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# The welfare of vertebrate pests in relation to their management

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## Abstract

Recently developed methods for the scientific assessment of animal welfare can be applied to pest species when considering management procedures.

Vertebrate pests include mammals, birds and some fish. The management activities which may affect the welfare of the pest animals include: killing by various means, restraining in traps, translocating, excluding from an area, scaring, using a repellent, withdrawing resources, changing physiologically, marking for population monitoring purposes and providing an alternative resource.

When an animal dies, welfare ceases and if consciousness is lost instantly and not regained before death, there is no welfare problem. However, when an animal dies slowly after being shot, trapped or poisoned in a way which causes pain, fear or distress, its welfare is very poor. Most infection with disease also has severe effects. Restraining traps may cause little ill effect but some, e.g. leghold traps, may cause pain and fear to the point where self-mutilation occurs. Some poor welfare may result from translocation, physical exclusion, marking and changing physiologically. In each case it should be assessed. An estimate of the magnitude of the problem for the animal is the area under the curve when the level of the poor welfare is plotted against its duration.

Human attitudes to pests are often different from attitudes to other species but if we interact with these animals we have moral obligations towards them and we should consider their welfare in every management operation. Traps, poisons and other pest control methods should be licensed for use only if scientific studies of their effects on the welfare of target and some non-target species have been carried out. The results of such studies should be publicly accessible. Cost-benefit analysis is useful in pest control but some methods which result in very poor welfare should be banned in all circumstances.

## Introduction

It is no longer possible for pest management to be carried out without due consideration of all of its consequences. In particular, there are public demands that effects on human health, wildlife conservation and animal welfare should be considered. When pest control methods are carried out, there could be adverse effects on the welfare of target or non-target species.

The attitudes of people to animals are often quite different according to the human activity which they affect or the human usage to which they are put. Predators, which attack humans or their domestic animals, were long regarded as targets for extermination by any means. Pest animals have been viewed in the same way. Members of the same species, may be thought of and treated in quite different ways, for example a person might be willing to cause substantial pain to a wild rabbit in a winter wheat field but be much less willing to cause the same pain to a rabbit in a laboratory cage, or a cage on a rabbit farm and be appalled at the idea of causing such pain to a child's pet rabbit (Broom 1989). Similarly, a hunter thinks of a feral cat and a pet cat quite differently (Serpell 1989). However, it does not matter to the animal what its impact on man is and when its welfare is assessed, this is done in exactly the same way whatever its human usage. Human moral obligations to animals with which they interact are to minimise any poor welfare which results from that interaction irrespective of the usage of the animal.

Public concern about animal welfare is increasing, the level of concern being demonstrated by the fact that Members of the European Parliament receive more letters about animal welfare then about any other topic. Although the greatest concern is for the most endearing animals, many people would now object to any brown rat *Rattus norvegicus* being knowingly caused serious pain.

## Animal welfare and its assessment

Animal welfare assessment is a scientific discipline which has developed rapidly in recent years. Much of the research has been carried out on domestic animals but the basic methodology is the same for all species. The welfare of an animal is its state as regards its attempts to cope with its environment (Broom 1986). Hence welfare is a characteristic of an individual at a particular time and it can vary over a range from very good to very poor. Welfare includes the extent of any difficulty in coping or of any failure to cope. It includes the feelings of the individual because feelings are part of coping systems and have evolved like any other part (Broom 1996, 1998). One kind of feeling which may be important in welfare assessment is pain and another is fear.

Wherever there is failure to cope, the animal is stressed as stress is an environmental effect on an individual which overtaxes its control systems and reduces its fitness or appears likely to do so (Broom and Johnson 1993). The term fitness refers to the individual's contribution to future generations and in most cases, potential fitness reduction has to be estimated.

Good welfare can be assessed by [a] considering the extent to which a range of normal behaviour can be shown, [b] determining what are the positive preferences of such animals and then evaluating how much the preferred resources are available or the preferred actions are possible, and [c] using indicators of pleasure where these are available. Indicators of poor welfare are listed in Table 1. Where measures of attempts to cope are considered, very easy coping with little energy expenditure indicates no problem but as coping becomes more difficult and more emergency measures are brought in, welfare becomes worse even when the coping is ultimately successful in that fitness is not reduced. The use of welfare assessment measures is discussed in detail by Broom and Johnson (1993)

**Table 1 Measures of poor welfare**

| |
|---|
| Reduced life expectancy |
| Reduced ability to grow or breed |
| Body damage |
| Disease |
| Immunosuppression |
| Physiological attempts to cope |
| Behavioural attempts to cope |
| Behaviour pathology |
| Self narcotization |
| Extent of behavioural aversion shown |
| Extent of suppression of normal behaviour |
| Extent to which normal physiological processes and anatomical development are prevented |

