# The Ethics of Wildlife Research: A Nine R Theory

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## Abstract

The commonsense ethical constraints on laboratory animal research known as the three Rs are widely accepted, but no constraints tailored to research on animals in the wild are available. In this article, we begin to fill that gap. We sketch a set of commonsense ethical constraints on ecosystem research parallel to the constraints that govern laboratory animal research. Then we combine the animal and ecosystem constraints into a single theory to govern research on animals in the wild.

**Key Words:** ecosystem; ethics; reduction; refinement; replacement; three Rs; wildlife research

## Introduction

The three Rs (replacement, reduction, and refinement) constitute ethical and legal constraints on research on animals in laboratories (Russell and Burch 1959), but no parallel constraints designed for research on animals in the wild are available. Such constraints would be useful not only to researchers and policy makers but also to the general public. In this article, we sketch a set of constraints to fill that gap.

One way in which wildlife research is more morally complex than laboratory research on animals is that wildlife research impinges on the environment. It, therefore, involves stakeholders over and above the target animals and the people who benefit from the knowledge gained from the research, stakeholders whose interests can conflict. Indeed, there has long been tension between advocates of animal welfare and managers of animal shelters, on the one hand, and advocates of environmental welfare and managers of ecosystems, on the other. Their academic correlates, the disciplines of animal welfare science and conservation biology, are not at each other's throats, but they are not exactly cooperating either. How to weigh animal and ecosystem welfare against each other is the main bone of contention. A resolution to this conflict and an agreement of cooperation between these disciplines would be desirable (Fraser 2010; Minteer and Collins 2005a, 2005b, 2008). In this article, we take three steps toward a solution to this moral problem and a resolution to the conflict.

Our first step will be to add a bit to the moral theory that governs laboratory animal research. This fourth R is already implicit in the three Rs, but for clarity's sake we shall state it explicitly.

Our second step will be to describe environmental analogues to these four Rs. That is, we shall describe four general strategies for improving research plans from an environmental welfare perspective. Just as the traditional three (or four) animal Rs describe ways of making research on animals less harmful and therefore more moral, so our parallel environmental Rs will describe ways of making research on the environment less harmful and therefore more moral.

Our third step will be to combine the animal Rs and the environmental Rs into a single set of moral constraints by providing a way of dealing with research that threatens harm to both animals and their environments.

## Ecosystem Harm

A necessary preliminary is to stipulate what we mean by harm to ecosystems (see Fraser 2012 for a detailed account of harm to animals). Along with most environmental researchers, we consider an ecosystem's health to be a function of its integrity, a complex term (Noss 1990). By "ecological integrity," we mean the stability, resilience, and robustness of the system. A system with high ecological integrity, as defined here, rebounds from significant disturbances but maintains its ability to evolve, both collectively and in its constituent parts. The more ecological integrity there is, the healthier the ecosystem is. The more an act reduces ecological integrity, the more harmful the act is. Thus, to determine

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the harm done by a research plan it seems that one must (1) identify the parts of the target ecosystem (e.g., animal, plant, and microbe populations, processes, subecosystems, rivers, rock formations), (2) measure the extent to which they are harmed, and then (3) sum up the harms.

