Viewpoint

CSIRO PUBLISHING

Reproduction, Fertility and Development 2007, **19**, 548–552 www.publish.csiro.au/journals/rfd

Measuring the effects of wildlife contraception: the argument for comparing apples with oranges

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Abstract. There are few wildlife populations existing today that can be supported without some form of management. Wildlife fertility control, as one option, has moved from the research stage to actual application with a number of species, including wild horses, urban deer, captive exotic species and even African elephants, but this approach remains controversial in many quarters. Strident debate has arisen over the possible effects of contraception on behaviour, genetics, stress and even management economics, among other parameters. Part of the debate arises from the fact that critics often fail to recognise that some form of alternative management will be applied, and a second problem arises when critics fail to identify and demand the same concern for the consequences of the alternative management approaches. Thus, any rational debate on the merits or possible effects of contraceptive management of wildlife must also recognise all alternative management approaches and apply the same concern and questions to these alternative approaches – including 'no management' – as are currently being applied to fertility control. Only then will the stewards of wildlife be in a position to make wise and informed decisions about management options.

Additional keyword: fertility control.

Introduction

The application of fertility control for the management of selected wildlife populations has become common over the past 15 years. A variety of contraceptive technologies has been applied successfully to wild horses, urban deer, captive exotic species, water buffalo, wapiti and African elephants (Kirkpatrick and Frank 2005). However, this approach to wildlife management has evoked strong emotions and passions both for and against the practice (Gill and Miller 1997).

The proponents of wildlife fertility control are an eclectic group, including, but not limited to, scientists who are merely engaged in the intellectual pursuit of new contraceptive agents and delivery systems, wildlife managers who face limited options in real-life settings with certain species, habitat managers and public health officials who are focused on reducing environmental or health impacts of wildlife overpopulations, zoo managers, who face uncontrolled reproduction, population growth and limited space, some factions of the animal rights and welfare community, who seek non-lethal solutions, and some politicians, who watch the mood of the public carefully. Each of these proponents embraces the concept of wildlife contraception for different reasons.

At the same time, there are numerous and equally eclectic opponents of wildlife management through contraception, for an equally large variety of reasons. State wildlife agencies generally oppose contraception for deer or other game species. The reasons have differed from site to site, but certainly include the historic derivation of wildlife managers from the hunting community and the economic reliance upon license fees. Large segments of the hunting community oppose the concept of contraception for game species because of concern that public hunting may be compromised (Shlensky 1991) or even due to the suspicion that the concept is part of a larger move to eliminate hunting. In some cases, the hunting community opposes the concept merely because of the polarisation that exists between anti-hunting organisations and consumptive wildlife users. Some animal welfare organisations oppose the application of contraception to predator species (Grandy and Rutberg 2002).

Some wild horse advocates oppose contraception for the fear that the managing agencies will abuse the technology and eliminate horse populations rather than simply maintain them at reasonable numbers. Still other advocacy groups fear that the acceptance of widespread application of fertility control for wild horses is a tacit admission that there are too many horses on the land. Contraception has also been viewed as an agency concession to the ranching community (Hardin 1984). A few animal rights groups even oppose wildlife contraception because 'it violates the reproductive rights of animals'. Some groups and individuals oppose wildlife contraception simply because it is new and different.

Many of the same debates are occurring in Africa with regard to elephant management. One side supports the idea of contraception because it is a more humane approach to an extremely sentient and intelligent species, whereas others oppose contraception on the grounds that fundamental behaviours may be changed or that culling generates both protein and revenue.

 10.1071/RD06163 1031-3613/07/040548

As with any controversial subject, the two sides of this issue seek evidence to support their views and a plethora of studies have been launched over the past 15 years to provide the necessary data for support or opposition. One need only to attend a community meeting or court hearing on the subject of urban deer or wild horse contraception, during which a parade of 'expert' witnesses from both sides of the table express their views or, less commonly, present actual data (Kirkpatrick and Turner 1997).

In one sense, this entire issue is little different than contemporary politics. A great deal of information is available, some from reliable sources, some data based, some purely anecdotal, some in the form of pure opinion and some even reminiscent of negative political campaigning. Human nature is such that we often grasp whatever form of information that fits our preconceived biases. Actual exercise of reason, based on logic and hard facts, is rare in these emotional arenas. Fortunately, most judges and agency officials eliminate unsupported opinions and consider information sources and bias in the decision-making process. However, a larger problem exists and that is the subject at hand. At the outset, let it be clear that this essay is not an attempt to argue for or against the application of wildlife contraception. It is an honest attempt to define and address a problem that will not go away: managing wildlife in compromised and shrinking environments. The unresolved question is, against what are we measuring the effects of wildlife contraception?

