

Re-thinking *ex situ* vs. *in situ* Species Conservation

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To maximize the effect of zoos and aquariums and reach the most number of species it is important that we reduce the overlap of institutional focus and partner effectively. It is suggested that WAZA or the regional associations become the body registering institutions and recording the species for which they will serve as the organizing leader. In this way multiple institutions will not be leading the effort for the same species.

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Species conservation has as its ultimate goal to protect species in their natural habitats, but increasingly often preservation of species in captivity is a necessary temporary measure because we cannot at this time adequately assure persistence of viable populations in the wild. A distinction is often made between *in situ* conservation – the protection of species in wild habitats – vs. *ex situ* conservation – the preservation of species in captive breeding programs. There has been a lot of discussion recently about the terms *ex situ* and *in situ*, regarding the roles of these two approaches to species conservation, but also often suggesting this dichotomy is becoming less meaningful and even suggesting that we should stop using the terms.

Although WAZA, IUCN, and other conservation organizations distinguish between *in situ* and *ex situ* approaches to conservation in many of their documents, and one core purpose of the IUCN SSC Conservation Breeding Specialist Group is to help make effective linkages between *ex situ* and *in situ* conservation, there are a number of problems with the use of the terms. First, the terms are in Latin, a language that no one speaks and few understand. Perhaps as a consequence, the terms are used inconsistently and often incorrectly.

Moreover, it may be inappropriate to dichotomize conservation actions into two boxes, because intermediate states do exist. Also, there may be other terms that would better describe the categories of conservation that we pursue. In spite of these problems, however, I will respectfully disagree with some of my colleagues who have suggested that the terms *in situ* and *ex situ* are no longer meaningful and should no longer be used. I will argue here that just eliminating the terms, rather than using them correctly, will not necessarily improve our discussions of conservation. For example, while we should clarify that there is not a sharp separation between *ex situ* and *in situ* conservation, we should avoid the equally misleading suggestion that there are no differences between the two methods for protecting species. Maintaining tigers in zoo exhibits, even very large and naturalistic ones, or even maintaining tigers in a multi-hectare enclosure that is a fenced piece of forest, is not the same as protecting tigers within their natural habitats where they compete for mates, hunt for prey, and serve an important role within an ecological community.

I think that we should clarify our terminology and use it correctly. Then, we can discuss meaningful and not so meaningful distinctions between the forms of conservation. Only then can we decide if the terms should be discarded because the methods of conservation have perhaps changed to the extent that the terminological distinction is no longer useful. However, we should not discard or replace the terms only because people sometimes misuse them, or because we want our work to sound more important, or because we wish to pretend that our conservation methods are something other than what they really are.

We should start with clarity about what we mean by species or biodiversity conservation. Biodiversity conservation can be defined as the maintenance of components of natural systems (populations, species, communities, and biophysical systems) and the ecological and evolutionary processes through which the components of biodiversity interact with and are sustained by natural systems. Thus, conservation is directed toward protecting the integrity of natural systems – both the pieces and the processes – and is not just the saving of pictures, or bones, or DNA, or even just captive animals in zoos and plants in gardens. Quite tragically, it is the case that no place on Earth is still untouched by humans, and perhaps no ecosystems is 100% pristine, but some places are more wild and have more intact and healthier ecosystems. For us to ignore this reality could be very damaging to our reputations as conservationists, and to our efforts in biodiversity conservation. After all, if no place is “wild” anymore, and no real “wildlife” still exists, then why are we working to preserve wild places and wild species?

The goal of species conservation is to support the survival of species in their natural ecological systems. If a program does not further this goal, then it is not species conservation. Before my zoo and aquarium friends react angrily that I seem to be denying the value of their work, I need to add two caveats. First, sometimes – and far more often than anyone of us would wish – sustaining a species in the wild will require activities outside of the wild. Second, by delineating what constitutes species conservation as distinct from simply keeping specimens alive, I do not mean that the only valuable role for zoos and aquariums is to help save species in the wild. Education, entertainment, inspiring awe and wonder, and scientific study are all valid and important roles for zoos, and living animal collections make these goals possible in ways and with effectiveness that would not be possible otherwise.