(after Broom and Johnson 1993)

During the evaluation of a pest control procedure, the extent to which welfare is poor can be determined by measurement, for example by finding elevated heart rate, plasma cortisol, abnormal behaviour or injury. The longer this poor welfare persists the worse is the evaluation. As explained by Broom and Johnson (1993 p.109-110), extent of poor

welfare can be multiplied by duration of poor welfare as an estimate of the severity of the problem. In fact, the time course of the change in welfare should be monitored as accurately as possible, as shown in Figure 1, and the area under the curve calculated. This procedure would take account of the difference between 1a, in which the welfare rapidly becomes very poor and then changes little, and 1b, in which a small initial effect eventually reaches level "y" at the same time "x" but the area under the curve is much less.

**Fig 1 here**

The range of pest management methods and their consequences for welfare

The methods used for the management of vertebrate pests (Table 2) are diverse and vary greatly in their consequences for the welfare of both target and non-target species. Later Sections in this paper refer to killing, trapping and scaring so only the other topics in Table 2 are considered in this section.

**Table 2 Vertebrate pest management methods which might affect welfare**

| |
|---|
| Kill |
| Use trap, chemical, or electricity to catch, then translocate |
| Remove resource temporarily |
| Physically exclude |
| Scare |
| Use repellent |
| Change physiologically, e.g. using vaccine or sterilising agent |
| Provide alternative resource |

Catching other than trapping

Trapping may be a prelude to killing, translocation or some form of scientific study. Alternatives to the use of a trap in these circumstances include the use of chemicals or electricity to allow capture. Some chemicals may be ingested and stupefy the animal. An example which is used for birds is α-chloralose which, when combined with seconal to decrease the time to unconsciousness, appears to act without causing adverse effects.

The stupefied birds should be collected up before environmental factors, such as too high or too low a temperature or predators, can harm them. Another example which is used for large mammals is a tranquillising chemical administered via a dart gun. Again, the effects on welfare may be very minor if good procedures are used. A method commonly used to catch fish alive is electric fishing by means of which all of the fish in a localised volume of water, such as a section of a stream, river or lake are stunned and float on or near the surface where they can be sorted into wanted and unwanted species. If the current administered is too great, the fish may be killed or permanently harmed. If the stunned fish are not collected they may be injured by being swept by a water current against a solid object or by being attacked by predators. Any fish taken out of water will be severely affected since fish show a maximal emergency adrenal response in this circumstance (Pickering 1981). Fish which are handled may have scale or skin damage which causes pain and renders them susceptible to fungal or other disease. The direct effects of the electric shock could be unpleasant for fish. Hence there are various ways in which fish welfare could be considerably worse if they are electrically stunned in this way.

Resource removal

The removal of a resource for the pest animals might involve, for example, the temporary removal of their food or the permanent removal of suitable nesting places. The successful reduction in the populations of urban pigeons in Switzerland (Haag 1995, Steiger 1997) was principally a result of a campaign to dissuade members of the public from giving food to pigeons. This procedure was much more publicly acceptable than any widespread killing of the pigeons would have been. However, although some pigeons may have moved away from the town centres, most of the reduction in pigeon numbers would have been due to reduced breeding success and direct starvation.

Physical exclusion

Another pest management technique is to physically exclude birds from places where they might cause damage or nuisance. For example, following the advice of Feare (1985), feral pigeons have been kept off statues and out of station entrance areas by the judicious use of taut inconspicuous netting. The effect on the welfare of the pigeons is likely to be very little directly but good indirectly because the birds are perceived to be less of a nuisance and hence receive less harmful human attention. In the same way, fish-eating birds can be prevented from gaining access to farmed salmon and trout by nets or cords stretched over marine salmon cages, over circular development tanks for young fish or around and over whole trout farms. The effects on the welfare of the fish-eating birds is to remove a food resource but without otherwise harming birds, with the possible exception of any which collide with the nets or cords.

Repellent usage

When repellent substances are incorporated into the food of pests, there is inevitably some unpleasant sensation for the animal but this is a small effect on welfare. Starvation is not likely because there will usually be alternative food sources. Repellents are unlikely to cause any damaging responses and, in general, their use will not result in poor welfare.