To simplify the subject, let us agree that the existing arguments put forth for or against the concept of wildlife contraception shall not include pure opinion or anecdotal observation. Let us also agree that only data from studies that have been well designed, professionally conducted, properly analysed and peer reviewed will be the substance of the debate. Finally, let us recognise that even after objective examination of the issues of wildlife contraception, the debate often remains strident, with rational conclusions ignored. It appears that something is awry, but what and why? To explore this, let us examine four frequently raised dimensions of the controversy: the effects of contraception on genetics, behaviour, economics and 'humaneness'.

Genetics

The American Association of Wildlife Veterinarians (AAWV) has recommended that 'fertility control be employed so as to not alter the gene pool of the species or subspecies as a whole' (Anonymous 1993). Alteration in population genetics is a legitimate concern and some contraceptive agents have the potential to bring about changes, depending on the focus of their application and in what species they are used (Nettles 1997). Contraceptives can affect genetics in two major ways. For example, treating only the biggest animals or only the pinto horses or only the elephants with the largest tusks can eventually shift the gene pool. A less obvious and more important issue is whether wildlife contraception, randomly applied, will limit the genetic potential for diversity simply because successful reproduction is being reduced. This, of course, speaks to the importance of carefully designed management plans, but the potential for genetic shifts still exists.

Immunocontraceptives, regardless of their physiological targets, most commonly the zona pellucida of the ovum (Tung *et al*. 1994; Kaul *et al*. 1996) or the gonadotropin-releasing hormone of the hypothalamus (GnRH; Hunter and Byers 1996), and contraceptives delivered in biologically modified organisms (Robinson *et al*. 1997) present another potential genetic concern. Because the immunocompetence of differing species (Frank *et al*. 2005), differing strains (Haddad *et al*. 1994) and even individual animals in a single population (Lyda *et al*. 2005) is often markedly different, immunocontraception has the potential to skew population genetics. For example, considering that immunocompetence has a genetic basis, what will be the result if only healthy animals of a particular species produce sufficient antibodies for contraception? Will a population of less healthy animals result? What will be the effects of delivering contraceptives via biologically modified organisms, such as bacteria or viruses? Will some segments of the population that are more susceptible to the organisms disappear (because of the resultant contraception; not because of infection by a non-pathogenic organism) or, conversely, will some segments of the population simply expand because they are resistant to infection by that organism?

Behaviour

The impact of contraception on the social behaviours of the target species is another subject related to wildlife contraception (Asa 1996). The AAWV has recommended that 'short- and long-term effects of fertility control on population or subpopulation dynamics, including age structure and behavioural effects, be evaluated through modelling' (Anonymous 1993). Some species have highly sophisticated social behaviours and organisations and the marked alteration of these structures would be undesirable. This has been particularly problematic with wild horses and African elephants, where sociosexual behaviours are vital to the maintenance of the larger social organisation, and with some captive species in zoos, where the display of natural behaviours is an educational goal.

As with genetic concerns, there are several ways contraception may alter social behaviours and organisation. A significant reduction in offspring may weaken social groups (Powell 1999) or, in the case of elephants, in some way dilute the maternal behaviours of matriarch females (Delsink *et al*. 2002). In the case of reproductive steroids, an effect on behaviour (sexual, aggression, maternal, etc.) may be elicited by direct action on certain centres in the brain (Asa 1996).

Changes in social behaviour have been less of an issue with urban deer, but behavioural changes may, hypothetically, lead to more movement and deer–car collisions. This issue has been based on data that demonstrate that female deer treated with one particular immunocontraceptive (porcine zona pellucida or PZP) extend the breeding season (McShea *et al*. 1997), which may conceivably cause more movement by male deer in pursuit of female deer. Another consideration is that the method of contraceptive delivery (capture or darting) has the potential to change behaviour, with animals becoming more secretive or wary.

Economics

Some of the debate focuses on the economics of wildlife contraception, producing arguments for and against the concept on the basis of costs and who will pay them. The aforementioned recommendations of the AAWV (Anonymous 1993) includes that 'costs of fertility control programmes be borne by the agencies or segments of the public that will receive the direct benefits'. Depending on the contraceptive, the delivery system and the accounting system used to calculate all the costs, estimates range anywhere from US$25 to US$500 (Rutberg 2005) to treat an individual deer, a wild horse, African elephant or even a captive kudu. Each contraceptive itself has a cost and the personnel and work time to deliver contraceptives have even greater costs. Regardless of the figure one accepts, the costs are significant and someone will have to pay them. Ultimately, it is not just costs, but cost-effectiveness in management, that is the determinant of contraceptive use and usefulness.

