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Viewpoint:

Are well-intended Buddhist practices an under-appreciated threat to global aquatic biodiversity?

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Abstract

1. The inherently pro-conservation and humane Buddhist practice of 'live release', entailing release into the wild of creatures destined for slaughter, poses potentially significant conservation consequences if inappropriate, invasive species are procured for release.
2. We collate evidence, citing one legal case and other examples, about the risks of live release of potentially invasive aquatic species that may result in serious, possibly irreversible conservation threats to aquatic biodiversity and natural ecosystems with ensuing adverse ecological and human consequences.
3. It is essential that practitioners are aware of these risks if their actions are not to work diametrically against the pro-conservation and humane intents of the practice.
4. Ensuring that live release occurs safely necessitates awareness-raising and guidance informed by science to ensure that good intentions do not result in perverse, environmentally destructive outcomes.

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5. We propose four simple principles to achieve this, for dissemination to the global adherents of these otherwise entirely laudable practices.

Keywords

Live release; mercy release; invasive species; humane; conservation; fish

1. Introduction

Biotic homogenisation – declining biological diversity resulting from environmental changes favouring a subset of species – is a pervasive global problem (McKinney & Lockwood, 1999), reaching substantial levels in some regions of the Palearctic and Nearctic realms (Villéger, Blanchet, Beauchard, Oberdorff, & Brosse, 2011). Scott & Helfman (2001) observed that fish species are prone to biotic homogenisation due to the pressures of habitat destruction, favouring a few tolerant species, as well as purposeful introductions that may also lead to extinctions of native species. Across other taxonomic groups, potentially invasive species introduced beyond their native ranges are a significant factor driving environmental change, extinctions of formerly locally representative species increasing the tendency towards genetic, taxonomic or functional similarity between locations with broader consequences for ecological and evolutionary processes (Olden, Poff, Douglas, Douglas, & Fausch, 2004). Liu, Comte, & Olden (2017) provide a review of life history traits of the world's freshwater fishes as predictors of invasion and extinction risk to support management decisions without needing to refer to individual species ecology to support decisions.

The Buddhist practice of 'live release', also known by many alternative names including 'fang sheng', 'mercy release' and 'prayer animal release', entails the release into the wild of captive animals and particularly those destined for slaughter. The practice is founded on the good intention of protection of living organisms. However, it also represents a potential pathway for introduction of non-native and potentially invasive species, which may have perverse outcomes for the conservation of ecosystems into which they are released. The primary aim of this paper is to provide initial evidence raising awareness of a potential emerging yet poorly researched threat to aquatic conservation. This aim is approached from an ecological perspective, without being critical of the human value dimensions that underpin these otherwise laudable actions.

2. Causes and conservation impacts of alien freshwater fish introductions

Riccardi & Rasmussen (1998) recognise eleven factors predisposing aquatic organisms to becoming invasive (see Table 1). Assessment of the suitability of fish species for aquaculture tends to address factors such as growth rate and hardiness (for example Ali *et al*., 2016), generally omitting consideration of native provenance or potential for invasion of the regions in which the fish are produced. Aquaculture is consequently widely observed to be a source of alien invasive species posing conservation threats to invaded ecosystems, with freshwater fish homogenisation driven by a few widespread

non-native species globally (Toussaint, Beauchard, Oberdorff, Brosse, & Villéger, 2016). Numerous examples range from temperate system non-native salmonid invasions associated with declines of native fishes (Arismendi *et al*., 2009) to widespread tropical invasions by Nile tilapia, *Oreochromis niloticus* (Linnaeus 1758) (Schofield, Peterson, Lowe, Brown-Peterson, & Slack, 2011). Table 1 records the high coherence between species suitability for aquaculture and predisposition to become invasive. Vilà & Hulme (2017) address multiple direct and indirect consequences of biological invasions on ecosystem services, including those of farmed fishes. The ornamental fish trade is also a significant vector for invasive fishes (for example Costa-Pierce, 2003; Gozlan, Britton, Cowx, & Copp, 2010; Raghavan, Prasad, Anvar-Ali, & Pereira, 2008). So too is fish stocking, both legal and illegal, in support of recreational angling (Davis, & Darling, 2017), as well as accident releases such as through bait releases, aquaculture escapes or ballast water transport (Lintermans, 2004; Gupta, & Everard, 2017). Notwithstanding individual species life history traits favouring population establishment, propagule pressure (i.e. the combination of numbers of introduced individuals, the number of introductions and temporal introduction rate) has also been demonstrated to be crucially important and a potentially overriding factor in determining invasion success and impact (Simberloff, 2009).

