagnosis and treatment of fish in Australia is an act of veterinary surgery as defined in the various State and

Territory Veterinary Surgeons Acts and should be carried out by a vet with the appropriate experience.

7. Water quality is very important and the following parameters need to be monitored:
   - dissolved oxygen;
   - dissolved carbon dioxide;
   - ammonia/ammonium;
   - nitrite and nitrate;
   - temperature and pH;
   - hardness (i.e. the amount of minerals, especially calcium, magnesium and carbonate, in the water).
8. Remember that tap water contains chlorine, which is toxic to fish. Tap water may be dechlorinated by the use of sodium thiosulphate.
9. Ensure that the stocking density of the animals does not exceed the tolerance of the animals, or of the holding system being used.
10. Gentleness is a prerequisite when handling aquatic animals – the layer of mucus on the surface of fish plays an important role in defence against disease and maintenance of their osmoregulatory balance. Always handle with wet hands, or better still use surgical gloves.
11. Use anaesthetics where possible to minimise stress during handling procedures and keep fish out of water for the minimal length of time. Removing fish from water can induce fusion of some of the gill filaments. If possible try and carry out procedures on a "wet table" i.e. one with an inch or two of water on it to keep the animals moist.
12. Consider the appropriateness of the euthanasia method. Where possible an overdose of anaesthetic is probably one of the kindest methods. Alternatively a sharp percussive blow on the top of the head can be quick and effective. Plunging into an ice/water slurry can be used, but ensure that the slurry is fluid enough to ensure immediate submersion. It is not acceptable to allow a fish to suffocate whether on ice or a bench top.
13. Always treat your animals with respect; they deserve our best endeavours regardless of whether or not it is believed they can sense pain.
14. If in doubt about anything, or if it is outside your area of experience, then seek advice. There are a number of sources of advice on aquatic animal health and welfare. Try your establishment's Animal Welfare Officer or your local fish health veterinarians. State governments fisheries or aquaculture departments will also usually have their own aquatic animal health experts and are a useful source of advice.

Finally, aquatic animals can be interesting to observe experimentally, fascinating and relaxing to watch socially and they catch the attention and spark the imagination of the general public; but only when they are healthy and maintained in a good state of welfare. Bear in mind that all users and carers of aquatic animals have their role to play to keep it that way.

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# Animal Welfare in Western Australia


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The new *Animal Welfare Act 2002* and the supporting *Animal Welfare (Scientific Purposes) Regulations 2003* and the *Animal Welfare (General) Regulations 2003* came into effect on 4 April 2003.

This Act replaces the *Prevention of Cruelty Act 1920* and provides penalties varying from $2000 to $50000 and up to five years imprisonment for various breeches of the Act.

For the first time, scientific establishments, including educational institutions, that use animals for scientific or teaching purposes, must be licenced. A prerequisite for a licence is compliance with the NHMRC Code of Practice and access to an Animal Ethics Committee that is structured and operates in accordance with the Code. Establishments, whose sole source of business is supplying animals for scientific use, also require a licence.

The Department of Local Government and Regional Development administer the Act and an Animal Welfare Branch has been created within the Department. Three full-time permanent employees will staff the Branch.

Within the new Act, power is provided to the Director General of the Department of Local Government and Regional Development to appoint all general and scientific inspectors. The RSPCA, Department of Agriculture, Department of Conservation and Land Management, Fisheries WA and local government authorities nominate members of their staff for appointment as general inspectors.

Scientific inspectors are responsible for monitoring all activities carried out under a licence and general inspectors are responsible for the general animal welfare provisions.

More information on the Act may be obtained by contacting the Animal Welfare Branch on (08) 9217 1560 or visiting the Department's web site at **www.dlgrd.wa.gov.au** and following the links to Animal Welfare.

# Morality and Animal Research

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Of all the things we currently do to animals, it seems to me the most vexing concerns the problem of what we do to animals in science, particularly in areas like biomedical science. An element of that problem is the question of whether we can, at least broadly speaking, support the current system of animal use for scientific research. I am interested not only in what we actually do to animals, but also the spirit in which we do it and the basis on which we claim it is morally justified.

These are demanding and difficult problems, and philosophically we have only just started to wrestle with them. Consequently, our understanding of the possibilities of moral relationships with animals is in a state of flux, and, perhaps, continues to evolve.