What is “*ex situ*” conservation? Literally, *ex situ* means “out of place”. In the context of species conservation it means activities that take place outside of the natural habitat for the species. *Ex situ* conservation might take place outside or within the range country of a species, and one common mis-use of the term is to ascribe it only to activities outside of the species range country. *Ex situ* activities could even take place immediately adjacent to the natural habitat, as in an exhibit enclosure within a natural protected area. In a sense, “*ex situ* conservation” is an oxymoron. Given what I stated above about the definition of biodiversity conservation, with the purpose of conservation being to protect natural systems, the very term *ex situ* correctly denotes that the activities are not where we wish them to be, and *ex situ* activities cannot by themselves achieve species conservation. A more accurate, if less concise, phrase would be “*ex situ* measures that support conservation”, so as to avoid the implication that the *ex situ* population itself is the conservation objective.

As this audience knows, many species have been restored to the wild from captive populations.

In such cases, the *ex situ* work was a necessary step that allowed species conservation to resume its efforts toward securing healthy populations in natural habitats, again interacting with other species in the ecological community, and evolving adaptations – *i.e.*, being the wild species again. Many other species were or still are on the edge of being lost from the natural habitats, but the wild populations have been reinforced via releases from captive stocks that served as insurance against loss. Thus, in stating honestly that *ex situ* efforts are not in themselves species conservation, we are not in any way implying that *ex situ* protection of species is not an important and even at times an absolutely essential action that allows conservation to succeed.

What is “*in situ*” conservation? *In situ* means “in place” and one dictionary definition is “in the natural or original position or place”. That leads to questions of “what is natural?” and “what is original?” We know that nature has been degraded everywhere, but it is still meaningful to describe *in situ* conservation as being activities that focus on protecting natural processes within as natural a system, in as original a location, as possible. As stated on the WAZA website, “Conservation of intact ecosystems is the only chance for the survival of our planet’s wildlife.” The World Zoo and Aquarium Conservation Strategy defines species conservation as “the securing of long-term populations of species in natural ecosystems and habitats wherever possible.” These definitions do appropriately identify our goals as we seek to conserve species, although I might quibble with the additional phrase “wherever possible” because even when it is not currently possible then the *ex situ* efforts are still directed toward an eventual outcome of securing the species in natural habitats.

Sometimes it is obvious that a program is *ex situ*, even if it is directly adjacent to a natural habitat, as with the Amphibian Ark programs that sustain breeding populations within modular “pods” created from shipping containers. Other times, it is not immediately clear if a program is *ex situ* or *in situ*. Until recently, the last known breeding site for the Puerto Rican Crested Toad (Sapo Concho Puertorriqueño, *Peltophryne lemur*) was a sand-substrate parking lot that is flooded after very heavy rains. The site may not look very natural compared to the ephemeral ponds that were once the breeding sites, but it is the breeding site that has sustained the species, the toads choose that site in which to breed, the tadpoles feed themselves on natural growing algae, and the metamorphosed toadlets disperse into the surrounding native woodlands to grow into adults. Thus, the system has been modified by humans, and it is dependent on humans for protection (the parking lot is closed to human use when the toads are breeding there), but the toads are still part of the ecological community of the area. Perhaps even less clearly *in situ* conservation, but *in situ* none-the-less, is a nearby secondary breeding site that was created with concrete, and was then populated with the release of more than 100,000 tadpoles. The pond itself is not original or natural, but the toads disperse from it, they again resume their role in the ecological community, and they return to that pond to breed. It is not perfect restoration of nature, but it is an important and successful effort to reinforce and protect the species within its original location, as a functioning part of that ecosystem.

