Coexistence conservation: Reconciling threatened species and invasive predators through adaptive ecological and evolutionary approaches

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Abstract
Invasive predators are responsible for declines in many animal species across the globe. To redress these declines, conservationists have undertaken substantial work to remove invasive predators or mitigate their effects. Yet, the challenges associated with removal of invasive predators mean that most successful conservation programs have been restricted to small islands, enclosures (“safe havens”), or refuge habitats where threatened species can persist. While these approaches have been, and will continue to be, crucial for the survival of many species, in some contexts they may eventually lock in a baseline where native species vulnerable to invasive predators are accepted as permanently absent from the wild (shifting baseline syndrome). We propose an explicit theme in conservation biology termed “coexistence conservation,” that is distinguished by its pursuit of innovative solutions that drive or enable adaptive evolution of threatened species and invasive predators to occur over the long term. We argue evolution has a large role to play but using it to adapt native species to a new environmental order requires a shift in mindset from small, isolated, and short-term leaps to deliberate, staged steps within a long-term strategy. A key principle of coexistence conservation is that predation is treated as the threat, rather than the predator, driving a focus on the outcome rather than the agent.
Without a long-term strategy, we face the permanent loss of many species in the wild. Coexistence conservation is a complementary approach to current practice and will play an important role in shifting our current trajectory from continued and rapid invasive predator-driven defaunation to a world where invasive predators and native prey can coexist.

**KEYWORDS**

adaptation, conservation translocations, evolution, extinction of experience, reintroductions, rewilding, shifting baseline syndrome

| ESSAY |

Rapidly increasing human impacts over the last 500 years have led to a “biological annihilation”; an extinction event akin to Earth’s previous five mass extinction events (Ceballos et al., 2017). A huge component of this sixth extinction event is the loss of animal species, or “Anthropocene defaunation” (Dirzo et al., 2014), caused by habitat modification and destruction, over-exploitation, and the introduction of species into non-native environments (Cardillo et al., 2005). In particular, the human-assisted spread of invasive predators (also termed exotic, introduced predators) has been responsible for declines in many native species (Banks et al., 2018). For example, invasive predators have contributed to 58% of all bird, reptile, and mammal extinctions, with a handful of species, such as the red fox (*Vulpes vulpes*), domestic cat (*Felis catus*), rat (*Rattus* spp.), mink (*Neovison vison*), and stoat (*Mustela erminea*), driving defaunation at a global scale (Doherty et al., 2016).

While the total eradication of invasive predators is a laudable long-term goal in ecosystems across the world, it is currently very difficult or impossible to achieve; particularly at large scales such as continents (Jones et al., 2016; Manning et al., 2021). We argue here for a complementary approach to current practice, that considers the possibility that species vulnerable to invasive predators could be adaptively managed to coexist. We term this new approach “coexistence conservation.” We outline limitations of current management practices and argue that current entrenchment of a “shifting baseline syndrome” (Manning et al., 2006; Soga & Gaston, 2018) could inevitably lead to native species vulnerable to invasive predators existing only in zoos and sanctuaries. We argue evolution has a large role to play in coexistence conservation, and that harnessing it to adapt native species (and possibly invasive predators) to a new environmental order requires a shift in mindset within a long-term strategy. We outline ways in which coexistence could be achieved, which include using tactics within a conceptual niche lens. We discuss the political and social dimensions of this approach, which are crucial considerations if coexistence is to be achieved.

