

Short Communication**Opinions of North American aquatic invasive species managers about potential Buddhist life release practices**Tim B. Campbell^{1,*}, Evelyn Hammond² and Bret Shaw^{2,3}¹University of Wisconsin Sea Grant Institute, 1975 Willow Drive, Madison, WI 53706, USA²University of Wisconsin Division of Extension Natural Resources Institute, 445 Henry Mall, Madison, WI 53706, USA³University of Wisconsin Department of Life Sciences Communications, 1545 Observatory Dr, Madison, WI 53706, USA

*Corresponding author

E-mail: tim@aqu.wisc.edu

Editors' Note: This is an additional contribution to the Proceedings of the 22nd International Conference on Aquatic Invasive Species held in Oostende, Belgium, April 18–22, 2022 (<https://icaais.org>). This conference has provided a venue for the exchange of information on various aspects of aquatic invasive species since its inception in 1990. The conference continues to provide an opportunity for dialog between academia, industry and environmental regulators.

Citation: Campbell TB, Hammond E, Shaw B (2023) Opinions of North American aquatic invasive species managers about potential Buddhist life release practices. *Management of Biological Invasions* 14(2): 289–299, <https://doi.org/10.3391/mbi.2023.14.2.07>

Received: 24 August 2022**Accepted:** 6 November 2022**Published:** 6 February 2023**Thematic editor:** Mattias Johansson**Copyright:** © Campbell et al.This is an open access article distributed under terms of the Creative Commons Attribution License ([Attribution 4.0 International - CC BY 4.0](https://creativecommons.org/licenses/by/4.0/)).**OPEN ACCESS****Abstract**

The Buddhist practice of life release is a known pathway of invasive species within the United States. However, there are no established outreach programs designed to address this pathway within the US. To facilitate the process of creating an outreach program, we surveyed members of the regional panels on aquatic nuisance species to determine their opinions on a series of potential life release practices that could both meet the cultural need of the practice and reduce invasion risk. Aquatic invasive species managers generally agreed that some practices were acceptable, including working with a wildlife rehabilitation center to release recovered wildlife and working with a wild bait harvester to release bait into the waterbody from which it was harvested. We hope that by identifying various life release practices and the associated opinions about these practices, aquatic invasive species managers can facilitate low risk methods of practicing life release.

Key words: mercy release, invasion pathways, religious release, ceremonial release, community engagement, outreach

Introduction

The Buddhist practice of life release consists of freeing an animal from captivity into the environment to live out the rest of its natural life (Zangpo 2005). Unfortunately, many animals that are part of ceremonies live shortened lives and the practice is a cause of animal suffering (Awoyemi et al. 2012). In instances they do survive, these released organisms can become invasive. The practice is a known pathway of invasive species globally (Magellan 2019), and it does occur in the United States (Campbell et al. 2021), with verified introductions being documented (Liu et al. 2012; Nico et al. 2019; USGS 2022). While some recommendations on interventions to reduce risk through this pathway exist within the literature (Awoyemi et al. 2012; Liu et al. 2013; Wasserman et al. 2019), apart from a pilot effort in New York (email from Cathy McGlynn, New York DEC, *pers. comm.*, July

2022), there are no known outreach programs affiliated with invasive species management programs that exist to work with practitioners to reduce the invasion risk of this pathway.

Interviews of practitioners of life release in the United States revealed potential lower risk means of practicing life release. These potential practices include releasing fish intended for stocking, working with animal rehabilitation centers, and partnering with organizations restoring populations of rare, threatened, or endangered species. Life release practitioners also indicated that they would be willing to speak to and work with natural resource professionals to develop low risk methods of practice, especially with the knowledge that the activity is likely illegal (Campbell et al. 2021).

Constructive collaboration between practitioners of life release and natural resource professionals is a logical next step to ensuring what both groups would like to avoid, which is the inadvertent introduction of a new invasive species that harms local ecosystems (Magellan 2019). Since natural resource professionals are likely to be the people permitting or approving any means of practicing life release, understanding the range of practices they are comfortable with could help develop broad recommendations on low risk practices that could work across the United States and Canada while also influencing the practice globally. To do this, we administered a survey of life release scenarios to natural resource professionals. The survey sought to determine natural resource professionals' opinions about a range of potential practices that could mitigate environmental risk while demonstrating cultural sensitivity about the practices of people who reside in their service areas.