Many of us now feel sure that the traditional picture of animals is quite wrong. In this picture, animals are regarded as so inferior to humans that they may be used pretty much as we please in science, perhaps without regulation and with only minimal restrictions. The traditional view is expressed by the great French physiologist Claude Bernard, who seems to praise a certain character ideal possessed by the real scientist:

> The physiologist is not an ordinary man (sic): he is a scientist, possessed and absorbed by the scientific idea he pursues. He does not hear the cries of animals, he does not see their flowing blood, he sees nothing but his idea, and is aware of nothing but an organism that conceals from him the problem he is seeking to resolve. (1)

So sympathy for animals in research is not appropriate. The German philosopher Immanuel Kant would agree. He argued that animals are merely means to human ends, because animals are not autonomous or morally responsible beings. Kant once considered the question of whether we have any duties to a dog who has been a loyal companion or worker for many years. His answer was unequivocal: we owe the dog nothing. We would not even be betraying the faithful dog if we shot him for no reason at all, or used him in a scientific experiment. Kant had other reasons for condemning such behaviour, but he would think that the notion of betrayal is only applicable to human beings.

Certain religious traditions, such as Christianity, are also associated with the view that animals, lacking souls, are quite unimportant. But it is difficult to reconcile this perspective with the equally Christian idea that God values animals as a part of His creation.

A more philosophically sophisticated defence of human uniqueness could be that there is something special about the capacity to lead a life in the light of values chosen by free moral agents (2). This is just one of the capacities we might refer to in the description of a person's full humanity.

If we accept arguments of this kind in terms of the human capacity for self-determination and moral responsibility, we are furnished with a reason for countenancing animal experimentation, and even for backing the institutional status quo. We think that animal experimentation is at least thinkable, whereas doing the same things to humans for the sake of animals or other humans is not. But we should note that this is only one reason for supporting research on animals. It is not a full defence of that research. In particular, many believe that it does not take the interests of animals seriously enough.

Welfarists tell us animal life and welfare is worthy of protection because the animals we are talking about are sensitive and sentient. Science should therefore, as the NHMRC Code says, "weigh the value of the study against the potential effects on the welfare of the animals".

But Utilitarians go further and urge us to count the suffering and harm animals are likely to experience no differently from our own. From this standpoint, science, which frankly exacts a terrible and enormous toll on countless animals, is, because of a prejudice, far too ready to sacrifice non-human interests for human ones.

Supporters of animal rights go further still. They decry Kant's assertion that animals are mere means to our ends. They deliver us the possibility of seeing some animals as potential bearers of moral and even legal rights.

These three views illustrate the way in which our appreciation of the moral standing of animals is evolving. But I think that such views reflect a deeper shift in our understanding of the lives of animals.

I noted earlier Claude Bernard's apparent suggestion about how we should regard animals in science. Real scientists, he says, in pursuing their scientific idea, detach themselves from the animals they perceive as mere organisms, not hearing their cries or seeing their flowing blood. Modern researchers who experiment on animals, of course, do not typically see this as an ideal to be championed.

On the other hand, it is true that much contemporary science regards animals as organisms, albeit organisms with psychological attributes. And it is not usually a notable feature of the practice of science that researchers form or imagine a real and lasting relationship with the animals they are studying. They do not observe the lives of their subjects in anything more than a fragmented and incomplete way (note that these matters of fact are not a criticism of such science and researchers).

However, not all science is like that. Here is Professor Barbara Smuts, an experienced ethologist, describing her work with baboons:

> I mingled with these animals under the guise of scientific research and, indeed, most of my activities, while "in the field" were designed to gain objective, replicable information about the animals' lives. Doing good science, it tuned out, consisted mostly of spending every possible moment with

the animals, watching them with the utmost concentration, and documenting myriad aspects of their behaviour ...

There were 140 baboons in the troop and I came to know everyone as a highly distinctive individual ... Every baboon had a characteristic voice and unique things to say with it; each had a face like no other, favourite foods, favourite friends, favourite bad habits.

Clearly, the baboons knew me as an individual…after a seven-year interval they clearly trusted me as much as they had on the day I left.

Trust, while an important component of friendship, does not, in and of itself, define it. Friendship requires some degree of mutuality, some give and take. Because it was important, scientifically, for me to minimize my interactions with the baboons, I had few opportunities to explore the possibilities of such give and take. But occasional events hinted that such relations might be possible, were I encountering them first and foremost as fellow social beings, rather than as subjects of scientific inquiry. For example, one day, as I rested my hand on a large rock, I suddenly felt the gentlest of touches on my fingertips. Turning around slowly, I came face to face with one of my favourite juveniles, a slight fellow named Damien. He looked intently into my eyes, as if to make sure that I was not disturbed by his touch, and then he proceeded to use his index finger to examine, in great detail, each one of my fingernails, in turn. This exploration was made especially poignant by the fact that Damien was examining my fingers with one that looked very much the same, except his was smaller and black. After touching each nail, and without removing his finger, Damien glanced up at me for a few seconds. Each time our gaze met, I wondered if he, like I, was contemplating the implications of the realization that our finger and finger nails were so alike. (3)

In her essay, Barbara Smuts vividly reveals our fellowship with members of the animal world. Moreover, she alludes to the conceptual possibility of real friendship not only with “tamed” animals but also with wild animals, even when the circumstances prohibit such a relationship. She shows how we might come to regard a baboon as a dear friend – a possibility she saw in the “slight fellow named Damien”.