| 1.1 | Limitations of current management approaches |

To redress species declines, conservationists have undertaken significant work to lessen the impacts of invasive predators on native species (Manning et al., 2021). However, total eradication of invasive predators is currently only possible under limited circumstances, such as on small islands or within fenced sanctuaries (where significant conservation gains have been made) (Jones et al., 2016). This means that the only place where predator-susceptible species are considered to be “safe” from the threat of invasive predators is in refuge habitats (Kerley et al., 2012) or in exclosures (hereafter termed “safe havens,” otherwise known as fenced sanctuaries, ecosanctuaries, predator-free reserves, or islands), where invasive predators are naturally absent or have been removed (Jones et al., 2016). Despite the undisputed importance of safe havens (Ringma et al., 2018) and refuge habitats for the conservation of declining species, they are unlikely to encapsulate the broad range of biotic interactions and abiotic conditions found across the species’ historic distribution, leading to future conservation efforts being hampered by maladaptive responses (Kerley et al., 2012). For example, recent work has shown that heritable predator-resistant behavioral traits, crucial for survival in a landscape containing predators, can be rapidly lost when mammals are not exposed to predation (Jolly et al., 2018). The problem of “refuge naïveté” (Evans et al., 2021) could have significant implications for the long-term viability of species in refuge populations (Ross et al., 2019). Maintaining populations in refuges can also be expensive. For example, fenced reserves require construction and ongoing maintenance (Hayward et al., 2007; Hayward & Kerley, 2009). Further, safe havens and refuge habitats are also unlikely to contain the full complement of ecological processes, which
might include, for example, top-down regulation of herbivores by native predators that is necessary to conserve a fully functioning ecosystem (e.g., wolves, elk, and aspen [Ripple et al., 2001]).

1.2 Shifting baselines

The contraction of species to refuges or safe havens not only risks deleterious effects to the threatened species and the environment which it inhabits, but it also limits our understanding of what constitutes species conservation in the first place. It sets up a perpetual “shifting baseline syndrome” (Manning et al., 2006; Soga & Gaston, 2018) because threatened species management is constrained by our inability to permanently remove or reduce predation by invasive species. There are generations of people whose only experience of threatened native prey species is in zoos and safe havens. This “extinction of experience” (Soga & Gaston, 2016) has resulted in most people’s baseline expectation of the natural world being a degraded environment with fewer native animals. The ongoing entrenchment of this baseline scenario constrains our vision and ambition for what might be possible in the future (Manning et al., 2006).

1.3 Coexistence conservation

Here, we propose “coexistence conservation” as an explicit theme within conservation science that brings together recent innovations and concepts that explore coexistence of invasive predators and threatened prey into a unified conceptual framework. We propose that this theme be defined as a specific scientific endeavor that is distinguished from other conservation sciences by its deliberate pursuit of innovations that drive or enable adaptation to occur over the long term, outside of safe havens or refuges. We define coexistence conservation as:

The long-term, iterative, and adaptive process to enable the coexistence of threatened species and invasive predators.

Coexistence conservation builds on and broadens the thesis of Urlich (2015), who called for the facilitation of long-term coexistence between native New Zealand avifauna and the invasive mammalian predators that have contributed to their decline. It is also a broader global term for what has been called “beyond-the-fence” in the Australian context (Evans et al., 2021; Manning et al., 2021; Steindler, 2019). While we recognize that our conceptual work originates from Australia, we highlight that coexistence conservation has universal applications. Our thinking applies to any situation where conservation scientists and practitioners are addressing the challenge of recovering native animals in the presence of invasive predators that are currently impossible to eradicate. Examples include invasive predators such as Burmese pythons (Python bivittatus) in Florida (Hanslowe et al., 2018), feral pigs (Sus scrofa) in South Africa (Fincham & Hobbs, 2013) and New Zealand (Coleman et al., 2001), house mice (Mus musculus) in New Zealand (Norbury et al., 2014), mongoose (Herpestes javanicus) in Okinawa, Japan (Watari et al., 2008), and American mink (Neovison vison) in the United Kingdom (Martin & Lea, 2020). Our conceptual approach is also relevant when considering coexistence of native species with exotic pathogens, such as chytrid fungus in eastern Australia and the Neotropics (Scheele et al., 2019).