Materials and methods

We developed a questionnaire that collected information about what type of work the respondent does, what agency they work for, and what jurisdiction they represent. We then asked a series of questions about the acceptability of a range of potential means of practicing life release that varied in invasion risk. Additionally, we provided three life release situations for which respondents categorized risk and their comfort level with the activity occurring in their jurisdiction. These examples and scenarios were either suggestions from life release practitioners (Campbell et al. 2021) or scenarios that we believed met the needs of the practice based on conversations with life release practitioners. Respondents were asked about how acceptable they found these activities, what they believed the invasion risk to be, and if they were comfortable with these activities occurring in their jurisdiction. At the end of the survey, an open-ended question was used to allow respondents to provide their own suggestions on how life release could be practiced in a lower risk manner. Select quotes from the open-ended responses are used to support interpretation of the

results in the discussion section. The survey instrument was reviewed by state aquatic invasive species (AIS) coordinators, AIS outreach specialists, and researchers before being fielded. Their feedback was used to clarify the survey instrument, which is available in Supplementary material Appendix 1.

We gathered contact information for potential survey participants from membership lists of five of the six regional aquatic nuisance species panels that help coordinate AIS activities across the U.S. and are part of the Aquatic Nuisance Species Task Force (ANS Task Force). The regional aquatic nuisance species panels foster collaboration across states to best meet regional priorities. Members consist of state, provincial, and federal agencies; tribes; non-governmental organizations; and commercial interests. The regional ANS panels also include international partners where appropriate. The regional aquatic nuisance species panels also make recommendations to the ANS Task Force, whose purpose is to develop and implement a program for U.S. waters to prevent introduction and dispersal of aquatic invasive species; to monitor, control, and study such species; and to disseminate related information. We chose this population as our target audience because it likely contains the staff in each state that would be developing or approving policy or conducting programming regarding prevention and outreach for this potential invasive species pathway. Members and alternates were included in the participant list. Since panel membership can overlap across states, all of the memberships were combined into a single list and duplicates removed. This resulted in a list of 183 regional panel members and alternates covering five of the regional panels. Although we were unable to directly obtain contact information for one regional panel, we were able to distribute the survey through their membership email.

We administered the survey via Qualtrics using an approach based on the Dillman Method (Monroe and Adams 2012). An initial email was sent to potential participants to inform them that they will be receiving the survey. Four days later, potential participants received an email with a link to the survey. Non-respondents were reminded about the survey one and two weeks after the original email. Initial data collection closed three weeks after the original email. We then sent emails with a link directly to the survey to AIS state representatives for states that were not represented in the initial data collection period. Those potential participants were reminded one week after their original email, and the data collection period for the project was closed another week later. For the regional panel that was unable to provide us with contact information for their members and alternates, a link to the survey was sent out twice to their membership during the initial data collection period. Responses that were more than 50% completed were included in the analysis.

This work was performed under University of Wisconsin Madison Institutional Review Board Protocol ID #2020-0162.

Survey Responses

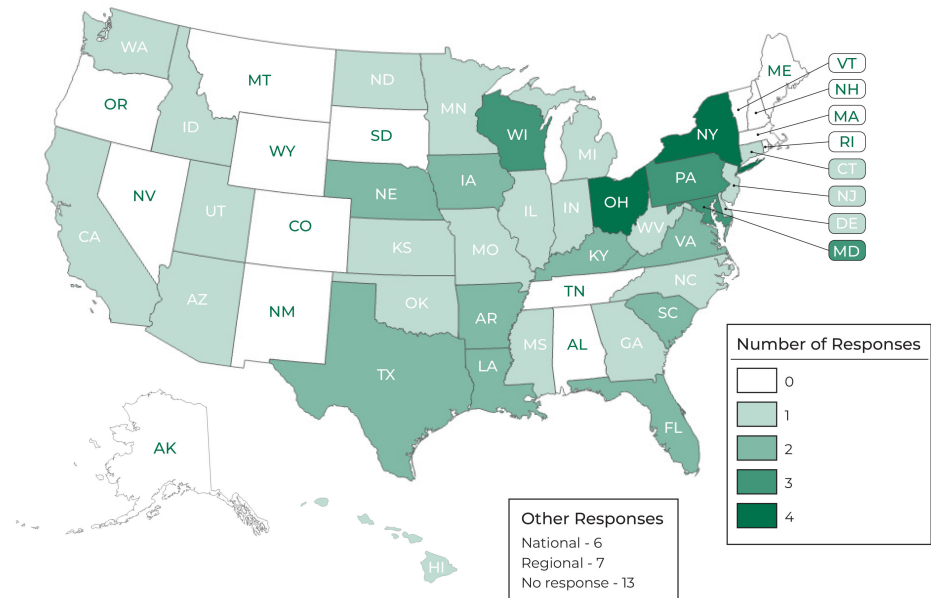


Figure 1. Aquatic invasive species professionals from across the country completed the survey. Western and northeastern states had fewer responses, likely due to a combination of factors including job vacancies and a difference in how the survey was administered to western states.