These considerations raise the further possibility of betraying an animal. You will recall that Kant denied this. Shooting a loyal dog was not for Kant an act of betrayal. I once read that the wives and daughters of Claude Bernard arrived home one day to find that Bernard had vivisected the family dog. The story goes that his family was outraged enough that they could not forgive him - indeed, they subsequently left him (and apparently set up an anti-vivisection society). Perhaps they thought that the character of someone who could coldly betray an animal in that way had become morally vicious. Quite possibly the experiment had real scientific value, but it was no small matter to them that Bernard had become a person who thought of animals in the way the story implies he did.

I take it that no-one would wish to deny that notions like fellowship, friendship, and betrayal, if they apply at all to baboons and dogs, could not also apply to animals other than baboons and dogs. (Interestingly, it seems that Claude Bernard himself refused to experiment on monkeys because they too closely resembled human beings (1)). I take it, too, that after reading an account of contact with animals like that of Barbara Smut’s, we can recognize the possibility of fellowship and friendship with animals that are not our pets and that we have no immediate relationship with. This implies that animals have a deeper value and dignity than is usually assigned to them, because notions like fellowship, friendship and betrayal are inseparable from a richer and fuller sense of an animal’s worth.

This challenges the idea that what we do to many of the animals in science is, *on the whole*, justified, even if *some* of it is justified – the most urgent, highly and directly beneficial experiments, for example. Our evolving moral appreciation of the lives of animals continues to exert pressure on our understanding of the institution of scientific animal research.

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1. Quoted in *In the Name of Science*, F. Barbara Orlans, Oxford Uni Press, 1993, p15.

2. For example, see *The Moral Status of Animals*, ANZCCART Newsletter, June 2002.

3. In *The Lives of Animals*, J M Coetzee, Princeton Uni Press, 1999.


## ANZSLAS contributes to ANZCCART

**The Australian and New Zealand Society for Laboratory Animal Science (ANZSLAS) was founded in 1975 by a group of veterinarians and scientists interested in the promotion of excellence in laboratory animal management and medicine. Over many years the two societies, ANZSLAS and ANZCCART, have enjoyed a close association.**

**At the 2002 Annual General Meeting of ANZSLAS, it was agreed that the society’s contribution to ANZCCART should be increased from $500 to $2000/yr for the next 3 years. This was in recognition of the substantial assistance to ANZSLAS members that ANZCCART has provided over the years. The ANZSLAS Treasurer, Dr Tim Kuchel, said “the Society is determined to help where it can to ensure the growth of ANZCCART in the face of funding difficulties”.**

# Monitoring the Fate of Wild, Native Bird Populations: 'Invasive' versus Non-invasive Techniques

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The ability to discriminate between different individuals of the same species is critical to many components of zoological research. Although the ultimate scale at which ecological research is focused remains populations, species and communities, a proximate understanding of ecological processes at these scales often requires knowledge of the fate of individuals. Specifically, knowledge of the identity of individuals can improve the quality of research in a range of ways. Population surveys, especially of mobile species, suffer from the ambiguity of counting individuals more than once, if the identity of these individuals is unknown; thus individual identification can strengthen the results of censuses (Baker 1998). The identification and monitoring of individuals can also be used to obtain information regarding the demography of animal populations, including longevity, survivorship, recruitment, as well as information on animal movements and habitat use. From an applied perspective, these data are critical to the conservation of threatened species, and therefore the identification of individuals of these species is extremely important for their management.

So how do zoologists tell individual animals apart? Traditionally, individual identification has relied upon the capture-mark-recapture technique. Essentially, this technique begins by capturing each individual (or, at least, a proportion of the individuals) in a population, and marking it in a unique way, such that, should the individual be recaptured, investigators will be able to identify it as the same individual. Although this general model of identification has been applied across a wide range of animal species, the method used to mark animals varies widely, and is often related to the biology or anatomy of the target species. Some well-known examples of individual identification marks include toe-clipping in reptiles, amphibians and mammals, and leg-banding in birds. However, independent of the marking method, all of these techniques rely on the initial capture and subsequent recaptures of each individual for identification. While such techniques have, and continue, to be extremely useful in the study of animal populations, the repeated capture of the individuals that make up these populations has the potential to influence the survival of these individuals, through stress and other effects.

