


Science & Society

Biodiversity
Conservation Requires
Management of Feral
Domestic AnimalsCristián Bonacic ^{1,2,*},
Rocío Almuna,^{1,3} and
J. Tomás Ibarra^{1,2,3,4}

The proliferation of feral domestic animals (FDAs) has been favored by human-induced landscape changes, a world population becoming increasingly urban, and by inappropriate management of domestic animals. Here, we describe the impact of FDAs and the opposing views in societies that affect the decision-making process and management actions. We provide general recommendations for the participatory management of this emerging threat to biodiversity and rural ecosystems.

FDAs in the Anthropocene

The loss of biological diversity is one of the severe global environmental problems of our age – the Anthropocene – during which human activities have become a force of global geophysical change [1]. Well-known human-induced factors affecting biodiversity in the Anthropocene include habitat loss, overhunting, nutrient and agrochemical pollution, climate change, and alien species [2]. Less known and underestimated is the growing effect of domestic animals, and especially the ones that become feral, on rural areas worldwide. Domestic animals have reached large numbers to supply food, services, and companionship in the case of pets, with an estimated 1.4 billion cattle (*Bos* spp.), 58 million horses (*Equus caballus*), 18.5 billion poultry, 986 million pigs (*Sus scrofa domesticus*), and between 1.2 and 1.5 billion dogs

(*Canis lupus familiaris*) populating the world [3]. Domestic animals are present and play a major role in human-dominated landscapes, to the extent that some 90% of all mammals on earth are now humans or our livestock [4].

Our aim is to present some of the multiple impacts of FDAs on biodiversity and rural ecosystems, and describe the process of domestic animals becoming FDAs. We discuss why opposing views in society affect policy-making processes to manage this emerging threat. Finally, we recommend specific actions to implement management plans regarding the fate of FDAs.

Ecological Consequences of the Proliferation of FDAs

When domestic animals are unattended, abandoned, or poorly managed, they can become independent from human care and roam free in rural areas (see definition in next section and Figure 1). FDAs have a negative impact on biodiversity in both developed and developing countries [5]. Recorded environmental impacts of FDAs in rural areas include soil erosion (e.g., feral pigs) and overgrazing (e.g., feral horses and cattle); disease transmission to people (e.g., by epidemics of rabies driven by feral cats and dogs), and to domestic animals and wildlife (e.g., leptospirosis by feral dogs); predation of and competition with wild carnivores (e.g., feral cats and dogs) [6]. Furthermore, FDAs increase human–wildlife conflicts by provoking mistaken retribution killings of wild carnivores when feral dogs prey upon livestock [7].

At least 322 species of terrestrial vertebrates have become extinct since the 16th century. Cats (*Felis catus*) have been an important factor leading to the extinction of many of those species [1]. Feral dogs and cats are effective predators of wildlife (reptiles, birds, and mammals) [8]. It has been estimated, for example, that cats kill 1.4–3.7 billion birds per year in the USA alone. In addition, cats are

competitors and a source of infectious diseases for wild carnivores [9]. Cat populations close to protected areas are growing in many parts of North America, Europe, and Australia, endangering native species. In the African continent, the Ethiopian wolf (*Canis simensis*) is a highly threatened species. It is well documented that the Ethiopian wolf has been affected in the past 20 years by several epidemics of rabies, which have led the population to decrease by around 75% in Ethiopia [10]. Native wildlife on islands is particularly vulnerable to the impact of FDAs as well [2,9].

From Domestic Animals to FDAs in the Anthropocene

The process of becoming feral (Figure 1), typically occurs when well-managed livestock and pets (Stage I) cease to be controlled and are either abandoned or lack proper care and management (Stage II). Before becoming completely feral, domestic animals often go through an intermediate stage in which they roam free, either temporarily or permanently. As FDAs begin to reproduce freely in the wild and become independent of humans, they cause a wide range of negative impacts on biodiversity and rural ecosystems (Stage III). A fundamental difference from a wild alien species [e.g. coati (*Nasua nasua*) or red deer (*Cervus elaphus*)] is that FDAs, such as cats or horses, were first domesticated while wild alien species were not. Consequently, human attitudes toward FDA control tend to diverge from attitudes regarding the control of wild alien species [11,12].