Changing animals physiologically

The use of bait to change an animal in some way so that its impact as a pest is reduced can be of considerable importance. The reduction of or eradication of disease such as rabies using oral vaccine might be considered in this category. If a fox is protected against rabies its welfare is better than if it were not protected. Chemicals which sterilise animals will have effects on their physiology and behaviour as well as on their reproductive output. None of these effects on the welfare of the animals is wholly known but substantial doses of hormones could have an unpleasant effect in the short term. The later effects might be just to rearrange the proportions of time spent in the several normal physiological states but there could be harmful side effects. Sterilised animals would be likely to have changed behaviour and changed relationships but the consequences for welfare are not known. It is quite possible, however, that the total effect on the welfare of animals of a sterilisation programme would be found to be considerably better than when other methods of control are used.

Providing alternative resource

Mammals or birds which can cause severe damage to certain crops can sometimes be attracted away from such crops by providing them with a more attractive alternative resource. In the case of the bird pest *Quelea*, they prefer to eat wild African seed bearing plants rather than rice, millet or sorghum so an area in which these plants grow can protect crops from *Quelea* depredations. Alternative resource areas also make scaring more effective. The provision of alternative resource areas has also been found to be effective for geese since reserve areas where good feeding places are provided, with much less disturbance than would occur on farm fields, will reduce the extent of goose damage (Boyd 1980, Patterson 1998). These methods of reducing damage to crops do not result in poor welfare in the pest species.

<u>Killing methods</u>

If an animal is killed in such a way that it becomes insensible to pain and distress (loses consciousness) instantaneously and this sensibility is not regained before death, there is no welfare problem. For example, a rabbit which is shot whilst feeding in a field may

become insensible immediately and die rapidly. Whilst some might question the morality of killing the rabbit, the welfare is good at one point, then non-existent at the next. The terms "humane killing" or "humane slaughter" are used in circumstances, such as veterinary euthanasia or food animal killing, where the welfare of the animal is not poor just prior to the initiation of the killing procedure and the procedure itself results in insensibility to pain and distress within a few seconds. When carried out properly, the welfare is either not poor at any time or is poor for those few seconds only. In practice, a captive bolt gun or electrical stunning equipment renders the animal insensible immediately, and a non-aversive gas or a veterinary euthanasia injection results in insensibility with no very unpleasant effect. It is legal at present in many countries to use carbon dioxide, which is an aversive gas, but an animal immersed in a very high concentration becomes insensible within 15-20 s. These are the humane standards with which other killing methods must be compared. Killing methods for vertebrate pests are summarised in Table 3.

**Table 3 Killing methods for vertebrate pests**

| | |
|---|---|
| 1. | Poisoning |
| 2. | Shooting |
| 3. | Use of killing traps |
| 4. | Gassing |
| 5. | Using explosives |
| 6. | Using electrical methods |
| 7. | Use of parasite, predator or disease |
| 8. | Hunting by chasing, often with dogs. |

In order to find out the effects of killing methods on welfare, the two kinds of measurement required are the severity of any poor welfare before death and the duration of the period during which the poor welfare continues. The assessment of welfare in such an acute situation necessitates the measurement of emergency physiological responses, behaviour, and injury level (Broom and Johnson 1993, Chapter 5). Much of this measurement concerns the assessment of pain but other forms of poor welfare such as fear, anxiety, and malaise should be considered.

Although some killing methods, for example some gases and ingestable agents, do not result in poor welfare, for most methods there will be a period of poor welfare which is the interval after the timed action of the killing method and before the animal becomes insensible to pain and distress. Hence the recognition of such insensibility is important. The term "insensibility to pain and distress" is used because it is more precise than "unconscious" and it takes account of the possibility that an individual could have pain suppressed by a killing procedure but still be subject to other kinds of poor welfare. Such insensibility is most precisely determined by loss of evoked potentials in the brain to visual, tactile or auditory stimuli or by loss of medium wavelength electroencephalogram patterns which are characteristic of sensibility. Reflexes such as the corneal and palpebral reflexes also give useful information but can be absent in animals with damaged cranial nerves or in very excited individuals where there is suppression of the reflexes.

Poisoning

Poisons are very widely used in the control of bird and mammal pests. There are poisons with various lethal effects, for example neurotoxic and haemorrhagic poisons, and the effects may be acute or prolonged following one or a series of doses. Reports from people who have survived poisoning and descriptions of the effects of poisons on the behaviour and physiology of other species provide information on the welfare of animals poisoned in various ways. However, few studies have incorporated an adequate range of welfare indicators and care must be taken in extrapolating results from one species to another as poisons may have different effects in different species. Manufacturers of poisons are required in many countries to check the degree of pain and suffering which they cause to the target species, and sometimes to other species, using a range of measures (Table 4).