Alternatives to this standard technique do exist, which eliminate the need for recapture in the identification process (although an initial capture is still required). Two commonly used techniques are colour marking and radiotracking. Colour marking involves placing some unique colour or colour combination on each individual after an initial capture, such that subsequent identifications can be made remotely, simply by observing each individual. Radiotracking involves placing a small radiotransmitter on each individual, with the transmitted frequency being unique to that individual. Subsequent identifications are then made using a radio-receiver. Even these less invasive techniques, however, can influence the behaviour or ecology of target individuals. For example, the use of unique colour-band combinations in wild zebra finch (*Taeniopygia guttata*) have been shown to influence female mate choice (Burley *et al.* 1982); it seems that female finches prefer males with red or orange colour bands, over those with green bands! Radiotransmitters, on the other hand, are known to reduce survival in a range of bird species, particularly through increasing predation risk (Marks and Marks 1987; Paton *et al.* 1991).

Standard identification techniques thus appear to impact on the behaviour and/or ecology of target animals in ways that depend on the species and the method used. These impacts are not only important from an animal welfare perspective: if the ecological parameters of interest are impacted on by the identification technique used to collect the data, the results of such investigations can obviously be called into question. Despite these concerns, such techniques are still widely used, simply because truly non-invasive techniques are extremely difficult to develop, and have only worked for a limited range of animal species. For the majority of studies that require identification of individuals, identification techniques are generally restricted to those that possess some degree of inherent invasiveness.

**Non-invasive techniques: Are there alternatives?**

While capture-mark techniques of individual identification currently dominate ecological research, non-invasive techniques have been developed for a limited range of animal species. Non-invasive techniques that have proven successful generally rely on natural variation between individuals, for example in coloration (e.g., stripe/spot pattern) or structural features. Notable examples of these techniques include identification of tiger individuals based on stripe pattern (Karanth 1995) and dolphin individuals based on the shape of the dorsal fin (Hammond *et al.* 1990).

Although such non-invasive identification techniques are largely based on visual features, the potential also exists for other cues to be used for identification. Many animal species rely on non-visual cues to discriminate between other individuals, such as territorial neighbours, mates, or kin. Amongst mammals, visual, chemical and acoustic cues are used. For example, giant panda are known to possess the ability to identify neighbours through the chemical nature of scent marks (Swaisgood *et al.* 1999). Amongst birds, however, the most important mode by which communication occurs is through acoustic signals, and an enormous body of evidence exists that demonstrates the use of these signals in individual discrimination. If the acoustic cues of bird species are indeed used for individual identification by the birds themselves, it follows that there is some acoustic feature of the signal that is unique to each individual. Should we be able to identify these unique features, the potential exists for zoologists to use these features to identify individual birds non-invasively. In addition, the use of acoustic cues specifically for identification would especially benefit the study of species that are normally difficult to observe and identify visually, such as cryptic species, nocturnal species, or those species that occur in dense habitat.

**Acoustic identification of individual Rufous Bristlebirds**

To test this idea, I recorded the songs of a number of known individuals of the Rufous Bristlebird (*Dasyornis broadbenti*) in the Coorong National Park. Rufous bristlebirds (Figure 1) only occur in a narrow strip of coastal shrubland between the Murray Mouth and Torquay, in Victoria. The species as a whole was listed by the recent Action Plan for Australian Birds as Near Threatened, though the eastern subspecies is Vulnerable, while the Western Australian subspecies is presumed Extinct, being last sighted with confidence in 1907 (Garnett and Crowley 2000). Bristlebirds as a whole are terrestrial, feeding on ground-dwelling invertebrates and, occasionally seed. They are extremely cryptic, and this, coupled with the dense shrublands within which they dwell, make them extremely difficult to see. Conversely, all bristlebirds are extremely vocal, possessing striking songs that carry considerable distances. For example, Ross (1911) wrote:

> "I spent the whole of the next day in that gully, but I had to return to the township in the evening without having caught a glimpse of a Bristle-Bird, although…I heard birds and followed the calls through the scrubs several times." *(Ross 1911, p120).*

Even the most recent published literature concur with these observations:

> "Bristlebirds are shy and cryptic, and inhabit dense vegetation. However, although difficult to see, rufous bristlebirds are easily located, even when among dense vegetation, by following their loud and charac teristic calls" *(Peter 1999, p10).*

Its threatened status, cryptic nature, and vocal prowess thus made the Rufous Bristlebird a prime candidate to test the idea that avian vocalisations are individually distinct, and can be used by zoologists to discriminate between individuals.