Results

A total of 82 AIS professionals responded to our survey. 50 people responded to links to the survey sent directly to them through the automated Qualtrics system while 32 people filled out the survey through the direct link sent to them individually by the researchers. Twenty-four of those respondents were sent the anonymous link directly to fill gaps in the geographic coverage of respondents following our initial fielding, while the other eight were responses gained through the emails to the one regional ANS panel for which we did not have individual contact information.

For the five regional panels for which we had personal contact information, the survey response rate was 40%. For the one panel where the survey was distributed through its email distribution list, the response rate is estimated to be 13% based on the number of members listed on their website ($n = 61$). We believe that this low response rate is due to the fact that the survey was sent as a general email to the group as opposed to repeated personalized emails.

Thirty-five out of 50 states had at least one respondent (Figure 1), with some Canadian provinces also represented. Forty-eight percent of the respondents were part of state government, while 20% were affiliated with a university, and 18% the federal government. The remaining 8% of respondents were from local governments, nongovernmental organizations, interstate agencies, and local government. Six percent of respondents did not indicate an employer but completed other parts of the survey. Most of the respondents (63%) performed program management work, while 38%

Table 1. The percentages of respondents that self-selected their employer categories and the type of work. Respondents were only allowed to select one employer category and they were allowed to select multiple types of work.

Employer Categories	Percentage of Respondents (n)
Federal Government	18% (15)
State Government	48% (39)
Local Government	1% (1)
University, Extension, Sea Grant	20% (16)
Nongovernmental Organization	2% (2)
Other	5% (4)
Did not answer	6% (5)
Type of work	Percentage of Respondents (n)
Program management	63% (52)
Research	35% (29)
Education and outreach	38% (31)
Law enforcement	2% (2)
Regulation development	12% (10)
Other	12% (10)

performed outreach, 35% did research, and 12% developed regulations. Only two respondents worked in law enforcement, and 10% performed other regulatory responsibilities related to AIS management like monitoring or permitting (Table 1). Respondents selected all classifications that applied to them. Sixty percent of respondents only selected one job classification, while 16% selected two and 21% three. 1% and 2% of respondents selected four or five duties.

When classifying potential life release practices (Table 2), we found that partnering with a wildlife rehabilitation center to release wildlife, releasing wild baitfish back into the waterbody they were harvested from, and releasing fish intended for stocking to be most acceptable among AIS professionals surveyed. One other activity—releasing wild caught seafood into the body of water from which it was harvested—had a slight majority of respondents say this was acceptable, but nearly as many needed more information or found it unacceptable. For the other potential practices, a majority of respondents either needed more information or found it to be unacceptable. The most unacceptable practice was purchasing a fish from a live food market and releasing it without natural resource manager assistance – no one found it acceptable, while 82% of respondents found it unacceptable, and 18% needed more information. Respondents were asked if it made a difference whether a natural resources professional was present during the life release or not. Generally, professional assistance made all activities slightly more acceptable and reduced the number of respondents that needed more information. However, professional assistance did not change the general patterns of what a majority of respondents found acceptable.

When classifying more specific scenarios (Table 3), 91% of respondents believed working with a wild bait harvester with an approved hazard analysis and critical control plan to release bait into the body of water from which it was harvested to be a low risk activity. A slightly lower percentage

Table 2. A summary of how respondents rated the acceptability of variations of the practice of life release that practitioners and natural resource managers believed met the need of practice.

Categorize these practices in terms of acceptable, unacceptable, and need more information. Assume these are all done by practitioners on their own without the help of a natural resource professional that can minimize risk.	Acceptable	Need more information	Unacceptable
Releasing wild caught baitfish back into the waterbody it was harvested from (n = 67)	75% (50)	15% (10)	10% (7)
Partnering with a wildlife rehabilitation center to release wildlife (n = 66)	71% (47)	23% (15)	6% (4)
Purchasing seafood from a commercial angler and releasing it into the body of water it was harvest from (n = 66)	38% (25)	27% (18)	35% (23)
Releasing fish intended for stocking (n = 67)	25% (17)	40% (27)	34% (23)
Purchasing and releasing earthworms from a bait shop (n = 67)	15% (10)	36% (24)	49% (33)
Releasing crickets from a pet store (n = 65)	15% (10)	42% (27)	43% (28)
Releasing farm-raised channel catfish intended for food consumption into a natural waterbody (n = 67)	7% (5)	30% (20)	63% (42)
Releasing farm-raised baitfish into a local waterbody (n = 64)	6% (4)	25% (16)	69% (44)
Purchasing a fish from a live food market and releasing it (n = 67)	0% (0)	18% (12)	82% (55)
Categorize these practices in terms of acceptable, unacceptable, and need more information. Assume these are all done by practitioners on their own with the help of a natural resource professional that can minimize risk and can help obtain any relevant permits.	Acceptable	Need more information	Unacceptable
Releasing wild caught baitfish back into the waterbody it was harvested from (n = 64)	84% (54)	8% (5)	8% (5)
Partnering with a wildlife rehabilitation center to release wildlife	85% (54)	13% (8)	2% (1)
Releasing fish intended for stocking (n = 63)	79% (50)	13% (8)	8% (5)
Purchasing seafood from a commercial angler and releasing it into the body of water it was harvest from (n = 63)	52% (33)	29% (18)	19% (12)
Releasing farm-raised baitfish into a local waterbody (n = 60)	32% (19)	27% (16)	42% (25)
Releasing farm-raised channel catfish intended for food consumption into a natural waterbody (n = 63)	30% (19)	30% (19)	40% (25)
Purchasing and releasing earthworms from a bait shop (n = 62)	23% (14)	35% (22)	42% (26)
Releasing crickets from a pet store (n = 63)	22% (14)	37% (23)	41% (26)
Purchasing a fish from a live food market and releasing it (n = 63)	19% (12)	27% (17)	54% (34)