Table 1: Attributes of aquatic organisms predisposed to become invasive and also suitability for aquaculture

Attributes of aquatic organisms predisposed to become invasive (Riccardi & Rasmussen, 1998)	**Suitability for aquaculture with suggested reason**	**Suitability for aquarist use with suggested reason**
1. Abundant and widely distributed in their original range		
2. Wide environmental tolerance	Hardy in crowded rearing conditions	Hardy in crowded aquarist conditions
3. High genetic variability		
4. Short generation time	Highly fecund with short generation time for rapid production	Easy to breed for ornamental fish trade
5. Rapid growth	Grows rapidly suiting production in aquaculture conditions	Rapid growth for ornamental fish trade
6. Early sexual maturity	Highly fecund with short generation time for rapid production	Rapid growth to maturity and breeding for ornamental fish trade
7. High reproductive capacity	Highly fecund with short generation time for rapid production	Fecund, for rapid production and profitability in aquarist trade
8. Broad diet (opportunistic feeding)	Acceptance of diverse diets in rearing conditions	Acceptance of diverse diets in aquarist conditions
9. Gregariousness	Tolerant of crowded rearing conditions	Tolerant of crowded fish-keeping conditions

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10. Possessing natural mechanisms of rapid dispersal		
11. Commensal with human activity (*e.g.* transport in ship ballast water, or trade of ornamental species for aquarists)	Suited to aquaculture with brood stock readily transported	Suited to aquarist conditions with ready transport for trade

3. The Buddhist practice of 'live release'

The Buddhist practice of 'live release' is founded on good intentions relating to the protection of living organisms. However, perverse outcomes may ensue if uninformed releases of potentially invasive organisms impact native biodiversity.

The release of captive animals for religious purposes has historically been a traditional practice in many religions of Asian origin, including both Buddhism and Taoism, and is especially prevalent in the Buddhist doctrine (Agoramoorthy & Hsu, 2007). Live release, also known as 'mercy release' or Tsethar in the Tibetan tradition, is the Buddhist practice of saving the lives of beings destined for slaughter and is part of all schools of Buddhism: Theravada, Mahayana and Vajrayana. By buying and releasing animals destined to be killed, live release puts the ideal of compassion into practical action, in part as compensation for the inevitable collateral killing of organisms as humans walk, breathe and conduct their lives. Whilst live release may be initiated spontaneously to save an endangered life, it can also be planned in the form of purchasing animals directly from slaughterhouses, fishermen or other sources, frequently planned around auspicious days in the Buddhist calendar to amplify the merit of the act. The Humane Society International (2012), in a report from a conference co-hosted with The American Buddhist Confederation, record that problems stem from the fact that "…mercy release has become an industry built on the capture and supply of wild animals, for whom there are devastating consequences of injury, illness or death".

The ancient origins of this practice may have meant that animals were released into their native environments. However, live release of animals in an increasingly internationalised society has the potential to generate negative environmental impacts. For example, some animals are captured for the explicit purpose of being released, or are released into environments where they are unable to survive (Humane Society International, 2009). A gross example is the bird market in Mong Kok, Hong Kong, a major tourist attraction, where captive-bred budgerigars (*Melopsittacus undulatus*), Java sparrows (*Lonchura oryzivora*) and various finch species are made available for purchase by the pious for freeing under 'fang sheng' ("giving life") rituals that tend to result in the early deaths of organisms not adapted to wild or local conditions (Wordie, 2017). However, a more problematic potential outcome is that live release provides an as yet unquantified pathway for introduction of invasive species into non-native environments, with the potentially perverse outcome of substantial ecological harm including the progressive loss of local biodiversity (Shiu & Stokes, 2008).