The impetus for this work came from an observation by some colleagues that the songs of bristlebirds appeared to vary, to the point that the songs of apparently different individuals could be differentiated by ear; such clear differences in song structure obviously warranted further investigation. However, my first observation was that these different songs were not necessarily being sung by different individuals; each individual bristlebird possesses a song 'repertoire' of between 14 and 30 different, distinct song types (Figure 2). Furthermore, identical songs are not necessarily sung by the same individual, as different bristlebirds share a proportion of the songs in their repertoire (Figure 2). The proportion of shared song types that two birds share depends partially on the distance separating the territories of the two birds; neighbouring birds tend to share more song types than birds separated by some distance, although sharing was observed at distances greater than 10 km.

Figure 1 Rufous Bristlebird, displaying its typically cryptic nature (*Photo: Lyn Pedler*).

The nature of these singing behaviours was important in the development of an acoustic identification system, for two reasons. First, the majority of songbird species possess repertoires of multiple song types, and the development of acoustic identification in bristlebirds may thus lead to the development of similar systems for a range of other species. Second, and, from a practical level more importantly, the presence of song repertoires and song sharing complicate how we may be able to compare the songs of different individuals. For example, while the shared songs of two individuals may differ subtly in structure, they will not differ nearly as much as two different song types sung by the same individual. How we make song comparisons within and between song types in order to identify individual animals requires much further research; for the moment, I was intent on comparing the song types that individuals shared.

Using two different statistical techniques, the shared song types of bristlebirds were compared between individuals. Both techniques yielded high levels of accurate discrimination of individuals based on song structure; discriminant function analysis, based on specific song features, correctly classified an average of 99% of songs, while spectrographic cross-correlation analysis correctly classified 86% of songs. Considering that these comparisons were based on songs that are essentially the same coarse structure (being the same song types), these levels of accuracy are high indeed.

Despite these promising numbers, the use of acoustic identification for monitoring bird individuals still has a number of important limitations, especially for a species with the singing behaviour of the Rufous Bristlebird. Currently, individuals can only be identified acoustically if the song types encountered are shared with other members of the population; this severely restricts the size and geographic distribution of the census population. Furthermore, there is currently no way of comparing different song types sung by the same bird. In collaboration with Dr Alan Burbridge (Dept of Conservation and Land Management, W.A.), I am currently developing a system of acoustic identification for a small, translocated population of the Western Bristlebird (*Dasyornis longirostris*). Systems of individual acoustic identification may well be best suited to monitoring such translocated populations of endangered species, where the population consists of a small, known number of individuals. However, further developments, such as the use of Artificial Neural Networks (Terry and McGregor 2002), may lead to the development of more universally applicable acoustic identification systems.

The development of non-invasive identification techniques is unlikely to completely replace standard techniques that require capture and artificial marking. For certain species and populations, however, non-invasive techniques may be preferred over traditional identification tools, from ethical, scientific and practical perspectives. More generally, non-invasive techniques can be used as good supplementary identification tools to traditional methods, although the size of many study populations may preclude their exclusive use. Certainly the development of such a technique is a valid avenue for future research, as even the potential for harm as a result of capture-marking must be minimised, for the sake of both animal welfare and scientific validity.

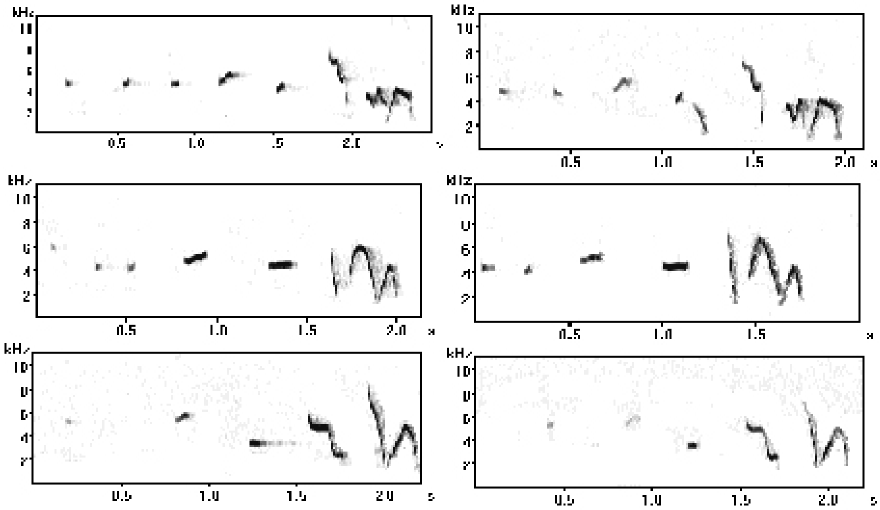

Figure 2 Sonograms of several song types used by male rufous bristlebirds at the Coorong, South Australia. The three sonograms on the left are three different song types from the same individual whereas the three sonograms on the right are the same song types as the ones on the left, but sung by three different individuals. Each horizontal pair of sonograms thus represents a single song type, sung by two different males.