A complicating factor in determining what is *ex situ* vs. *in situ* is that because of climate change the original and natural place for a species may no longer exist, the original place may become very unnatural (very unlike the habitat in which the species evolved), and the most natural habitat available might be far from the original location. In such cases, I think that it can be argued that the importance of maintaining as much integrity and naturalness of the ecological community and ecosystem processes within which a species evolved should take precedence over possibly futile attempts to preserve those systems within the same physical location. Thus, the “*situ*” of *in situ* might have to be interpreted at times as an ecological and evolutionary place, rather than a physical place. Indeed, to see it otherwise would require that we accept that a zoo of caged animals that replaces, on site, a natural area as an acceptable endpoint in the conservation of biodiversity.

Although the above examples make clear that *in situ* and *ex situ* are not pure concepts with an easily defined or sharp boundary between them, and the latter is sometimes necessary to conserve the former, I will argue that it is still important to recognize that there are real differences between populations *in situ* and *ex situ*. To see the distinction, one needs to ask how natural the situation is for the species. Is the physical environment “natural” in the sense of being similar to that which the species evolved adaptations? Are daily and seasonal fluctuations in the environment what the species expects? Is there opportunity for the normal foraging behaviors of the species? Do predation and predator avoidance make use of the adaptations evolved in the species for those purposes? Are courtship, mate choice, and parental care as they are in the wild? Is there competition and other interactions

with other species of the community? Does the population encounter and mount responses to diseases and parasites? Is the population continuing to evolve as part of a complex ecological community responding to environmental change? (Note that these descriptions of natural have rather little relationship to the concept of “naturalistic” exhibits, which are designed to look natural to casual human observers, rather than to function naturally for the species within them.)

Many captive propagation centers have elements of true natural habitats, sometimes even including extensive areas of complex landscapes in which species interact with at least some other components of communities and ecosystems. Yet it would be hard to argue that most of the aspects of a species living in a natural system – exist in *ex situ* programs. Another way to consider whether a population is “*in situ*” vs “*ex situ*” might be to ask: Who is in control? Does the species determine its diet, mates, behaviors, home range, nest sites, etc., or does the human manager determine most or all of these? Is the ongoing evolutionary trajectory one that is driven mostly by the species interacting with and often competing with other species in the habitat, or is it a response almost solely to our manipulations of its locale, if not also our control over who breeds?

Again, the distinctions are not always clear and sharp. The Florida Key Deer (*Odocoileus virginianus clavium*) is an endangered subspecies that inhabits several islands in the Florida Keys (USA). Although the deer can still be seen in a few areas of relatively intact island habitat, including a small wildlife refuge, many of the deer have adapted to living primarily amidst the houses and in the lawns and gardens of the human residents of the islands. Most of the habitat is highly modified, but the deer are still (mostly) in control of habitat selection, food, and mating choices, and weather patterns and other general aspects of the local environment still match those to which the species evolved. (However, the entire range may become submerged with rising sea levels driven by climate change.) The habitat of the deer is now a human-dominated landscape, with, for example, the primary “predator” being automobiles. It could be debated if this situation should be considered *in situ*, and if the current situation of the deer population should be considered an acceptable end point for the conservation of this component of the biodiversity of the region. Surprisingly, wildlife management authorities have deemed it unacceptable to move even temporarily a portion of the Key Deer population into fully captive care (in order to protect it against possible catastrophes, such as a direct hit by a major hurricane), because it was felt that such action would put the deer into an unacceptably unnatural situation, thereby destroying the essence of the Key Deer.