**Table 4 Assessing the degree of pain and suffering: U.K. legal requirements for testing poisons**

| |
|---|
| Changes in body weight |
| Reductions in food or water intake |
| Aspects of appearance |
| Vocalisations |
| Changes in undisturbed behaviour |
| Changes in responses to handling |
| Changes in heart or respiration rate |
| The influence of analgesics |
| Post-mortem examination |

A result of studies of the effects of poisons is that some poisons are banned in some countries and the usage of others is very closely regulated. This is because the poisons readily kill people or domestic animals or they have too extreme an effect on the welfare of the pests. The severe effects of strychnine on individuals are evident from observation after poisoning as well as from the reports of poisoned people. Some other poisons, such as cyanide, cause extremely rapid death if the dosage is sufficiently high but 1080 and phosphorus can cause signs of poor welfare for a much longer period. Eason *et al* (1997) found that the times to death for brush-tailed possums *Trichosurus vulpecula* were 14 minutes for cyanide, 12 hours for 1080 and 32 hours for phosphorus. Other poisons have effects on welfare whose extent is not readily determined without careful study of the poisoned individual. Direct studies should be carried out using an adequate range of welfare indicators. Where these are not available, evidence from parallel effects on humans must be considered. For example, warfarin, brodifacoum and other anticoagulants cause widespread haemorrhage within the bodies of pest mammals. Studies of the effects of anticoagulant induced haemorrhages in humans show clearly that haemorrhage is generally very painful and may result in other poor welfare (Table 5). It therefore seems to be likely that such poisons result in very poor welfare in the affected animals (Kirkwood *et al* 1994, Eason *et al* 1996). The effects on welfare have often not been obvious to people who have not conducted a proper study of the welfare of the poisoned animals since the changes in behaviour when there is internal pain may not be great in the earlier stages and may be general lethargy in the later stages.

**Table 5 Pain from anticoagulant-induced haemorrhages in humans**

| | Severity of pain | Other distress |
|---|---|---|
| Intestinal wall | Severe | (not noted) |
| Retroperitoneal | Severe | (not noted) |
| Rectus sheath | Severe | (not noted) |
| Kidney | Severe | (not noted) |
| Adrenals | Severe | (not noted) |
| Liver | Severe | also rupture |
| Spleen | (not noted) | also rupture |
| Gonads | Acute | (not noted) |
| Lungs | Severe | breathing difficulty |
| Heart | (not noted) | breathing difficulty |
| Intracranial | "Headache" | pain elsewhere |

| | | |
|---|---|---|
| Spinal | Severe | (not noted) |
| Mouth/airway | Mild | breathing difficulty |
| Eye | Intense | (not noted) |
| Joints | (not noted) | swollen joint |
| Skin necrosis | Severe | (not noted) |

Shooting

The use of a gun with a free bullet is approved in most countries as a method of humane killing for the slaughter of farm animals or euthanasia by veterinary surgeons. In the same way, the shooting of a pest animal so that it becomes insensible instantaneously, or within a few seconds, is humane. An animal shot in the head so that brain function ceases or shot in the neck so that the spinal cord is severely damaged will become insensible immediately. A shot which stops the heart functioning also results in very rapid insensibility. If the shot causes rapid bleeding, the insensibility will occur after an interval which may range from a few seconds to a minute or more. However, shots which have other effects on the body may result in death after many hours or some days or weeks. During the interval before death, the welfare will usually be poor, sometimes very poor. Hence shooting can have a wide range of effects from no welfare problem at all to very severe and prolonged problems.

Using killing traps

Traps which are set to kill a pest species operate in various ways. Many traps for small mammals have a mechanical action in which a bar moves rapidly and hits the back or neck in such a way as to break it. A few traps just squash the animal with a heavy weight. Mechanically operated traps for somewhat larger mammals may clamp the animal, often leading to suffocation if set in air. Killing snares are traps in which the animals head enters a noose made of wire or other material and the animal's own movements result in it being strangled. A few killing traps operate by the animal being killed by automatic shooting, injection or electrocution when the trap is activated. Traps which restrain an animal underwater or restrain it and cause it to fall or dive into water and remain under the surface, are killing traps in which drowning is the cause of death. This last is the most commonly used method for catching and killing many fur-bearing mammals.

The best killing traps are selective for the target species and they kill instantaneously. Whilst selectivity is not in itself a welfare problem, when animals of the wrong size or

shape enter a killing trap they may be severely injured but not killed so their welfare is very poor. A crude trap such as a heavy weight which falls when a trigger is moved by the animal could cause injury or a slow death to any animal. A more sophisticated spring operated trap like a Conibear set so that it will close on the thoracic region of a marten *Martes* could injure and kill slowly a larger animal such as a badger *Meles* or *Taxidea* or a smaller animal such as a squirrel *Sciurus*. However, even the target species may be injured and not killed rapidly (Pohlmeyer *et al* 1995).