Three factors complicate things. First, ecosystems can be harmed by mere reorganization of their parts. Moving an alpha-male lion hundreds of miles away from his pride may not immediately harm the lion or the pride but might precipitate a struggle for dominance to fill the power vacuum, eventually leading to the death of the original alpha-male's cubs at the hands of the victor. These major changes among top predators might disrupt a fragile ecosystem. Second, ecosystems can be harmed by replacement of one part with another. Replacing one species with a seemingly similar one has resulted in widespread ecological disturbances with large economic impacts (Vitousek et al. 1997). Cheatgrass (*Bromus tectorum*) in the Western United States is a good example. Introduced in the late 1800s, this species has replaced native plants throughout California and the Great Basin. The ecological consequences of cheatgrass establishment have been an increase in fire frequency and intensity, a decrease in species diversity, and a landscape susceptible to severe erosion. Bunchgrasses interspersed with long-lived perennial shrubs have now been replaced with either nearly pure patches of cheatgrass or swaths of cheatgrass and short-lived perennial shrubs (Knapp 1996). Third, parts can be harmed without harm to the ecosystem. Some parts make significant contributions to ecosystems, others less so. Killing a few members of a populous, nonkeystone species harms those animals, but not the ecosystem because, as Darwin (1859) pointed out, many of the offspring die anyway. Thus, killing a few is of no significance to the population. Ecosystems have evolved with particular kinds, frequencies, and intensities of disturbance. However, ecosystems can be harmed without significantly harming any of their proper parts, and harming a proper part may not harm the ecosystem as a whole.

To accommodate these complicating factors, we shall use the term "part" in a somewhat technical way. We shall call the organizational structure of an ecosystem a part of that ecosystem, and we shall restrict the term "part" to the sort of part whose loss or harm would harm the ecosystem as a whole by destabilizing it.

We assume that harming ecosystems is *prima facie* wrong, just as harming animals is *prima facie* wrong. Both animals and ecosystems have moral value. It is wrong to harm animals or ecosystems unless there is some morally overriding reason to do so. Thus, neither animal nor environmental ethics may be ignored. Both must be applied. The task is to bring these two ethics together.

Why harming animals or ecosystems is morally wrong is a further question, a question beyond the scope of this paper. Some think that animals and/or ecosystems are intrinsically valuable; others think harming them is wrong because they are valuable (perhaps in long-term, difficult-to-specify ways) to people. We shall take no position on these foundational questions here. Similarly, we assume that more knowledge is better than less knowledge, but we offer no metric for measuring knowledge in this article. Our assumption is that research that harms animals or ecosystems less is morally preferable to research that harms animals or ecosystems more, other things being equal (in particular, knowledge gained being equal). If research plan A is likely to harm an animal or ecosystem less than research plan B, other things being equal, then plan A is morally preferable to plan B.

## Refusal

Three nice things about the three animal Rs are (1) they constitute a common sense theory of animal research ethics, (2) they give significant guidance to researchers, and (3) animal researchers have come to a virtual consensus that (although not how) they should be applied. At first glance, the three animal Rs might be read as implying that all research should go forward, although some plans might first need to be modified. But a moment's thought about the point of the three animal Rs reveals that this would be a misconception. The three animal Rs aim to eliminate unnecessary harm to research animals. Harm that is unnecessary to the pursuit of knowledge is immoral; it is just cruelty to animals. Now in the research context, unnecessary harm is of two sorts: (1) harm incurred on the way to knowledge when it is reasonably easy to see how the same knowledge could be obtained without the harm, and (2) harm incurred when no knowledge could reasonably be expected to be gained through that harm. The three animal Rs address only the first sort of harm explicitly. However, by mandating that harm be minimized on the way to knowledge, the three animal Rs implicitly assume that harm is bad and therefore should not be inflicted gratuitously.

Everyone must recognize that each research plan's likelihood of success is extremely difficult to predict. Yet everyone must also recognize that some research plans are so badly conceived that the chance that they will produce any significant knowledge at all is almost nil. The three animal Rs implicitly imply that such studies should not be implemented. It is just common sense that research plans that would harm animals greatly and that would yield at most only trivial gains in knowledge should not be pursued. (Thanks to Anne Epstein who helped to formulate this principle. For a discussion of commonsense justifications, see Lemos 1986 and Rawls 1971.) Notice that this is a very mild principle. It does not enjoin researchers from pursuing fruitful lines of research or even fruitless, harmless research but merely from pursuing research plans that are very likely to be both extremely harmful and essentially hopeless. It prohibits only futile, harmful research. (Specifying a criterion of futility is beyond the scope of this paper. A test for futility may perhaps be borrowed from medical ethics [Schneiderman et al. 1990]. By law, the Institutional Animal Care and Use Committee is the ultimate judge of which research is worth pursuing.) For similar reasons, research that would harm animals greatly and that would yield nontrivial gains in knowledge that are not worth the harm should not be pursued. (This is a bit more controversial, but we will not argue the point here.) To emphasize this point, we formulate a fourth animal R:

> *Animal Refusal* rejects the initial animal research plan completely to prevent animals from suffering futile harm or harm not worth the gain.