Have We Forgotten to Manage FDAs?

A major characteristic of the Anthropocene is that humans are increasingly living in urban areas; current projections for the mid-21st century point to 70% of the world population becoming urban [12]. Correlated with this increasingly urbanized world is the growing number of pets, and

Feralization and its effects on rural ecosystems

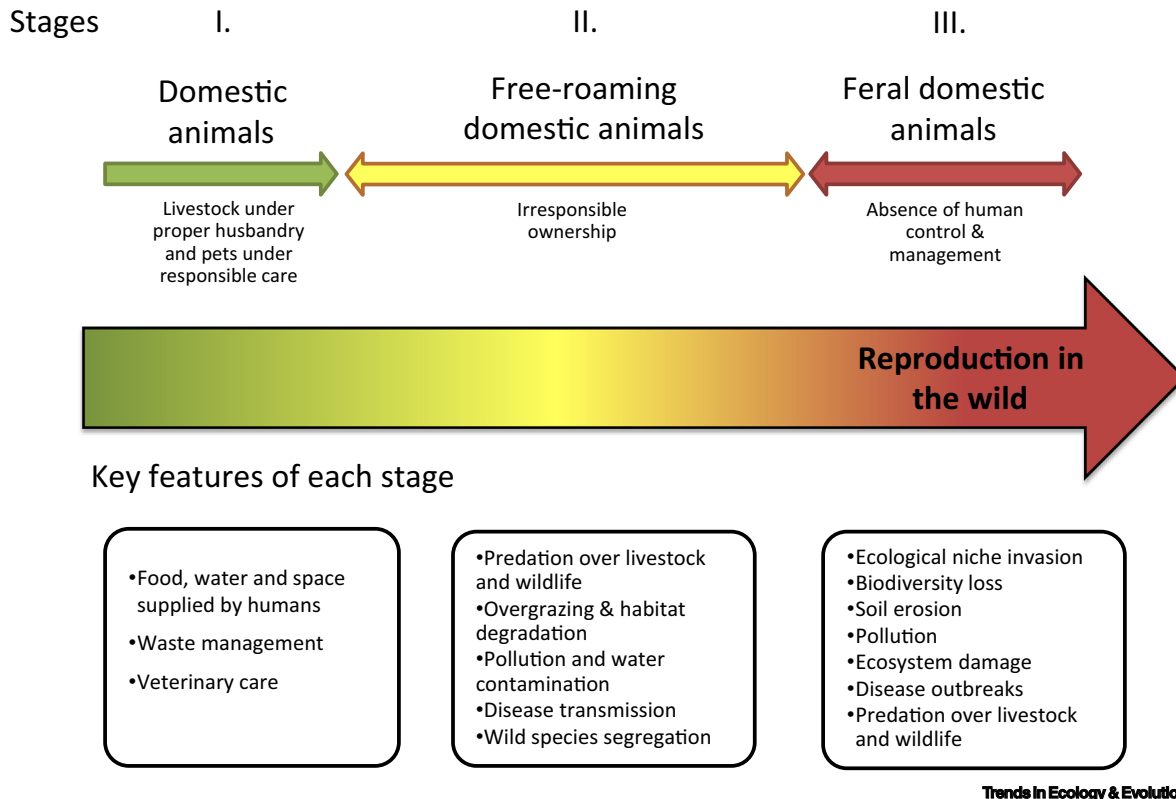


Figure 1. Stages of Feralization and Its Effects on Rural Ecosystems and Biodiversity.

For a Figure360 author presentation of Figure 1, see the figure legend at <https://doi.org/10.1016/j.tree.2019.05.002>.

Stage I: animals under responsible ownership (all their needs are supplied by humans and they are restricted in defined areas). Stage II: lack of direct supervision (free-roaming or strays). They can have potentially negative consequences on the environment (e.g., pollution and habitat damage) and compete or prey upon other domestic animals and wildlife. Animals in Stage II may revert to Stage I if they are managed again. In some places around the world, they are harvested commercially (e.g., horses and goats in Australia). Stage III: animals become almost completely independent of human care. They live and reproduce in the wild (avoiding direct human contact).

the abandonment of unwanted animals both within cities outskirts and rural areas [8,13]. Both livestock and pets are sources of FDAs, which are characterized by rapid reproduction, adaptive social learning and resistance to cosmopolitan diseases.