Coexistence conservation assumes that the total eradication of the invasive predator is not possible under current technical, financial, or societal conditions, although we do acknowledge the potential of some genetic mechanisms in the future (Esvelt et al., 2014). A crucial difference between coexistence conservation and other approaches of invasive predator management, is that pre-dation is treated as the threat, rather than the predator, driving a focus on the outcome rather than the agent. Thus, the language changes from “threat control” to “threat impact mitigation.” Additionally, coexistence conservation recognizes that threat impact mitigation is not a binary presence/absence of threat, but instead there are levels of threats and tolerances experienced under different predator and prey densities and behaviors, and different habitats or landscapes, that is, the threat-tolerance relationship is dynamic (Evans et al., 2021). Further, a tolerable level of predation could be viewed as a favorable outcome, with benefits including improved population fitness and reduced naïveté in the prey species.

Coexistence conservation also recognizes that, in many cases, reintroducing threatened species in areas with extant populations of invasive predators is extremely challenging and unlikely to succeed in a single, small, isolated, short-term leap. Any solution, therefore, must aim to address the challenge over the long term, and by extension, must be long term in nature. To achieve long-term success requires a staged, multi-phase process of trials (Batson et al., 2015) toward the ultimate “stretch-goal” (Manning et al., 2006) of establishing populations in the presence of invasive predators. Successfully planning and implementing coexistence conservation, therefore, not only involves a shift in application, but also a large paradigm shift from rescuing animals in safe havens to planning how, where, and when coexistence could occur in the future.
| Tactic | TTCS | Details | Example |
|--------|------|---------|---------|
| Predator reduction | P | Reduction of predation by removing some invasive predator individuals to reduce predation impact. | Removal of invasive cats (*Felis catus*) and Burmese pythons (*Python bivittatus*) from Key Largo resulted in increasing Key Largo woodrat (*Neotoma floridana smalli*) occurrences (Cove et al., 2019). |
| Enemy constraint hypothesis | P | A hypothesis that apex predators constrain mesopredators, resulting in reduced predation pressure on the prey of the mesopredator. | The gray wolf (*Canis lupus*) constrains the range of the coyote (*C. latrans*) and golden jackal (*C. aureus*) in the US and Europe respectively. The dingo (*C. dingo*) constrains the red fox in Australia (Newsome et al., 2017). There is caution however, with increasing evidence that the hypothesis is not supported (Castle et al., 2021). |
| Bettering the devil | P | Impose directional, positive selection toward predators that have minimal impact on vulnerable prey and threatened species. | Manning et al. (2021) argue that a nearly century-long attempt to control red foxes (*Vulpes vulpes*) in Australia could be selecting for foxes that are more difficult to control in the long term. Analogous to pesticide resistance in agriculture (Hawkins et al., 2019). |
| Conditioned taste aversion (CTA) | P | Creating an association between a negative taste (bitter, nausea inducement) and the prey species to reduce predation levels. | Using CTA, Gustavson et al. (1974) were able to suppress attacks by coyotes on lambs without affecting predation on other prey. |
| Misinformation tactics | P | Exposing invasive predators to unrewarded vulnerable prey odors. | Research in New Zealand has demonstrated that by providing unrewarded bird odors to invasive predators in the landscape (ferrets [*Mustela putorius furo*], cats, and European hedgehogs [*Erinaceus europaeus occidentalis*], resulted in significant increases in chick recruitment of native ground-nesting shorebirds (double-banded plover [*Charadrius bicinctus*], wrybill [*Anarhynchus frontalis*], and South Island pied oystercatcher [*Haematopus finschi*]) (Norbury et al., 2021). |
| Headstarting | E | Protecting prey from predators during the early life stages when they are most vulnerable. | Eastern box turtles (*Terrapene carolina*) in Michigan, US survived longer if they were head-started (grown in captivity) for longer before reintroduction (Tetzlaff et al., 2019). |
| Small mammal refuges | E | Creation of small, permanently fenced habitat patches as safe refuges from invasive predators. Requires the focal prey species to move through the fence and spend some time outside the refuge. | Proposed by Smith and Quin (1996) in the context of recovering native rodents in Australia. |
A key point with many species considered for coexistence conservation is that, although they are probably declining and at low densities, they are not yet extinct. Understanding why some populations of species have survived when others have not, and remembering that their contemporary ranges might be sub-optimal (i.e., refugee species (Kerley et al., 2012)), provides a foundation for practitioners to find new contexts that enable recovery and adaptation.