After trying and failing to tweak the plan by reducing the extent to which it harms animals, Animal Refusal sends the researcher back to the drawing board. After all, if no significant knowledge is going to be gained, then even a bit of harm to animals is excessive. Similarly, if significant knowledge might be gained but at a cost in animal suffering that is way out of proportion to the value of that knowledge, then again the research is immoral. The addition of the fourth R does not dramatically change the character of the theory, but it does change its rhetorical force. The fourth R makes it quite clear that animals have moral standing; they are not to be harmed without a good reason.

Similarly, if an environmental research plan will be unproductive or will produce knowledge that is obviously not worth the harm caused and no amount of tweaking will render the plan nonfutile, going forward with the plan is unacceptable. The plan should simply be abandoned.

> *Ecological Refusal* rejects the initial environmental research plan completely to prevent an ecosystem from suffering futile harm or harm not worth the gain.

Common sense says that research plans must be well enough designed that they have a reasonable chance of yielding at least some nontrivial knowledge; otherwise they will be just a waste of environmental harm. Of course, the value of environmental research, like that of animal research, is notoriously difficult to predict. But again some research is obviously so badly conceived that it will almost surely show almost nothing. Research that would harm an ecosystem greatly and that would yield only trivial gains in knowledge should not be pursued. If the knowledge sought is not worth the harm (or risk of harm) to the ecosystem, then the research should not be performed.

We acknowledge that the terms "reasonable chance," "significant knowledge," "great harm," and various other terms we shall use are frustratingly vague. We are not going to be more precise because our goal in this paper is to sketch an approach to the vast majority of cases rather than to solve hard cases. However, keep in mind that (1) like the distinction between day and night, vague distinctions are often quite useful, and (2) like showing spurious digits beyond significant figures, precision in ethics is often misleading rather than helpful.

## Replacement

If an initial research plan is promising but seems likely to harm animals, the researcher should seek an alternative plan that would yield the same (or equivalent) knowledge, but produce no (or less) harm by targeting different entities. This intuition might be expressed as follows:

> *Animal Replacement* decreases harm to animals by switching from targeting animals for research to targeting nonsentient entities that will not be harmed (e.g., computer models) or to targeting animals that will be harmed less (e.g., lower-order animals) without decreasing the amount of knowledge gained.

In particular, because higher-order animals are capable of more complex pleasures and pains than lower-order animals, research that harms lower-order animals is generally morally preferable to research that harms higher-order animals, other things being equal.

One way to formulate environmental research parallels to the traditional three Rs of animal research would be to treat ecosystems as analogous to animals. But it will turn out to be more useful to take the analogues to animals to be ecosystem parts. Our parallel in the field of environmental research to Animal Replacement is as follows:

> *Ecological Replacement* decreases harm to an ecosystem by switching from research targeting certain ecosystem parts to research targeting parts that will harm the ecosystem less or not at all without decreasing the amount of knowledge gained.