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**RSPCA**
**Alan White Scholarship**

Daniel Rogers (the author of this article) and Faith Walker (see article on page 12) are previous recipients of an *RSPCA Australia Alan White Scholarship*. The scholarship is open to students enrolled in full-time education in an accredited course at an Australian University or College. Students must demonstrate in their application that the scholarship would be supportative of the policies of the RSPCA and would be used to further animal welfare. Details are available at the RSPCA website: **http://www.rspca.org.au/**

# Readership Survey of *ANZCCART NEWS*

Julie Nixon

Thank you to all those readers who completed our reader survey. The responses to several key questions are indicated in the pie diagrams. The information that we received has been very valuable. The suggestions, problems and other useful comments will help us shape a more user friendly ANZCCART News.

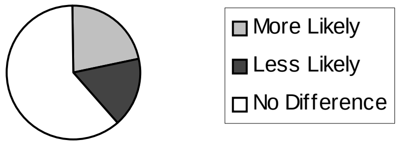
We were relieved to note that 84% of respondents felt that it made either no difference or that it was more appealing, that ANZCCART News is published electronically. Amongst respondents, 99% were happy with pdf format, and did not feel that acrobat reader or information on its use needs to be provided.

Due to the fairly even distribution of people who read *ANZCCART NEWS* on screen, or print it first, or do both, we will be aiming to produce a layout that is conducive to both on-screen reading and printing. The problems some people found with printing text boxes will be addressed.

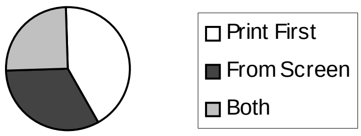
Respondents most frequently ranked invited papers and brief specialist papers as their first preference for content. General announcements were most commonly ranked as third preference with book reviews and letters to the editor ranked last.

Many respondents said they would like a more practical focus to the articles, with an emphasis on topics such as animal treatment techniques and examples of "Reduction" that would be helpful for Animal Ethics Committees. We are eager to incorporate these preferences in future issues and would welcome articles on these subjects from our readers.

**Are you more or less likely to read the ANZCCART News in electronic Form, or does it make no difference?**




**How do you read the ANZCCART News?**




**Article Preference**


## Correction

In the previous edition of this newsletter, we highlighted a report by the RSPCA (UK) on rodent welfare (p. 10, ANZCCART News vol. 16 no. 1). Unfortunately, the email address we supplied was incorrect. The correct address is: **Research_Animals@rspca.org.uk** (note the underscore between "Research" and "Animals"). We apologise to the RSPCA for this error.

**The Editors of *ANZCCART NEWS* would welcome contributions from readers. These can be in the form of short articles, book reviews or letters. Submissions may be subject to review, and should be strictly relevant to the aims of ANZCCART. The Editors reserve the right to select material for publication as they think appropriate.**

**ANZCCART 2003 CONFERENCE**

*Lifting the veil: finding common ground*

Hotel Grand Chancellor
Christchurch
New Zealand

**18-19 August 2003**

Full details are available from the ANZCCART websites in Australia and New Zealand:

www.adelaide.edu.au/ANZCCART
www.rsnz.org/advisory/anzccart

# Membership of ANZCCART

Readers of this newsletter may be interested in the various categories of membership of ANZCCART.

### Sponsoring members:

Sponsoring members make a major contribution to the funding of ANZCCART and are represented on the Board. The present sponsoring members are:

1. Australian Vice-Chancellors Committee (AVCC)
2. Australian Research Council (ARC)
3. Commonwealth Scientific and Industrial Research Organisation (CSIRO)
4. National Health and Medical Research Council (NHMRC)
5. Royal Society of New Zealand (RSNZ)

### General Members:

General Members are organisations that have been invited by the Board to join ANZCCART and be represented on the ANZCCART Council. General Members make an annual contribution to ANZCCART. To be eligible, such organisations groups / associations must be:

- involved in the administration and / or funding of substantial amounts of animal-based research or teaching;
- Commonwealth or State bodies involved in the regulation of animal-based research and teaching;
- professional groups whose membership consists predominantly of persons involved in animal-based research or teaching;
- organisations with an established commitment to furthering the welfare of animals used in research and teaching.

At present there are 13 General Members:

1. Agricultural and Veterinary Chemicals Association of Australia (AVCARE)
2. Australian Academy of Science
3. Academy of Technological Sciences and Engineering (ATSE)
4. Australian and New Zealand Society for Laboratory Animal Science (ANZSLAS)
5. Australian Animal Technicians' Association (AATA)
6. Australian Veterinary Association (AVA)
7. Department of Agriculture, Fisheries and Forestry, Commonwealth of Australia
8. New South Wales Agriculture
9. Department of Local Government and Regional Development, Western Australia
10. Department of Sustainability and Environment, Victoria
11. Department of Primary Industries, Water and Environment, Tasmania
12. Department of Primary Industries, Queensland
13. Department of Environment and Heritage, South Australia

### Lay members:

At the invitation of the Board, up to two lay members may be invited to join ANZCCART if they represent the interests of the community or have expertise which can contribute to the objectives of ANZCCART.
At present there is a single lay member, Andrew Brennan BA, PhD.