The relationship between humans and domestic animals is complex, and has emotional, religious, moral, ethical, and philosophical dimensions. As a result, there is often conflict within human societies regarding the management of FDAs. At present, for example, conservationists overwhelmingly support management of

FDAs to minimize ecological harm. Some animal rights groups, in contrast, fight to protect FDAs at any cost. As a result of changing attitudes and vigorous political pressure, policy is currently shifting toward the protection of FDAs in several countries. Unfortunately, this comes at a clear cost to wildlife and environmental protection. Examples of these shifts include the new Chilean law for responsible ownership that protects free-roaming dogs (Law 21,020, Ministry of Health, 19 July 2017) and the no-euthanasia policy in Italy, Argentina, and Chile. Paradoxically, the avoidance of lethal control is having a

negative effect on the welfare of both wildlife and FDAs [5] and, in the particular case of Chile, contributing to the decline of guanacos (*Lama guanicoe*), Andean deer (*Hippocamelus bisulcus*), and kodkod cat (*Leopardus guigna*). Argentina is another example where wildlife in large areas of Patagonia is now under threat by feral packs of dogs. Another example is new legislation that includes the no-euthanasia regulation to prevent the lethal control of feral horses in a National Park of New South Wales, Australia, where endangered species of plants are overgrazed [14]. Feral horses are also

protected in federal land in the USA, despite their impact on local ecosystems. These examples highlight the urgent need for informed and case-specific approaches to mitigate the multiple negative impacts of FDAs on biodiversity.

Because culling policies for management of FDAs are generally not accepted by animal rights groups and other members of society [15], there is a new challenge to mitigate the large-scale impact of FDAs on biodiversity, ecosystems, and rural livelihoods. Public agencies and policy makers are failing to overcome these new challenges worldwide [1,2,7,8,10]. There is not a single solution for every case of FDAs. For example, some FDAs provide economic benefits in some rural areas in Australia. In other cases, FDAs have become key prey for endangered predators and drastic removal could be detrimental for native species conservation that depend upon them. Grazing vegetation by FDAs contribute to prevent fires when native herbivores have been extirpated from human dominated landscapes.

Recommendations for Management of FDAs

Our specific recommendations to address the effects of FDAs, following adaptive management principles, are: (i) to identify sources of FDAs and assess, case by case, their detrimental ecological effects on biodiversity and ecosystem composition, structure and function; (ii) to estimate the sociocultural and economic effects that FDAs have when they impact local biotas and rural livelihoods; (iii) to raise community awareness of the negative impacts of FDAs to gain support for management

solutions; and (iv) to engage local and global stakeholders in participatory management of FDAs that addresses ethical, cultural, religious, economic, and environmental concerns.

Our view is that a fundamental goal of government policy should be the protection of biodiversity, ecosystems, and rural livelihoods. The protection of biodiversity and ecosystems over-rides the defense of FDAs in importance, because the presence of FDAs contributes to biodiversity loss and causes widespread changes throughout ecosystems, which governments have a duty of care to protect. In creating these policies, governments need to engage stakeholders from different sectors of society to tackle control of FDAs with effective actions adapted to each socioecological context. Only through the design and implementation of effective control strategies, accepted by the different stakeholders, will we mitigate the rising worldwide impact of FDAs in the Anthropocene.

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¹Fauna Australis Wildlife Laboratory, School of Agriculture and Forestry Engineering, Pontificia Universidad Católica de Chile, Santiago, Chile

²Centre for Intercultural and Indigenous Research (CIIR), Faculty of Social Sciences, Pontificia Universidad Católica de Chile, Villarrica, Chile

³ECOS (Ecology-Complexity-Society) Laboratory, Centre for Local Development (CEDEL), Villarrica Campus, Pontificia Universidad Católica de Chile, Villarrica, Chile

⁴Millennium Nucleus Centre for the Socioeconomic Impact of Environmental Policies (CESIEP), Pontificia Universidad Católica de Chile, Santiago, Chile

*Correspondence:
bona@uc.cl (C. Bonacic).

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