1.4 | Harnessing evolution

Evolution is a constant and ubiquitous process involving mutation, genetic drift, gene flow, and natural selection that acts on all populations, including humans (Stearns et al., 2010). Indeed, during the current human-driven biodiversity crisis (Otto, 2018) humans have had widespread, diverse, dramatic, and often negative (Weeks et al., 2011) influences on the evolution of species (Hendry et al., 2017). The field of conservation genetics has its roots in understanding the genetic and evolutionary mechanisms that negatively affect small and threatened populations, such as inbreeding, random genetic drift, and genetic load (Frankham et al., 2010). More recently, there has been greater recognition of the importance of genetic variation in facilitating adaptation and resilience to change (Hoffmann et al., 2021, Bonnet et al., 2022). We argue here that we now need to consider further how we can harness evolutionary processes (evolutionary adaptation) to enable the coexistence of native prey and invasive predators.

Incorporating adaptive processes into conservation to increase fitness is not a new concept (e.g., Urlich, 2015). Some reintroduction biologists, for example, have used...
tactics (Batson et al., 2015) to improve their chances of establishing a population by taking into account trait diversity within a species and differences in predation resistance (Table 1). These tactics include choosing founders in reintroduction and translocation programs with particular behavioral (Kelly & Phillips, 2019; Le Gouar et al., 2012) or physical traits (Letty et al., 2007) or with particular demographics (e.g., sex, age) (Wilson et al., 2020). Conservation scientists have also used pre-conditioning, such as training animals to avoid predators or prey that might threaten their survival (Indigo et al., 2018; White et al., 2012). Moseby et al. (2016) argue that in-situ predation at management-controlled levels could prevent refuge naïveté by helping species to survive over the long term and potentially adapt to coexistence with invasive predators. There have been several studies that test hypotheses related to how reintroduced small Australian mammals can adapt to coexist with invasive predators, contributing several important discoveries (Blumstein et al., 2019; Evans et al., 2021; Moseby et al., 2018; Ross et al., 2019; Steindler et al., 2020; West et al., 2018; White et al., 2018). A promising tactic for enhancing adaptation is “targeted gene flow,” where individuals with desirable (heritable) traits that increase survivability and fitness, are introduced into a recipient population (Kelly & Phillips, 2019). Critical to the context of the adaptive evolutionary process is that traits are inherited (genetically determined), allowing selection to increase the frequency of beneficial traits over time. Differentiating between tactics that may be applied to traits to facilitate and drive selection will be key to harnessing adaptive evolutionary processes for coexistence conservation.

The decision to implement a long-term coexistence conservation project may also be influenced by the evolutionary starting point of the species in question (Kelly & Phillips, 2016). For example, in Australia, fauna have evolved with some level of mammalian predation and have been shown to recognize invasive predators (Banks et al., 2018), which may indicate some adaptive responses that could be built upon. In contrast, species with no evolutionary history of exposure to mammalian predation, such as those isolated on oceanic islands like New Zealand and Hawaii, are naïve to invasive mammalian predation (Banks et al., 2018; Banks & Dickman, 2007; Blackwell, 2005; Carthey & Banks, 2016). For example, the eggs of flightless birds of New Zealand are particularly vulnerable to predation by invasive mammals such as rats (Rattus spp.), stoats (Mustela erminea), weasels (M. nivalis), and ferrets (M. furo) (Blackwell, 2005; O’Donnell et al., 2015; O’Donnell et al., 2017). The history of exposure may therefore influence the speed and likelihood of achieving coexistence through evolutionary processes between threatened species and invasive predators.