Despite the best of intentions, some examples of live releases have been associated with conservation concerns and sometimes legal consequences (Severinghaus & Chi,

1999; Agoramoorthy & Hsu, 2007; Liu, McGarrity, & Li, 2012). As one example, Tsethar practices are arising as a significant concern in Bhutan, an exceptional region for freshwater fish biodiversity, where African Catfish (*Clarias gariepinus*) are imported live from Bangladesh via Kolkata and sold for release by religiously inclined Bhutanese people (Gurung, 2012). Whilst *Clarias gariepinus* is itself of Least Concern on the IUCN Red List (Freyhof, FishBase team RMCA, & Geelhand, 2016), it is also listed as having a wide tropical distribution beyond its native range where it has been listed as a 'Potential Pest' (Froese, & Pauly, 2018) and has been associated with significant ecosystem disruption (for example Cambray, 2003; Weyl, Dagaⅱ, Ellender, & Vitule, 2016). If awareness and education about the ecological consequences of such practices is not provided to local communities, this may serve as a major avenue for the introduction of alien species into the freshwaters of Bhutan (Gurung, Dorji, Tshering, & Wangyal, 2013). In the Yunnan province of China, Jiang, Qin, Wang, Zhao, Shu, *et al*. (2016) concluded that the introduction since 2009 of two species of non-native weatherfishes (*Misgurnus anguillicaudatus* and *Paramisgurnus dabryanus*) through the practice of 'prayer animal release' and their subsequent increasing populations was putting at risk the threatened native freshwater fish *Ptychobarbus chungtienensis* in Shangri-La region. In considering 'Deliberate release for cultural reasons', constituting one of twelve pathways of human-assisted dispersal of freshwater fishes in Australia, Lintermans (2004) noted that the 2001 Census recorded that 1.9% of the Australian population were Buddhists and reported anecdotal evidence suggesting that purchase and release of aquarium species for live release was not uncommon albeit entirely unquantified

Unregulated mercy releases have also resulted in the red-eared slider turtles (*Trachemys scripta elegans*) native to central America, but which are widely invasive (van Dijk, Harding, & Hammerson, 2011) yet readily procured from pet shops in the US, dominating and outcompeting native terrapin species in New York's Central Park (Selleck, 2015). Indicative of the potential scale of the problem, mindful of the large number of ceremonial animal release events occurring globally in accordance with the traditions of Buddhism and other Asian religions, Liu, McGarrity, Bai, Ke, & Li (2013) evaluated the release of two highly invasive species (American bullfrogs *Lithobates catesbeianus* and red-eared slider turtles *Trachemys scripta elegans*) by 123 Buddhist temples surveyed across four provinces in China correlated with intensive field surveys of release sites, finding that both bullfrogs and sliders were present at the majority of sites where release of these species was reported. Given the large numbers of such temples in this region and the pervasion of religious observants across the world, the scale at which live release could potentially be happening is substantial. Gong, Chow, Fong, & Shi (2009) record that China is the largest consumer of turtles in the world serving markets for two main types of local and international trade: for food and traditional Chinese medicine; and for release by Buddhists. Liu *et al*. (2012) tabulate evidence from a search of literature and news reports for the global occurrence of religious wildlife release, though the literature on aquatic species and particularly their impacts are largely addressed in this summary highlighting the scale of the knowledge gap.

West (1997) reports that a small congregation of seven Buddhist adherents led by a monk procured 2,500 goldfish from a storefront temple in New York's Chinatown and transported them for ritual release in Westons Mill Pond, a reservoir for the city of New Brunswick as an act of compassion but which was perceived by scientists and wildlife experts as introducing competition to and potentially outbreeding native species of perch, sunfish, catfish and of aquatic fauna. The same report recorded conservation concerns likely to arise from freeing caged birds that are more likely to die than thrive in their new environments, and that release by Buddhists of turtles into ponds in Brooklyn's Prospect Park and Central Park also had the potential to perturb local aquatic ecosystems directly and through the introduction of diseases as a well as genetic dilution. As a general principle, relevant to some instances of live release but also wider conservation matters, introductions of even conspecific species may perturb ecosystems posing a threat to conservation though genetic homogenisation including the introduction of non-native genes and the loss of local adaption (Champagnon, Elmberg, Guillemain, Gauthier-Clerc, & Lebreton, 2012).