Some mechanical killing traps are designed to be selective and to control the point of impact or clamping so that killing is rapid. The place of setting the trap and, where appropriate, the bait which is used are important in ensuring selectivity and rapid killing. Danger to the larger non-target species can be prevented by setting the trap in an appropriate tunnel. A trap whose bait is attractive to one kind of animal and which has an aperture in front of the bait which allows head access to one size of animal only, can be selective and kill rapidly. A break-back type mouse trap can be set and baited so that most of the animals caught will be mice of one species which are killed soon after it is activated. Hence the trapping system should be considered when the effects on welfare are considered, rather than just the trap itself. Trapping systems should be tested in such a way that the time to insensibility to pain and distress and the extent of any poor welfare caused are known.

When trapping systems are tested it is sometimes found that assumptions made by manufacturers and users as to the method and speed of killing are incorrect. For example, aquatic mammals such as beavers *Castor canadensis*, musk rats *Ondatra zibethicus* and mink *Mustela vison* are sometimes caught in mechanical traps set under water. Conibear traps are often set at an underwater entrance to a beaver lodge. The trap clamps the neck or thorax of the beaver and it was thought that this clamping action killed the beaver. However, sprung traps exert less force in water than on land and a recent study of nine beavers caught in this way showed that death was due to drowning rather than directly due to clamping. When aquatic animals are restrained under water they take much longer to die than terrestrial animals as they invoke their diving responses. Work like that of Gilbert & Gofton (1982) has shown that the time to drowning in mammals restrained under-water is usually less than one minute in a land mammal but 3-4 minutes in a mink, 8 minutes in a musk rat and 15 minutes in a beaver. The welfare of such an animal will be very poor from the point at which it knows that it is restrained under water to the point of insensibility.

Gassing

The effects of gases on welfare range from nil, where they are undetectable, to extreme where they have very irritant effects and where the animal's recognition of the gas leads

to reactions such as those of panic. When an animal is killed by pure carbon monoxide, the presence of the gas is not detected and the animal becomes insensible and then dies. This property of carbon monoxide makes it very dangerous to humans so considerable care is required if it is to be used.

Gases which have a pungent odour will be detected by the animal being gassed so they will result in poor welfare for the period before insensibility occurs. A gas which is commonly used for killing animals but which is irritant and causes gasping and choking reactions is carbon dioxide.

In general, the effective use of gasses for killing wild animals is difficult because they have to be in confined spaces, all of whose outlets are known. In a burrow system, the use of smoke can help to identify outlets but in some circumstances they cannot all be blocked. If the gas concentration is not sufficiently high, animals may be affected by the gas but not killed. For some gases there can be long-term adverse effects of such exposure. If a gas is to be used, the effects of sub-lethal doses on welfare, as well as the speed with which a lethal dose kills, should be known.

Using explosives or electrical killing

Where there are very dense concentrations of pest animals, for example a communal roost of *Quelea quelea*, explosives may sometimes be used as a killing method. Birds or mammals killed instantaneously by an explosion are humanely killed but some individuals can also be injured but not killed in such circumstances. A further effect of explosives can be destruction of habitat which may cause problems for the animals which remain. Where explosives are used to kill fish, the likelihood of sub-lethal effects is greater, especially for species with a swim bladder.

Electrical killing is sometimes used on the periphery of a valuable human resource which might be damaged by rodents. The electrified region must be carefully protected from contact with humans or other non-target animals. Electrified barriers can sometimes be used in a discrete area like a tunnel to prevent unwanted land mammals from passing. Contact with the electrified surface may kill animals instantly but contact which is via an electrically insulated part of the body could cause poor welfare but not death.

Using predators, parasites or disease to kill pest species

One predator which people use for vertebrate pest control is the domestic cat. Cats can catch mice and rats but the extent to which most individuals do so is affected considerably by the availability of other sources of food. Cats kill some small mammals and birds rapidly but others are caught and released by the cat repeatedly for long periods. These animals may be maimed, for example by having their back legs or spine

broken, so will be in pain during this period, and all of them will be in fear throughout. Hence the welfare of some individuals of pest species is very poor when cats are used for pest control. The fact that predators catch prey species in the wild does not mean that the welfare of the prey species is good. Thus their use for killing, especially species which sometimes cause prolonged poor welfare to their prey, is questionable. However, some predators may also simply scare the pests and can be very effective in this respect.