### 1.5 Better the devil you know

Complementary to a focus on predation, there is also interest in using techniques to condition predators against preying upon threatened species (Cowan et al., 2000; Macdonald & Feber, 2015). Recently, Manning et al. (2021) discussed the possibility that a long history of fox control in Australia has applied selection pressure on foxes that might make their continued and future control more difficult. The authors, of which we are several, outlined ways in which scientists and practitioners could research predator control methods that shift the survival advantage away from predators that avoid lethal control, toward those that are less likely to depredate threatened species. They discuss the potential to elicit aversion in invasive predators using shock collars or conditioned taste aversion and “toxic trojan” (Read et al., 2015) poison implants as a last resort. Since predator adaptation will happen regardless, it is logical to try to promote or create pressures that select for traits that promote coexistence. When used in conjunction with tactics that seek to allow adaptation of the native prey species, predator adaptation might enable threatened species populations to survive over the long term (Figure 1).

### 1.6 Implementing coexistence conservation

Recognizing that the goal of restoring threatened species in the presence of invasive predators cannot be addressed in a single step, moving from theory to practice can be aided by applying a niche lens (Figure 2) and using a suite of animal-, environment- (Batson et al., 2015), and predator-focused tactics (Table 1).

### 2 THE NICHE LENS

Once widespread, many native prey species have experienced niche contractions, with the addition of a threat (e.g., invasive predator, disease) resulting in a much smaller realized niche (i.e., refuge habitats) than their previous historical niche, in some cases, totally reducing the contemporary niche breadth to zero (extinction) (Scheele et al., 2017). Applying a niche lens to coexistence conservation projects can increase the chances of success in two ways (Figure 2). First, it can help identify environmental conditions underpinning non-random patterns of species decline, where certain conditions may favor lower rates of predation or increase a prey species’ capacity to persist despite predation. Identifying such conditions can help tip the odds in favor of the native prey species, maximizing
survival. Second, awareness of niche contractions is important, since species may be restricted to habitat that is sub-optimal (even in the absence of invasive predators). Therefore, restricting conservation efforts to species’ contemporary realized niches may unnecessarily constrain options for recovery and adaptation if the predation threat can be addressed elsewhere (Kerley et al., 2012). Applying a niche lens can enable practitioners to move beyond mimicking characteristics of locations where remnant populations currently or historically persisted, toward identifying regions within a target species’ fundamental niche or allowing for adaptation to changed environments within the historical geographic range (Scheele et al., 2017).

Of course, coexistence conservation programs will be occurring in an uncertain future, with climate change meaning that former geographic ranges might not be suitable for threatened species, even with invasive predator removal (Prober et al., 2019). Our niche-focused framework addresses this concern, uncoupling the management decision from the assumption that species should always be reintroduced to a landscape which replicates historical conditions or current refuge habitats, instead focusing on ensuring conditions are within species fundamental niche limits (which could involve “assisted colonization” [Seddon, 2010] in some situations).
3 | TACTICS

By iteratively trialing a suite of tactics (Table 1), a coexistence conservation project can be refined until coexistence with invasive predators is achieved, remembering that this is a long-term endeavor and is not likely to be possible in a single leap.

We outline here the “pathway to the wild” strategic framework for coexistence conservation (Figure 3). The framework allows a series of trials over a long timeframe, where individuals persisting in remnant populations (Step 1) are used as founders to re-build populations in safe havens (Step 2). Safe havens need to be large, have adequate founders (for trait diversity), and can be used for the next steps: the trials required to achieve coexistence (Steps n). Note that between Steps 1 and 2 (Figure 3) is the opportunity to use captive institutions (zoos, breeding facilities). However, caution is needed because populations in captivity can be very small and, therefore, may be unsuitable for the establishment of safe haven populations. The aim with captive breeding should be to “get them in and get them out” as quickly as possible and within a few
generations from the wild to avoid maladaptation (and to minimize husbandry costs) and other risks and challenges of captive breeding (Noel et al., 1996; Weeks et al., 2011).