### Animal welfare member:

At the invitation of the Board, one member may join ANZCCART if that person has experience in, and knowledge of, animal welfare.
The present animal welfare member is John Strachan LLB .

# The Effects of History and Habitat on the Genetic and Relatedness Structure of the Southern Hairy-nosed Wombat, *Lasiorhinus latifrons*

Faith Walker
Dept of Biological Sciences
Monash University
Clayton, Victoria 3800

*This article was originally written for The Friends of Brookfield Newsletter. It has been revised and updated for this edition of ANZCCART NEWS. Faith Walker is from Northern Arizona in the United States and is studying for a PhD in Conservation Genetics at Monash University. Her work enables her to tiptoe across Australia after the Hairy-nosed Wombat, and even though she has also studied the Mojave Desert Tortoise, Mexican Spotted Owl, Gunnison's Prairie Dog and Kenya's de Brazza's monkey, she finds this wombat to be the most captivating creature she has encountered.*

For the past four years I have been stealing hair of Southern Hairy-nosed Wombats by suspending double-sided sticky tape across burrow entrances. As wombats enter or exit their burrows, they kindly donate hair, from which I extract DNA and generate unique DNA profiles (including gender) for individuals. Thus, I molecularly track these wombats using modern forensic techniques, and thereby non-invasively illuminate many areas of wombat biology that would be impossible to approach using more traditional, invasive methods.

Such genetic techniques, involving markers called microsatellites, allow one to: 1) track individuals over time to work out patterns of burrow use, presence in an area over time, and home range estimates; 2) determine relatedness of burrow users; 3) determine which is the dispersing sex; 4) infer whether a population is isolated from others, even without prior knowledge of population history or information about how far individuals typically disperse; 5) determine the influence of isolation on population processes; and, 6) understand the effects of ecology on these processes. In a nutshell, my project aims to illuminate the relatedness structure of the Southern Hairy-nosed Wombat, and determine how ecology and habitat fragmentation affect it. Brookfield Conservation Park, in the Murraylands of South Australia, is the site at which I first characterised relatedness of burrow-users. This is a large, contiguous wombat population. Each sampling period I taped all burrows of 40 warrens for seven days, giving the inhabitants roughly 1,500 opportunities for hair donation. Over three years I detected 102 wombats. I scored these individuals for 17 loci, which means that I have great statistical power for relatedness tests and dispersal estimates. My other study site that is in the midst of a large, contiguous wombat population is on the Nullarbor Plain, which has a different soil type and should hint to whether different warren structure yields different patterns of burrow use between relatives.


Figure 1 Although the project is primarily laboratory-based, Faith Walker took extended trips across South Australia in the Wombatmobile to collect wombat hair.

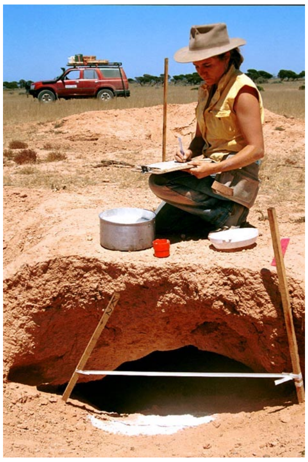


Figure 2 Hair is caught on double-sided sticky tape as wombats enter or exit their burrows. Only a single hair follicle is needed to identify an individual. Footprints in flour scattered at burrow mouths enables age estimation of individuals.

Finally, to address the habitat fragmentation query I first spent three months, 15,000 km, and 6 flat tyres travelling across South Australia collecting wombat hair from populations that appeared to be small and isolated, and then identified in the laboratory which indeed were, using genetic techniques. I then returned to two isolated populations and captured a lot of hair.

This fragmentation query is interesting because it may shed light on the mechanisms of extinction, something we know very little about. While it is well known that human-induced habitat fragmentation causes a decline in both species richness and abundance, it isn't clear precisely how this occurs. This needs to be elucidated if we are to conserve native wildlife. Both demographic and genetic factors are likely to be involved in observed local extinctions, and it may be that this occurs through altered dispersal patterns and social organization resulting from fragmentation of habitat. Both, however, have always been difficult to measure using traditional ecological tools, which are also quite invasive, often entailing radio-tagging or a permanent marking system. Thus, the advent of microsatellite markers is a timely, more effective, and less disruptive approach to addressing this query.