Evan Blumer and others have suggested that a better term than *ex situ* to describe many of our conservation breeding programs is “intensively managed populations” (or intensive management of populations). An intensively managed population is one which is dependent on management at the individual and population levels. (I thank colleagues at the Wildlife Conservation Society for suggesting this definition, although their usage does not match exactly the way the Evan and I use the term.) Among *ex situ* populations there is a range of the intensity of management, from pairs of animals kept in cages to flocks of birds in large aviaries. However, every *ex situ* population probably qualifies as being intensively managed; otherwise it will perish because it is outside of a functioning natural system. However, some *in situ* populations are also intensively managed, even if perhaps somewhat less intensively managed than are most *ex situ* populations. For example, black rhinoceroses in some reserves in Kenya are individually monitored, often protected individually from poachers, provided with veterinary care, and moved (in trucks) among reserves according to a management plan that considers the need to regulate numbers to match local capacity, to assure a good sex ratio of breeders, and to avoid inbreeding. But they are still living in natural habitats and interacting with the native, local fauna and flora. Thus, they would be considered to be intensively managed, *in situ* populations.

Puerto Rican Parrots (*Amazona vittata*) persist in their native habitat in a protected forest, although management has sometimes included providing artificial or modified nest sites and protection from predators. This relatively intensively managed, but still *in situ*, population has been supplemented by releases of birds reared in a captive breeding facility that while located at the site of the wild population is clearly an *ex situ* population. The *ex situ* population in the forest-located captive facility is more intensively managed than is the *in situ* population in the forest, but both are appropriately described as being under intensive management while the important distinctions between the *ex situ* and *in situ* populations are clear. The parrots in the *in situ* population are living a very different existence than are the *ex situ* birds, within an ecological community and continuing to adapt to the selection pressures of a shifting natural habitat. Most importantly, the *in situ* population is the goal of the conservation program, while the *ex situ* population is a temporary way station to help assure that the *in situ* population will persist.

Thus, the term “intensively managed” is not a replacement for the term “*ex situ*”, but rather it has a somewhat different focus, different meaning, and different use. Intensive management of populations describes the level of management that is used, regardless of where it is used, while *ex situ* refers to a population under whatever kind of management that is being held outside of the wild. Intensive management focuses on the methods of species conservation, while *ex situ* focuses on the place. Intensive management is more clearly descriptive of one side of a continuum (from very intensive management, to less intensive management, to extensive management at the level of population manipulations that do not involve direct management of individuals, to conservation dependent populations that would be threatened if external processes such as trade are not controlled), rather than implying as does the *ex situ* – *in situ* dichotomy that the distinctions are always clear. In that respect, “intensively managed population” is a less precise (and therefore probably more confusing) but more accurate term.

Throughout the discussions of *ex situ* and *in situ* conservation methods, or intensive management and less intensive management of populations, we should keep in mind that while various approaches will be needed to stem the losses of biodiversity, the goal of species conservation is to protect and restore biologically diverse communities that are functional, natural systems. We are not aiming for perpetual intensive management of *ex situ* representatives of species. (At least not when we are working for the conservation of that species. We often do aim for long-term *ex situ* management for the other purposes for which zoological collections are maintained.) Rather, we use *ex situ* populations when necessary and use-ful to help restore *in situ* populations, and we intensively manage populations while working toward a goal of biodiversity that can thrive again in healthy systems that require less intensive care.

In conclusion, we should try to use terms correctly and use the terms that best describe the concepts we are attempting to describe, without getting too concerned if occasionally someone uses less suitable terminology. At the same time, while recognizing that the terms can be imprecise and at times confusing, we need to keep in mind that there are real and meaningful differences – to the animals, to the species, to us, and probably to everyone except zoo media consultants – between *ex situ* and *in situ* approaches to biodiversity conservation. *In situ* is the goal, but often *ex situ* is a necessary way station for many species.

Acknowledgements

I thank Evan Blumer, William Conway, Jeffrey Bonner, and many other colleagues in CBSG and WAZA for their insightful and immensely valuable discussions on the issues presented here. It should not be presumed that they agree with all or any of my arguments and views, and I hope that this paper stimulates ongoing discussion and effective action on behalf of species.