The trials in our framework allow scientists to test a priori hypotheses (Taylor et al., 2017) in an iterative manner to determine which tactics improve outcomes within an adaptive management framework. A fundamental requirement of the pathway to the wild is that risk to the species is kept below that species’ upper threshold of tolerance (Evans et al., 2021), meaning that the only possible path to coexistence is one of accumulating knowledge and innovation to maximize persistence (Figure 3[b]). Further, as knowledge is accumulated, larger trials with more animals can be implemented to increase the likelihood of evolutionary adaptation. This multi-step approach is far more likely to succeed in the long term and be more palatable to the conservation community than one single “giant leap” reintroduction that contains many unknowns and significant risks.

3.1 | Political and social dimensions

The challenge of establishing or recovering populations of native prey in the presence of invasive predators does not occur in a vacuum—but within human society. It is crucial for programs to gain the support of the broader community (Kendal & Ford, 2018). In conservation programs, there is commonly potential for disagreement between stakeholders stemming from environmental, economic, social, cultural, and conceptual factors (Lorimer et al., 2015). For example, reintroduced species may have impacts on agricultural operations (Martin et al., 2020), cause environmental change not acceptable to some stakeholders (Gaywood, 2018), or become a risk for human safety (Gore et al., 2007).

Progress toward large-scale restoration and conservation, in the face of invasive predators, requires innovation and new ideas with the ability to “think outside the box,” and test scientific approaches, which may be in direct opposition to prevailing wisdom (i.e., paradigms) (Nurse, 2021). This can result in resistance to new ideas and concepts, yet not trying new ideas reinforces the status quo and will, by extension, “lock in” the current shifting baseline. For example, the idea that we might consider adapting rather than killing invasive predators might seem counter intuitive. The process of natural selection, however, which adapts populations to the prevailing conditions, requires removal of unfit individuals from the population, which in the case of coexistence conservation will occur via predation. This may seem antithetical to what conservation is perceived to strive for by some people, and implementation of this approach will likely be challenging. Indeed, conservation science, in the eyes of the wider community, is generally perceived to be at the individual level (rather than the population, species or ecosystem) with an assumption that all individuals within the species can be saved (Biermann & Anderson, 2017; Coghlan & Cardilini, 2022). Practice indicates that this is almost never the case—even in the best-case scenarios. Similarly, selecting for threatened species to be more resistant to predation (by exposing them to predation) is potentially contentious (Corlett, 2016), but hard to avoid if we wish to overcome the challenges of invasive predators. Scientific parsimony is critical (see below).

3.2 | Harnessing or ignoring evolutionary forces?

Our argument that we need to harness evolution to achieve coexistence conservation is not without potential controversy. For example, actively manipulating traits of threatened species, such as seeking to enlarge a species,
change its color, or make it more aggressive to avoid predation by an invasive species, may improve its ability to coexist with invasive predators, but would this be acceptable to the community? We argue that regardless of whether we harness evolutionary principles or not, during the current biodiversity crisis (Otto, 2018), evolution due to human-induced selection pressures such as habitat fragmentation, climate change, urbanization, shooting, baiting, hunting, or indeed safe havens, continues to occur (Hendry et al., 2017). Thus, we must recognize that the continuation of the status quo is a management decision in itself and will have indirect consequences that can be equally or more profound.

### 3.3 Scientific parsimony

Science should be underpinned by good experimental design, which includes appropriate replication, randomization, and contrasts (controls and treatments). Funding constraints, and the inherent responsibilities of working with threatened and rare species, affects the number of individual animals available for experimentation, particularly when there is a clear risk to the animal. In addition, conservation projects can involve species with long generation times. These two factors make investigating evolutionary mechanisms challenging, because evolution is most rapid in species that have short generation times and large population sizes (De Meester et al., 2016). As such, we need to take a parsimonious approach where we maximize learning gains using the minimum number of individuals while maintaining the genetic and adaptive integrity of the species. Perhaps one of the most important distinctions to clarify in conservation science, therefore, is that the long-term goal of a conservation program is the sum of a number of short-term conservation trials (Wilson et al., 2020).