A well known example of the use of a disease or parasite in order to control vertebrate pests is the deliberate infection of rabbits with myxomatosis. This is illegal in some countries and even without an extensive study of the effects of myxomatosis on rabbits, it is clear that the disease condition is prolonged and that it must result in very poor welfare. Hence deliberate infection with myxomatosis results in very poor welfare in rabbits. The extent of effect on welfare of pest control methods utilising disease-causing or parasitic organisms will vary according to the duration and severity of the effects of the disease but in most cases the effects on welfare will be considerable.

Human chasing of pest species

If a person uses a peregrine falcon *Falco peregrinus* to chase pest birds and the peregrine stoops on the bird and kills it immediately there may have been no prior fear and no pain. However a deer hunt in which a deer (*Cervus elephas* ) is pursued by dogs and humans for six hours until it is exhausted clearly has very severe effects (Bateson and Bradshaw in press). This form of pest control is usually very expensive and not efficient so it is generally continued for human entertainment purposes rather than for pest control. If that is the case, the methods used may well be contrived to prolong the chase and hence to cause the welfare of the chased animal to be poorer than it would be if the sole objective was pest control. For example, if deer hounds and people are used to cause deer to leave hiding places, it would be most efficient to shoot the deer at the earliest possible opportunity in the hunt but this is not usually done. People involved in fox-hunting or deer-hunting with dogs may even move out of the way of the hunted animal so that the hounds can again chase it or may prevent it from entering land where hunting is forbidden which would otherwise provide a refuge.

The effects on the animal hunted by a pack of dogs and people are to cause it great fear as soon as it appreciates that it may be caught. The maximal emergency physiological and behavioural responses are used and the animal will use up or damage body tissues in its efforts to avoid capture. The very high adrenal cortex and blood enzyme responses and the energetic behavioural flight responses reported for hunted deer by Bateson and Bradshaw are sufficient evidence in themselves for very poor welfare. In comparison with results of studies of deer welfare during handling and transport these measures are

extreme. The effects of high levels of exertion and tissue utilisation in long hunts, demonstrated by this study, add further evidence of just how poor the welfare of the hunted animal was at the end of a hunt.

Restraining traps

When vertebrate pests are caught in restraining traps, the intention is often to kill them but to release or discard non-target species. Some restraining traps, however, are used prior to translocation of animals, or some form of study, and the intention is to have minimal effects on the animals. Table 6 is a summary of types of restraining traps.

**Table 6 Trapping vertebrates: restraining traps**

| |
|---|
| Leghold with jaws |
| Snare - foot or body ± stop |
| Cage or box |
| Adhesive, e.g. bird lime |
| Pitfall |
| Hook and line, e.g. fish hook |
| Net which is set, e.g. mist net, drift net |
| Mobile net e.g. trawl, seine. |

An important variable which affects the welfare of animals caught in restraining traps is the interval between trapping and the checking of the trap. Most of the adverse effects of being in the trap are exacerbated or made more likely by spending a longer time in the trap. Hence the frequency of checking traps has major effects on animal welfare. For some restraining traps, the frequency of checking should be once or more per hour whilst for none is an interval of more than one day acceptable. However, less frequent checking takes up less time and may improve trapping efficiency. Some of the worst welfare is that of animals which are caught in a restraining trap and then take several days or weeks to die.

Using leg-hold traps with jaws

Leg-hold traps are widely used for mammals which will be killed for their fur and for predators such as foxes *Vulpes vulpes* and coyotes *Canis latrans*. The traps are generally set in places where the animals might walk and hence are usually non-selective, catching various mammals and birds. They would not normally catch those which are

considerably lighter in weight than the target species. A sprung trap which will hold the leg of the target mammal may break the leg of those birds which activate it and may also injure larger animals which catch part of a leg or some other part of the body in the trap. Hence these traps will often result in very poor welfare in non-target species. Target species may be injured directly by the trap closing and injured further during their attempts to escape by pulling and moving the trapped leg. Such injuries are usually more severe if the trap has serrated metal jaws than if it has smooth metal or rubber-coated jaws. The trapping procedure as a whole has a considerable effect on welfare which is wider in its effects than the direct effects on the trapped limb. The trapping causes fear in the animal and welfare is also poor because it is unable to control its interactions with its environment in the normal way. Kreeger *et al* (1989, 1990) reported substantial increases in heart rate and plasma cortisol in foxes caught in leg-hold traps. Further injuries may arise during attempts to escape from any design of leg-hold trap, for example, some animals will chew off their own leg in these circumstances. Animals in leg-hold traps are also particularly vulnerable to predators because they are held in a place where they may well be conspicuous. Predators sometimes learn where trap-lines are set and regularly visit them to kill and eat trapped animals. This is one of the reasons why leg-hold traps, set in cold regions to catch animals for their furs, are often set next to water in such a way that the trapped animal will fall into the water and drown, thus being less likely to be eaten by predators. Whenever trapped animals chew their own limbs, their welfare is particularly poor. The welfare of an animal attacked by a predator whilst held in a trap is also very poor. Animals caught in leg-hold traps are often more exposed to extreme weather conditions than they would be normally and they may freeze in very cold conditions or die because of exposure to hot sun. In the assessment of the welfare of animals caught in leg-hold traps, as in other welfare assessment, the extent of the problem will be a function of the severity of the effect and its duration.