Fish invasions are known to have significant knock-on effects on the conservation of freshwater ecosystems, their functions and associated biota. Whilst not inferring that it was consequent from live release, radical degradation of both aquatic and avian biodiversity has followed the introduction of alien common carp (*Cyprinus carpio*) to Medina and Zoñar Lakes in South Western Spain. Driven by the destruction of submerged macrophyte beds via mechanical disturbance and elevated turbidity, the invasion of *C. carpio* and other non-native fishes throughout the fresh waters of the Mediterranean region is now recognised as a major threat to water birds**,** including globally threatened taxa such as white-headed duck (*Oxyura leucocephala*), listed as Endangered on the IUCN Red List (BirdLife International, 2017) (Maceda-Veiga, López, & Green, 2017). Similarly, tilapia, *Oreochromis* spp. and *C. gariepinus* have invaded and now totally dominate Jal Mahal, the water palace lake in Jaipur (Rajasthan state, India), with knock-on consequences for avian biodiversity, further extending the negative socioeconomic implications for bird-watching based ecotourism (H. Vardhan, pers. com. & author observations). (Invasion of Jal Mahal by *Clarias gariepinus* and *Oreochromis* spp. has yet to feature in the peer-reviewed literature but is well-known locally, observed by the authors and other local biologists, and there are many YouTube.com clips of the two species in vast numbers and also sometimes turning up dead as the lake goes anoxic.)

There is limited case law at present relating to the potential ramifications of live release. However, in the UK, two Buddhists performing a live release ritual were convicted, fined and ordered to pay compensation in September 2017 of offences under the Wildlife and Countryside Act 1981 for releasing non-native lobsters into the sea, potentially causing "untold damage" to marine life (Sherwood, 2017).

4. Conclusions and recommendation

At present, there appears to be little awareness about potential perverse, unintended outcomes from live release practices for aquatic and other wildlife, a lack of quantification of conservation impacts, and consequently no effective, proactive

interventions to avert them. Nor is there a great deal of scientific study to back up management advice. Table 2 documents the outcomes of searches on the University of the West of England's online library resources (dated 20th April 2018) using the filter of 'Scholarly and peer reviewed' sources. Although many pertain to the intent of doing no harm, only a small number of sources relate directly to the problem of unintended alien species invasions affecting aquatic conservation.

Table 2: Searches of the online libraries for 'scholarly and peer reviewed' documents relevant to alien species invasions form live release affecting aquatic nature conservation

Search terms	Number of hits	Number of relevant hits
(live release) AND (buddhist) AND (invasion)	657	3, assessed from top 100 beyond which relevance declined substantially (Agoramoorthy & Hsu, 2007; Shiu & Stokes, 2008; Gong, Chow, Fong, & Shi, 2009; Liu, McGarrity, Bai, Ke, & Li, 2013)
(live release) AND (buddhist) AND (fish)	680	4, assessed from top 100 beyond which relevance declined substantially (Agoramoorthy & Hsu, 2007; Shiu & Stokes, 2008; Gong, Chow, Fong, & Shi, 2009; Liu, McGarrity, Bai, Ke, & Li, 2013)
(live release) AND (buddhist) AND (conservation)	346	5, assessed from top 100 beyond which relevance declined substantially (West, 1997; Agoramoorthy & Hsu, 2007; Shiu & Stokes, 2008; Gong, Chow, Fong, & Shi, 2009; Liu, McGarrity, Bai, Ke, & Li, 2013)