Humaneness

One issue that always emerges is how humane contraception may be (Oogjes 1997). To avoid undefined parameters, let us use here, instead of humaneness, the concept of physiological stress, which, at least, has some measurable dimensions. The matter of firing darts at deer, wild horses, zoo animals or African elephants is serious and deserves discussion. Much can go wrong. A dart can hit the wrong site and injure the animal, or cause infection. The adjuvant used with immunocontraceptives may cause discomfort or even an abscess (Broderson 1989; Munson *et al*. 2005). Among animals that must be caught before the contraceptive is applied, the physiological stresses of capture are significant and can, on occasion, be injurious or lethal. Some contraceptives, such as those using steroids, have been shown to cause a variety of pathologies in the target animal, including endometrial hyperplasia and pyometria (Henik *et al*. 1985), mammary gland hyperplasia (Hinton and Gaskell 1977) and mammary cancer (Munson *et al*. 2002).

What are we comparing?

The above issues bring up legitimate questions. Quite properly, we should be conducting research to answer the questions posed. We should be encouraging additional study of the genetic effects of contraceptive management, studies of behaviour among treated animals, the economic assessment of the cost of wildlife contraception and the study of levels of stress associated with this approach to wildlife management. These studies and analyses should be conducted on the basis of sound experimental design, modern proven methodologies and careful statistical evaluation. Many studies have already been conducted and the data exist in the literature (Asa and Porton 2005). Nonetheless, even with existing and future studies, something more is needed. Two questions that have not been addressed in the course of the debate need to be addressed. They are: (*1*) to what are we comparing the results of these studies of the effects of wildlife contraception; and (*2*) what management alternatives are we assuming will be implemented if wildlife contraception is not used? To merely show there is a genetic or behavioural effect or physiological stress, or to present an economic analysis of costs as a consequence of wildlife contraception, is useless within the debate unless we provide a context for those changes; that context is clearly the consequences of alternative management strategies.

What is the control group?

Normally, and properly, in the course of responsible science we measure the effects of any experimental manipulation against a control group. This can be an untreated, placebo-treated or alternative active treatment group. Thus, if we were to examine the effects of a contraceptive on a specific social behaviour, we would study the differences between a group of treated animals and a group of untreated animals or, at the very least, pre- and post-treatment effects in the same population. That procedure is proper as far as it goes. Although there are no published reports of current immunocontraceptives affecting social behaviours in wild horses, many anecdotal reports express concern that treatment is causing lethargy in mares or, interestingly, social 'unrest' or changed band cohesion, and even more aggression in the stallions accompanying the treated mares. For the sake of argument here, let us assume that these effects are real. The question still remains, what is the value of this information to the manager of those horses?

The wildlife manager seldom has the option of doing nothing. Indeed, if that was the case there would be no argument for contraception. These concerns about behavioural changes, even if they were supported by hard data, only have meaning to the manager in the context of alternative management strategies. If the manager is concerned about the effects of contraception on social behaviours, or where the mare stands within the harem group, or how often she moves to another band, then the effects of alternative management strategies on the same social behaviours should be a concern too. The AAWV recommendation regarding potential behavioural changes is a good one but is of limited value unless the effects on behaviour are measured against all alternative management options. Thus, in this case, we need a new control group, which is a herd of wild horses chased with all-terrain vehicles or helicopters, culled, captured, corralled, sorted, separated, some removed and some returned to the range. Only then do the effects of contraception on behaviour have any relevant meaning.

Stalking or ambushing urban deer and shooting them with darts containing a contraceptive probably represents a degree of physiological stress, and perhaps even an alteration in social behaviour. A well-designed study may even quantify that stress with something like the measurement of blood or faecal stress hormones. But measuring that degree of stress against that of deer that have not been stalked, ambushed or darted only tells us what we probably already knew and nothing important to the manager. If the manager's alternative strategies are capture and translocation or culling, the same parameters measured in the darted deer must be measured in populations subjected to the two alternative management strategies. Only then can the manager make an informed decision.