Snaring

Snares are used for mammals such as rabbits and foxes. In some cases the animal is caught around the neck and it is a killing method. In other cases the snare is stopped, so that it does not kill the animal if it becomes caught by the neck, or it catches the animal by the leg or by the body with or without a stop. Well-designed stopped snares can hold an animal without exerting painful pressure on it. However, the fear associated with being trapped and the lack of control over interactions with the environment, e.g. cold conditions or predators, are a problem for snared animals just as they are a problem for animals caught in leg-hold traps. Self-mutilation can also occur in snares but it is less common in stopped snares than in leg-hold traps. Snares without a stop can cut through all soft tissue and have very severe effects on welfare so they should be used only for killing. Snares can be attached to a long line so that the trapped animal has a better

chance to find a hiding place so that predator attack and exposure to extreme environmental conditions are less likely.

Cage trapping

One of the few successful eradications of a pest species utilised cage trapping. As described by Gosling *et al* (1988) and Baker & Clarke (1988) the coypu *Myocastor coypus* was systematically trapped in Eastern England until a population of many thousands was reduced to zero. Inside the cages the coypu did not appear very disturbed but no thorough study of their welfare was carried out. Foxes are more disturbed by being in a cage trap and showed some physiological reactions (Kreeger *et al* 1990) although not as much as did foxes in leg-hold traps. Cage traps are also used for some birds. For both mammals and birds the cage offers some protection from predators. However, poor welfare is minimised if the cage or box trap includes some shelter from extreme weather conditions. In a wire cage, a box in which the animal can hide will improve welfare and may also facilitate catching when the trap is checked.

Box traps set for very small mammals are often used in population monitoring studies. The fastest metabolising mammals, such as shrews, require food frequently and may be very active inside a trap so although unharmed by a trap they may die in 6-8 hours. Hence traps should be checked frequently and sufficient food should be put in the trap to provide for the animal's nutritional needs during its period in the trap. Small birds caught in traps may also benefit from food provision in the trap but some species of birds and of mammals will not eat when they are in a trap. Fish caught in traps seldom die because of lack of food but may be adversely affected by low oxygen tension or accumulation of excretory products.

Using adhesives

Bird lime was once commonly used to catch song birds in European countries. Even if removed rapidly from the sticky material, the birds were often seriously affected by many feathers being stuck together and such trapping would be likely to elicit a substantial emergency response. Hence welfare is often very poor when such substances are used to catch birds and its use is unacceptable to most people. It is not normally an important method of pest control. The use of a caged conspecific to attract birds to the place of trapping is also generally unacceptable. These arguments concerning the use of adhesives would also apply to sticky boards for catching mice.

Setting pitfall traps

Pitfall traps can be designed so that an animal which falls in is not injured but some of those which fall in are likely to be injured even if there is a soft substance at the bottom of the pit. Such traps are unselective within a certain size range so there is a risk of a

prey species being confined in the trap with a predator. Some of the considerations listed above for cage traps are applicable for pitfall traps. A shelter within the pit may protect individuals from extreme weather conditions or from predators.

Fishing with hook and line

The use of a baited hook and line to trap fish is occasionally used to trap fish which are regarded as pests, for example in ornamental lakes and fish farms. Since the mouth of most fish is richly innervated with sensory receptor cells, fish have a very similar pain and adrenal system to those of birds and mammals (Matthews & Wickelgren 1978, Pickering 1981, 1989a,b) and fish will learn to avoid places where they have had unpleasant experiences including those in which they received tissue damage from hooks (Ingle 1968, Verheijen & Buwalda 1988) it is clear that fish welfare is poor when they are caught on hooks and when they are removed from water, even for a short period.