It is not the intent of the authors to denigrate or deter any pro-conservation or pro-environmental intent. The authors have not received any external funding or influence to research and publish this paper, simply acting on their own volition and concern to raise the profile of an emergent and material concern in support of improving the safety and the intended outcome of the practice of live release. However, this analysis of potential and still largely unquantified risks of perverse outcomes for nature conservation and dependent human livelihood needs arising from a traditional practice is highlighted as an issue requiring more research and precautionary action. In particular, we invoke the Precautionary Principle, a strategy to cope with possible risks from human activities that may lead to morally unacceptable harm that is scientifically plausible but uncertain (EC, 2000). The Humane Society International (2012), in collaboration with The American Buddhist Confederation, announced an intention to "…support animal welfare instead of the ritual of releasing animals, such as birds, fish and turtles, into the wild", a useful contribution to modernisation of the inherently virtuous intent to Buddhist practices but falling short of addressing conservation risks and particularly across the wider world.

The Theravada, Mahayana and Vajrayana schools of Buddhism are common in Tibet, Nepal, Mongolia, Inner Mongolia, Tibet, China, Myanmar, Laos, Thailand, Cambodia, Vietnam, Korea, Japan and Sri Lanka, also spreading into adjacent nations and more remotely in pockets. Consequently, although published evidence is lacking, it can be

assumed that ecological risks associated with uninformed live releases are potentially globally pervasive. Further research is needed to establish the level of risk, and so to inform the most appropriate responses.

Liu *et al*. (2013) found that ecological knowledge of invasive species reduced the probability of release at the Chinese temples they were studying, but that conversely market availability increased the probability of release. Targeted public education about invasive species could therefore be an effective strategy for preventing religious release of invasive species on a global scale. Drawing from the eleven attributes of aquatic organisms predisposed to become invasive (Riccardi & Rasmussen, 1998), we therefore recommend that Buddhist adherents undertaking the traditional practice of live release should observe the precautionary considerations in Table 3. This form of precautionary approach is already inherently included in some national legislation relating to import of alien fishes, for example under the UK's *Import of Live Fish (England and Wales) Act 1980* (HM Government, 1980). ILFA (as the Act is known) specifically schedules a number of known problematic invasive fish species, but also applies more generally to all fish species that have the potential to escape and form self-perpetuating populations.

Table 3: Precautionary principles for ecologically safe Buddhist 'live release'

Precautionary principles for ecologically safe 'live release' include that aquatic species should be:
• Native to the geographical range in which they are to be released; • Of local genetic provenance, so as to avoid dilution of locally adapted strains; • Released only in numbers that will not dominate the ecosystems into which they are placed; and • Unlikely to change ecosystem balance, for example by significantly increasing predation or sediment mobilisation.

Chong (2012) calls upon conservationists to recognise the powerful role of religion in Burmese society and to engage its potential in support of sustainable development. Gong, Hamer, Meng, Meng, Feng, & Xue (2012) recognise that Buddhist leaders can play significant roles in environmental protection in Myanmar and potentially other Asian countries, whilst also acknowledging that this may be hampered by lack of ecological understanding citing particularly uninformed practice of 'prayer animal release' and the captive animal trade associated with it. The aim of the paper is to assist conservation and religious organisations and other institutions with influence on live release practitioners and communities to raise awareness and offer practical guidance about the holistic animal welfare issues associated with fang sheng. We recognize the need to assist Buddhist practitioners and their advisers about what constitutes a non-native species, for which we suggest the definition "*A species* introduced by humans – either

intentionally or accidentally – outside of its natural past or present distribution", adapted from a definition provided by IUCN (2018). Science-based professional societies, conservation organisations and NGO networks may also have roles to play in helping disseminate key messages, as the Humane Society International has already demonstrated in its collaboration with The American Buddhist Confederation.

As a significant, as yet unquantified, number of releases of aquatic organisms occur in developing countries where data about biological baselines as well as widespread knowledge of risks to ecology and ecosystem services is lacking, these risks will generally be proportionately under-recognised. In the longer term, further research linked to local capacity building with associated education can shape a more precautionary approach by local communities. However, a more direct route for uptake of these precautionary principles in the interim is their onward communication by influential people and institutions in the global Buddhist community to ensure that practical outcomes are consistent with the pro-conservation and humane intent of live release, averting perverse unintended negative consequences for nature conservation and human livelihoods.

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