### 3.4 Long-term thinking

Many of the challenges faced in redressing defaunation can be overcome by creating a long-term vision (i.e., stretch-goal (Manning et al., 2006)) that is proactive, parsimonious, and clearly articulated. A significant challenge to a long-term plan, however, is “short-termism.” The majority of ecological and conservation research is conducted over short timescales (<5 years) with discrete projects spanning the length of the funding cycle (Lindenmayer, 2015; Taylor et al., 2017). Short-term measures that prematurely categorize projects as “successes” or “failures,” risk locking in the degraded shifting baseline, and ignore the long-term nature of species recovery (noting short-term “success” might still be long-term failure, and short-term “failure” might lead, through adaptive management or adaptation, to long-term success). Coexistence conservation addresses these current short comings with a focus on adopting a long-term, iterative, and adaptive process for learning and refining tactics (Batson et al., 2015; Wilson et al., 2020) (Figure 3).

### 3.5 When is risk too high to use coexistence conservation?

Coexistence conservation will not be possible or desirable in every context. Application, like any conservation intervention, is context specific. As discussed above, risk to the species should always be kept at a level that does not threaten its existence. In some contexts, exposing extremely rare threatened species to invasive predators would be too risky, and full control/eradication/exclusion of invasive predators should remain the goal. For example, the entire population of kākāpō (Strigops habroptilus), a large, flightless, nocturnal parrot formerly common in New Zealand (Savage et al., 2021), consists of only 199 individuals (May 2022, NZ DOC, 2022). Increasing the kākāpō’s population has been a considerable challenge due to its irregular and distinctive breeding patterns and high level of reproductive failure (Elliott et al., 2001; Savage et al., 2021). Exposing this species to predation, with its population size at such critical levels, would obviously be irresponsible. Other examples include the kakī or black stilt (Himantopus novaezelandiae) in New Zealand (Van Heezik et al., 2005), the sihek or Guam kingfisher (Todiramphus cinnamominus) (Trask et al., 2020; Trask et al., 2021), and some small mammals that are extremely susceptible to invasive predators in Australia (Radford et al., 2018). Coexistence conservation is applicable in scenarios where context (e.g., population size, public support, conservation managers’ goals, and logistical constraints) supports a proactive push to reverse the shifting baseline and significantly expand the range and population size of threatened species (e.g., beyond-the-fence within the “pathway to the wild” framework in Australia, Figure 3). This approach should be seen as complementary to current conservation approaches and selected through a decision-making process where an intervention is contextually fit-for-purpose.

### 3.6 Concluding remarks

In conservation science, there are two seemingly intractable issues: (1) the challenge of changing course from the current trajectory of global species loss, which risks
becoming the degraded shifting baseline for the conservation of threatened species, and (2) current efforts to manage threatened species and invasive predators can make the prospect of conservation more difficult to achieve, resulting in the reinforcement of (1). We argue that evolutionary adaptation has a large role to play in achieving successful coexistence. With this in mind, a key principle of coexistence conservation is that predation, rather than the predator, is treated as the threat. However, using evolution to adapt native and invasive species to coexist requires a large shift in mindset from short-term leaps to long-term steps. Without a long-term strategy, we face an inevitable future of the permanent loss of native fauna in the wild. Coexistence conservation will play an important role in pivoting from the current trajectory of biological annihilation to a world where invasive predators and native prey can coexist.

**AUTHOR CONTRIBUTIONS**

Maldwyn J. Evans and Adrian D. Manning led the conceptualization and Maldwyn J. Evans led the writing of the manuscript in which all authors contributed.

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**CONFLICT OF INTEREST**

The authors declare no conflicts of interest.

**DATA AVAILABILITY STATEMENT**

There are no data associated with this manuscript.

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