If an initial research plan seems likely to harm the ecosystem, the researcher should seek an alternative plan that would yield the same (or equivalent) knowledge but produce no (or less) harm by targeting a different part (or parts) of the ecosystem. One way to do this is to switch from fragile ecosystem parts to hardy parts, if that can be done while gaining the same amount of knowledge. Some ecosystem parts are more resilient, either in the sense of recovering more rapidly or being more resistant to impacts. For example, many desert ecosystems can take decades to recover from as simple an act as driving over them. If the research site may be accessed equally easily by driving through either forest or desert, opting for the forest route would probably reduce harms. A second way to eliminate or minimize harm to ecosystems is to switch to parts of less value to the ecosystem, again if that can be done while gaining the same amount of knowledge. By "parts of less value," we mean elements that are less crucial for ecosystem function. For example, some organisms (often termed "keystone species") have a disproportional effect on their environment, and their loss would result in negative impacts on many other species (Mills et al. 1993). Other things equal, a researcher should choose to harm another species rather than a keystone species.

## Reduction

Reduction enjoins animal researchers to look for ways to acquire the knowledge they seek (or equivalent knowledge) without harming as many animals of the same sort.

> *Animal Reduction* decreases harm by decreasing the number of animals targeted by the research plan without decreasing the amount of knowledge gained.

Harming many more animals to gain very little additional knowledge is obviously not worth it on a straightforward cost–benefit analysis, but harming a few more animals to gain lots more knowledge is obviously worth it. Neither minimizing the number of animals harmed nor maximizing the amount of knowledge gained always takes precedent. Sometimes neither number of animals harmed nor amount of knowledge gained can be held constant. Moving from one research plan to another could significantly increase both the amount of knowledge gained and the number of animals-harmed. In such cases, common sense says that both plans are morally acceptable. Morality does not demand that researchers find the optimum option but only that obviously skewed options be rejected.

Again our environmental parallel is framed in terms of ecosystem parts. When a research plan must target vulnerable or valuable ecosystem parts, an obvious way to reduce harm is to reduce the number of parts targeted, if that can be done while maintaining the same amount of knowledge gained. Reduction attempts to extract the same amount of knowledge from fewer parts, and thus with less harm.

> *Ecological Reduction* decreases harm to the ecosystem by decreasing the number of harmed ecosystem parts in a research plan without decreasing the amount of knowledge gained.

When knowledge gained is constant, the fewer harmed parts the better, and when harm to parts is constant, the more knowledge gained the better, but sometimes neither variable can be held constant. That is, sometimes the more parts researchers harm, the more knowledge they will likely gain (or the more likely they will be to gain knowledge), but the returns eventually diminish as the number of parts increases. (Larger sample sizes provide more scientifically defensible results, for example.) In such cases, determining the best option is typically impossible or impractical, and indeed there may be no morally best option. Many options would be equally good; many more would be morally acceptable. The important thing is to avoid the extremes: vast harm with little knowledge gained or vast knowledge gain foregone for the sake of avoiding just a bit of harm. Other things being equal, if one research plan harms parts only a bit more than another and yields much more knowledge, then it is morally preferable, and if one research plan yields only a bit less knowledge and harms parts much less, then it is morally preferable. But if one plan is likely to harm moderately more parts than another and is also likely to yield moderately more knowledge, then neither plan is morally preferable to the other.

## Refinement

Refinement enjoins the principle that the less each animal is harmed and the less likely it is to be harmed, the better, so long as reducing the harm does not reduce the knowledge gained. Moreover, if animals must suffer or die for the sake of knowledge, then their suffering or death should be as fruitful as possible. Researchers should also squeeze as much knowledge as possible out of each bit of unavoidable animal harm.

> *Animal Refinement* changes the research procedure to decrease the amount of harm inflicted on each targeted animal per bit of knowledge gained.

This principle significantly increases the number of trade-off problems. Animal Reduction dealt with trade-offs between number of animals harmed and knowledge gained. To these trade-offs, Animal Refinement adds degree of harm and likelihood of harm. That yields five additional possible bilateral trade-offs. How are these trade-offs to be made? Common sense answers that just as knowledge does not simply trump decreased harm or vice versa, so none of these values simply trumps the others, but rather each outweighs the others at extremes and not in the middle.