The costs of reducing deer populations by means of public hunting are attractive to the fiscal manager, with free labour and even some degree of revenue from license fees. It is doubtful that costs of contraception can ever compete. Yet, at the same time, it is possible that the costs of culling or translocation are probably as high or higher than contraception. The cost of using contraception to manage a population of wild horses includes the contraceptive, the strategy used (capture and treatment or remote treatment with darts) and the cost of the personnel necessary to do the job. A recent financial analysis (Barthalow 2004) of the cost of treating a population of wild horses with an immuno-contraceptive on a Montana range and then returning them to the range came to US$106 (1-year duration) to US$309 (2-year duration) per horse, depending on the duration of the contraceptive agent. On the surface that is a substantial cost and would give cause for concern to any wild horse manager with limited resources. If those figures were presented to any public interest group or even a judge, they would not inspire confidence that fiscal responsibility was in force. The figure of US$309 is troubling, but troubling compared with what? Certainly it is troubling compared with doing nothing, but is it troubling compared with the alternative facing that manager. The same analysis indicated that the cost of capturing, holding (for just 1 day), adopting and meeting compliance checks for that same horse is US$2165 (Bartholow 2004). However, that figure is only for capturing the horse. Unless it can be adopted, the animal will be incarcerated in federal holding facilities and will cost the government close to US$1000 per year for food and care thereafter. Currently, the US government spends approximately US$20 million a year to care for more than 20 000 animals that cannot be adopted out. All of a sudden, the US$309 and a mare on the range that isn't producing new foals doesn't look so costly. The aforementioned recommendation by the AAWV regarding who should pay for wildlife contraceptive programmes has merit, but the same standard should be applied to all other management alternatives.

The reduction of breeding by treated animals of almost any species may have some serious genetic consequences. Some females, on the basis of their genetic makeup, produce a larger number of offspring than others during their reproductive years and, even with random selection of target animals, the population genetics of that population will be affected. That is a simple and valid conclusion if we compare these results with those of an unmanaged herd that is not treated with contraceptives. It is likely that presenting these data *ex parte* to a public interest group or a judge would yield a conclusion to avoid contraception. But that conclusion rests on the assumption that no alternative management options will be used. The manager, however, seldom has that option. Only when that same public interest group, or judge, are presented with data showing the genetic consequences of removing animals, some of which have never bred and will never have the opportunity to make genetic contributions to the population, can an informed decision be made about which management option is more or less damaging to the genetic integrity of the herd. The AAWV recommendation (Anonymous 1993) regarding potential genetic alterations is a good one, but of limited use unless it is applied to all alterative management options.

In the case of captive wildlife populations, virtually all the aforementioned parameters come into play. Contraception may affect the behaviour of a species in which the zoo's goal was to display natural behaviours and careful genetic management of zoo species through sophisticated programmes such as Species Survival Programs can face serious consequences as a result of contraception. The zoo manager (director, curator, veterinarian, keeper) must consider the consequences of contraceptive costs in institutions where resources are almost always scarce. Finally, the captive animal manager faces more scrutiny from the public with regard to causing stress in collection animals than does any free-ranging wildlife manager.

Only four parameters have been addressed here as examples with which to make a point. There are others as well, and the same rules of meaningful comparison should be applied to all. For example, the AAWV recommendations (Anonymous 1993) included one that states, 'all fertility control agents and methods of delivery be fully considered for each species and circumstance'. Should not that standard be applied to all management options? The recommendations included, 'the fertility control agent be effective only on the target species'. Should we not apply that same standard, then, to trapping as a management tool or to species that represent either a predator or prey relative to the target species? Another recommendation stated, 'the employment for fertility control be evaluated prior to employment in each circumstance by the appropriate regulatory and wildlife agencies with full public participation in the evaluation process'. Should not that process be applied to all management options? The concluding point here is that no management option should be exempted from or singled out for responsible standards or comprehensive evaluation. Indeed, the National Environmental Policy Act (NEPA) theoretically requires that approach.

Conclusion

Relatively few examples of wildlife populations currently exist in the world, free-roaming or captive, that can be supported without some form of management. Therefore, management in some form will usually be required, whether it is aimed at wild horses, urban deer, African elephants or even captive populations. Wildlife contraception, as one option, will remain a controversial topic for many years to come and perhaps it will never be free from strident debate. However, wildlife managers and the public, who ultimately 'own' most wildlife, must be in a position to make wise and informed decisions about management options, based on benefits and risk assessment. A guiding principle for wildlife management in recent years has been the admonition for and application of sound science, which, hopefully, will guide managers towards responsible decisions. All management options, historic and more recent, have consequences. It will be increasingly important to have information at hand with which to measure those consequences. However, consequences of management options only have meaning to the manager if they are compared with one another, in addition to the mostly hypothetical, and perhaps even mythical, 'unmanaged' control populations.

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Manuscript received 8 December 2006, accepted 26 March 2007