Catching in nets

Fish are frequently caught in nets and mist nets are sometimes used to catch birds. Catching in nets is occasionally used for pest control. Mist nets set for birds seldom cause direct injury if they are set properly but if set over water birds could drown and in windy conditions birds could be blown against solid objects or injured by the tightness of the net. Injuries can also occur when birds are extracted carelessly or too rapidly from a mist net. If birds are left in a mist net for too long a period they may be adversely affected by weather conditions or lack of food. Birds in nets may also be attacked by predators. When caught in a net, birds must show some emergency response and a further response will be shown during human approach and handling.

Drift nets set for fish are also likely to elicit emergency responses in those caught and may cause injury. The trapped fish may be attacked by predators and may starve if left in the net for too long. Removal from the net will often cause pain and injury. Drift nets can also catch and drown aquatic birds and mammals including, if the mesh is of a size used for catching tuna, small cetaceans. In some cases these birds and mammals are regarded as pests by the fishermen. However, in other circumstances, death by drowning is not regarded as a permissible method of killing since welfare is very poor during drowning.

Some other forms of nets, such as trawl nets, may cause very poor welfare in some animals which they trap but are not normally used in pest control. Hand nets and seine nets can cause fear and some injury but the most extreme effect is likely to be on removal from water which results in the maximal adrenal response in fish.

<u>Scaring</u>

**Table 7 Scaring methods**

| |
|---|
| General startling, visual, auditory, odour, tactile, electrical |
| Human as potential predator |
| Human plus aids as potential predator |
| Other live predator |
| Model predator |
| Other model animal apparently responding to danger |

Methods of scaring are summarised in Table 7. The methodology varies but most of the methods involve either a generally startling stimulus or a real or simulated human or other predator. In some cases the scaring agent could cause damage to the animal scared, for example a live falcon used to scare birds from aircraft runways. In other cases, there is no real danger but the scaring stimulus shares some characteristics with a predator, for example the kite used to scare wood pigeons (*Columba palumbus*) off crops (Fazlul Haque & Broom 1985) or the model brent geese *Branta bernicla* in alarm posture used to scare other geese (Inglis & Isaacson 1978, Inglis 1980). In general, more frightening stimuli, which must have more immediate effects on welfare, are more effective in scaring the animals. When light aeroplanes are used to scare large flocks of starlings *Sturnus vulgaris* in vineyards in Austria, the birds may return within a few minutes so the aeroplane must resume its risky flights at frequent intervals and bird welfare is probably not much affected.

Scaring seldom has very serious effects on pest welfare and, indeed it works best when there are alternative resources which the animals can use. Whenever the animals would starve if kept away from a resource they are difficult to scare off it.

Discussion

The central theme of this paper is that pest animals, however undesirable their impact on man, have welfare like any other animal. Whenever pest control methods are considered, their effects on the welfare of the pests should be taken into account. In some cases a cost-benefit analysis is a reasonable approach, the real adverse effects of the pest being compared with the extent of poor welfare of the pest animals which a control method would cause. However, some effects on animal welfare are so extreme that their use is

never justified: some poisons and trapping methods fall into this category. The philosophy that some actions are never acceptable but cost-benefit analysis should be used when taking decisions about the use of some methods is also used in spheres of human activity other than those involving animals. For example, in human warfare the use of germ warfare and lethal gases is generally proscribed and anti-personnel mines may soon come into the same category.

When several pest control methods are compared and one is better for animal welfare but more expensive, this cost should be considered in relation to the total value of the product or resource which the pest might damage and whether the increased cost of pest control could be passed on to consumers. Consumers are sometimes so appalled by the effects of pest control methods on pest welfare that they are willing to pay a little more for a product which is protected in a humane way and they may refuse to buy products whose production causes suffering. National pest control policies may affect the purchase of the products of that nation (Eason *et al* 1997).

Actual decisions as to which pest management methods should be used will depend upon detailed analyses of the effects on welfare. Indeed, there should be assessment of pest animal welfare in the evaluation of all pest management methods and equipment, especially for traps and poisons. Some generalisations about welfare aspects of pest management may be made, however. Physical exclusion, scaring, use of repellents and provision of an alternative resource usually cause few welfare problems. Some killing methods are very good but others are extremely bad. Some poisons and gases act very quickly to kill pest animals but anticoagulants may cause poor welfare for a long time and this should be investigated. Shooting should be accurate to avoid poor welfare and hence good codes of practice and good training are necessary. The use of disease causing organisms and most predator usage, including chasing with dogs, are not acceptable methods of pest control. The best traps have relatively small adverse effects but welfare is very poor in some traps which are commonly used around the world.

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