So far I have found that females are the dispersing sex. Males tend to remain near the place of their birth and are hence more related to one another than they are to females or females are to each other. This is unusual among mammals, and consistent with findings for their close relative, the Northern Hairy-nosed Wombat (*Lasiorhinus krefftii*), and the Common Wombat (*Vombatus Ursinus*). I have also found that the patterns of association and burrow-sharing within and between the sexes differ in contiguous and fragmented habitat, and am analysing these data now.

This is one of the first studies to comprehensively analyze population processes by remote collection of hair. The technique I am using will become more commonplace since microsatellite genotyping and statistical programs for analysis have only recently come of age.

It's quite an honour to work on the Southern Hairy-nosed Wombat. If you are out there and see a red Toyota Forerunner with the word WOMBATMOBILE on the side, that's me. Let's have tea and chat about these amazing creatures called wombats, which incidentally aren't bald yet!


### Acknowledgements

The project was funded by: the National Geographic Society, Mark Mitchell Fund, *Australian Geographic*, and an Alan White Scholarship from the RSPCA. This latter scholarship is awarded annually to a student whose project has animal welfare implications and who demonstrates a commitment to conservation.


## ANZCCART WORKSHOP

The ANZCCART Workshop, held at the University of Melbourne on 23 May 2003, focused on the proposed revisions to the *Australian Code of Practice for the Care and Use of Animals for Experimental Purposes.*

A full report of the Workshop is available from the ANZCCART website *www.adelaide.edu.au/ANZCCART*

A copy of the report has been forwarded to the Animal Welfare Committee of the NHMRC, for discussion by the Code Liaison Group.

ANZCCART thanks the NHMRC for the provision of sponsorship.

# ANZCCART FACT SHEETS

**Periodically, ANZCCART publishes "Fact Sheets" (see list below). These short articles on specific topics or species, represent a valuable yet perhaps underutilised resource. We encourage readers to make use of our fact sheets – all of which can be downloaded from the ANZCCART website.**

The Rat (1993) David Pass, Graham Freeth

The Mouse. Parts 1 and 2 (1993) Catheryn O'Brien, Margaret Holmes

Experimental Techniques and Anaesthesia in the Rat and Mouse (1994) Steven Marshall, Angela Milligan, Ray Yates

The Laboratory Rabbit (1994) Ivor Harris

The Guinea Pig (*Cavia porcellus*) (1994) Denise Noonan

The Common Marmoset (1994) Julie M Clarke

The Sheep (1995) David Adams, Michael McKinley

The Laboratory Cat (1995) AE James

Australian Marsupials (1995) Louise McKenzie, Clive Cheeson, Rory Hope, Janine A Duckworth, Lynne M. Meikle

Restraint and Handling of Captive Wildlife (1996) Andrew Tribe, Derek Spielman

*In vitro* and other non-animal experiments in the biomedical sciences (1996) Bas J Blaauboer

TheDomestic Chicken (1996) Philip Glatz, Kim Critchley, Christine Lunam

The Dog as an Exeperimental Animal (1997) Mary Bate

Variables in Animal Based Research: Part 1Phenotypic Variability in Experimental Animals (1997) Ivor Harris

Occupational Health and Safety in the Animal House and Associated Laboratories (1998) Tony James

The Importance of Non-Statistical design in Refining Animal Experiments (1998) David B Morton

Variables in Animal Based Research: Part 2 Variability Associated with Experimental Conditions and Tecniques (1998) Julie Reilly

Pain - Assessment, Alleviation and Avoidance in Laboratory Animals (1999) Paul Flecknell

Frogs and Toads as Experimental Animals (1999) Michael J Tyler

Importation, Quarantine and Monitoring of Laboratory Animals, Particularly Rodents (1999) Kevin Doyle

Development and use of Trans-genic Rodents in Preclinical Research - Practical Issues (2000) Patrick Hardy

Doing Better Animal Experiments; Together with Notes on Genetic Nomenclature of Laboratory Animals (2000) Michael Festing

Managing Fallow Deer (*Dama dama*) and Red Deer (*Cervus elaphus*) for Animal house Research (2001) ZH Miao, PC Glatz, A English, YJ Ru

## *Flinders University Research Ethics: Animal Welfare Committee*

A casual vacancy exists for a qualified

# Veterinarian

to serve on Flinders'

**Animal Welfare Committee (AWC)**

In accordance with the
SA *Prevention of Cruelty to Animals Act*,
appointments to the AWC are made by the
Minister for Environment and Conservation.

In the first instance, suitably qualified people interested in nominating to fill this position should contact the Committee Secretary for more information.

Ms Lesley Wyndram
tel. (08) 8201 5466

email: *lesley.wyndram@flinders.edu.au*

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