Our environmental parallel is as follows:

> *Ecological Refinement* changes the research procedure to decrease the amount of harm to the ecosystem by decreasing harm inflicted on each ecosystem part per bit of knowledge gained.

The difference between Reduction and Refinement in environmental research is that Reduction seeks to harm fewer parts of the environment whereas Refinement seeks to lessen the harm to each harmed part. One Ecological Refinement strategy is to obtain the same amount of knowledge with less harm (or less likelihood of harm) to the ecosystem parts. The less the ecosystem parts are actually harmed and the less likely they are to be harmed, the better, so long as reducing the harm does not reduce the knowledge gained. A second Ecological Refinement strategy squeezes more knowledge out of the same harm by changing the research design. For example, many field studies entail a certain amount of disturbance regardless of the extent of the study, simply by virtue of creating trails to allow access to the site or by marking animals (Cotter and Gratto 1995; Perry et al. 2011). Such fixed costs cannot easily be reduced, but the amount of information gained can be increased if compatible studies are bundled together.

As we said above, in a bilateral trade-off, sometimes neither value is constant. Researchers must often choose between (1) a research plan that gains more knowledge by harming ecosystem parts more and (2) a research plan that gains less knowledge by harming the same ecosystem parts less. Again, likely gains of lots of knowledge justifies small harms (or risks), but large harms (or risks) do not justify likely gains of little knowledge. And when the likely increases in knowledge and in harm are both significant, then the choice to proceed is morally optional.

## Summary of Environmental Rs Parallel to Traditional Animal Rs

In summary, our environmental Rs that parallel the traditional animal Rs state the following: (1) When their research plan is futile, researchers should simply give up on it and start over. (2) If their plan is not futile, researchers should try to eliminate or minimize harm to an ecosystem by switching from research on certain parts of the ecosystem to research on hardier or less valuable parts. Failing that, (3) they should try to apply their harmful research procedure to fewer parts of the ecosystem or (4) try to change their research procedure to a less harmful method. Reducing the number of harmed ecosystem parts and refining the research design to decrease the amount of harm per part are different ways to improve the morality of environmental research plans. Plans may be improved by decreasing the number of vulnerable or valuable ecosystem parts harmed or by decreasing the degree of harm without decreasing the amount of knowledge gained. Alternatively, plans can be improved by increasing the amount of knowledge gained without changing the number of vulnerable or valuable ecosystem parts harmed, or changing the degree of harm. (Research plans can also be improved by adding benefits to compensate for the harm they do to ecosystems.) Of course, these four strategies for reducing harm to ecosystems can often be combined.

## Relaxation

In ethics as in the rest of life, hard problems are best avoided. Although at first glance it seems that wildlife researchers must sometimes carefully weigh the interests of animals against the health of ecosystems, we shall argue that this is an illusion. The daunting and divisive task of careful balancing is avoidable. Let us consider a range of cases.

Case 1: Our knowledge of ecosystems and animals is small. Both animal studies and ecology are young sciences. Thus it often happens that so little is known about the animals and/or the ecosystem threatened by rival plans that predicting the harms that could accrue from these plans is simply impossible. If the harms cannot be estimated, then they cannot be compared either. In the absence of knowledge about a species' ecosystem role—something that is unfortunately quite common, especially for nonvertebrates—assessing impacts is nearly impossible.

Case 2: Some research plans harm only ecosystems (e.g., modifications to abiotic factors in regions where animals do not live or, more confusingly, experiments like that done by Simberloff and Wilson [1969] assessing insect recolonization of islands after complete removal [because insects are not vertebrates, they are not considered animals by Institutional Animal Care and Use Committees assessing ethics of such research]); others harm only animals (e.g., mice in labs that are, therefore, not part of an ecosystem). These plans are governed by the environmental Rs or the animal Rs, respectively. In these cases, clearly there is no need to go further, no need to balance animal versus ecological harms.

Case 3: Harming ecosystems often harms its denizen wildlife and vice versa. Thus, what might seem, at first glance, to be a choice between harming individual animals and harming ecosystems often turns out, upon further consideration, to be a choice between two different ways of harming both individual animals and ecosystem parts. Although there are species-specific differences related to the importance of their roles in the ecosystem, generally harming too many individuals will harm the ecosystem, and harming the ecosystem severely enough will also impact individuals. Therefore, this is not really a trade-off because both are harmed either way.

With these straightforward cases out of the way, we turn to consideration of trade-offs. Note that when thinking about the morality of research plans that harm both wild animals and ecosystems, animals must be double-counted: once as parts of the ecosystem and again as individual animals. After all, animals are valuable in two ways. When one harms wild animals one is both harming individual animals and (typically) harming the ecosystem in which the animals dwell.

Case 4: If one research plan is likely to cause serious harm to lots of animals whereas another plan is likely to cause only trivial harm to the ecosystem, then the second plan is obviously preferable, other things being equal. Conversely, if one research plan is likely to cause serious harm to the ecosystem whereas another plan is likely to cause only trivial harm to animals, then the second plan is obviously preferable, other things being equal.

Case 5: But aren't there some cases in which conflicts are significant, harms are known, and the choice is not obvious? Aren't there some cases in which researchers must carefully weigh animal verses ecosystem welfare? Sometimes a researcher considers two ways to gain the same amount of knowledge: one plan that will harm animals much and ecosystems little (but not trivially), the other plan the reverse. How is a researcher to decide between such plans?

Indeed, how is a researcher to make the other trade-offs mentioned above? When thinking about trade-offs, one should avoid the temptation to demand excessive precision. It is easy to fall into the trap of thinking that in every situation there is a single morally right answer. But, of course, morality does not demand anything like this. In every situation, there are many morally acceptable options. Consider an ordinary, low-stakes case. Your plans for the day have been disrupted by a minor crisis; one of your colleagues called in sick and you took his/her morning class on short notice. Now you have enough time either to (1) finish preparing a lecture for your own afternoon class or (2) finish grading the last few exams so you can hand the exams back, but not both. Which should you do: (1) go into class with a polished lecture but no exams or (2) go into class with a half-baked lecture and the graded exams? Although there are various pros and cons and one choice might be better than the other, it would clearly be morally acceptable to do either one. Similarly, when one must choose between (1) a plan that moderately sacrifices the welfare of animals to protect the ecosystem and (2) a different plan that moderately sacrifices the welfare of the ecosystem to protect animals, there are various pros and cons, and one choice might be better than the other, but both options are morally acceptable. As in the rest of life, extreme cases are no-brainers, and the options in moderate cases are all morally acceptable. Thus we offer a ninth R:

> *Animal/Ecological Relaxation* comforts the researcher with the thought that whenever a choice between research plans is not obvious, both are morally acceptable.

We do not deny that morality sometimes rules out one option and demands the other. But we maintain that these are the extreme cases where the right answer is clear. Our theory has a great practical advantage of forwarding rapprochement between welfare science and conservation biology (and between the managers who apply these two sciences). In many cases, apparent conflicts are not real. When there is a choice to be made between moderately harming animals and moderately harming ecosystem parts, both options are morally acceptable. This should defuse some of the tension between advocates of animal and environmental welfare over how to conduct ethical research on wildlife.

## Conclusions

No commonsense moral theory to govern research on wildlife is currently available. In this article, we have taken three steps toward constructing such a theory. Beginning with the three Rs of ethical animal laboratory research, we added a fourth R, making explicit the need to block futile, harmful animal research from going forward. We then sketched a set of guidelines for ethical environmental research parallel to the four Rs for ethical animal laboratory research. Finally, we combined the four animal Rs and the four environmental Rs into a single theory governing research on wildlife. To do so, we added a ninth R, reassuring researchers by defusing what seemed to be a significant moral problem. Our nine Rs combined theory may not completely fill the gap, but it shrinks the gap considerably.

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