of respondents (80%) were either extremely or somewhat comfortable with this activity occurring in their jurisdiction. A scenario involving releasing oysters from an aquaculture operation was also believed to be low risk, with 88% of respondents indicating this practice was low risk and 73% of respondents either extremely or somewhat comfortable with this practice happening in their jurisdiction. Fifty-one percent of respondents thought a scenario involving hatchery rainbow trout was low risk and 49% were either extremely or somewhat comfortable with this happening in their jurisdiction.

Discussion

The results of this survey serve as a starting point for natural resource managers when working with communities that practice life release. This collaborative approach to reducing the risk of life release has been promoted by the Society of Conservation Biology (Awoyemi et al. 2016). With these options already partially vetted, managers may find it easier to work with communities that want to practice life release and who may conduct the practice with or without collaboration with natural resource professionals. Even if these options are not ultimately what are used by communities, they provide some ideas that can be tailored to fit what would work best in specific areas.

Table 3. How natural resource managers classified the invasion risk and their comfort with three different life release scenarios. An explanation of each scenario using language from the questionnaire is below the table.

What do you believe the invasion risk is for this activity?	Wild Bait Release (n = 60)	Oyster Restoration (n = 61)	Hatchery Trout Release (n = 60)
High risk	0% (0)	2% (1)	7% (4)
Moderate risk	8% (5)	5% (3)	36% (22)
Low risk	92% (55)	86% (53)	50% (30)
Unsure	0% (0)	7% (4)	7% (4)
How comfortable would you be with this or a similar activity happening in your jurisdiction?	Wild Bait Release (n = 60)	Oyster Restoration (n = 59)	Hatchery Trout Release (n = 60)
Extremely comfortable	32% (19)	36% (21)	17% (10)
Somewhat comfortable	46% (28)	39% (23)	28% (17)
Neither comfortable nor uncomfortable	7% (4)	10% (6)	13% (8)
Somewhat uncomfortable	13% (8)	3% (2)	20% (12)
Extremely uncomfortable	2% (1)	3% (2)	10% (6)
Unsure	0% (0)	9% (5)	12% (7)

Wild bait release – A wild bait harvester that has an AIS HACCP (Hazard Analysis Critical Control Point) plan harvests a single species of bait. Before it leaves the site of capture, a Buddhist group purchases the bait fish and releases them back into the body of water they were captured. If you are unfamiliar with HACCP, you can find more information here: <http://www.seagrant.umn.edu/ais/haccp>.

Oyster restoration – The same aquaculture operation that provides juvenile oysters to oyster farms to raise for consumption also provides organizations working to restore natural oyster reefs oysters that they then release onto reefs for restoration purposes. The oyster releases for restoration are permitted activities. A Buddhist group wants to purchase oysters from the aquaculture operation and release them onto a reef with the help of the restoration group.

Hatchery trout release – Hatchery raised rainbow trout are being stocked into a put-and-take stream system. A Buddhist group wants to take a small number of those fish and release them in a part of the system that is not near the main release site and before the scheduled release in order to give them a better chance of living their natural life.

To our knowledge, the potential methods of practicing life release mentioned in this paper have not been tried with communities in the United States at any sort of scale. They have been only the subject of conversation between practitioners (Campbell et al. 2021) and the managers surveyed in the research reported in this study. Future efforts should attempt to consider some of these options so that when a community or practitioner wants to practice life release, an easily recommendable and actionable option exists. Ideally, this will be done with both natural resource managers and life release practitioners working together to develop a program. A respondent to the survey noted:

They need to work with the state natural wildlife agencies or others trained in AIS and ecology. I have no problem with this activity if it is done safely. I think there is ample room for compromise here and in the scheme of things it is not a “hard” problem. Just takes some time and clarity of purpose and process.

Past research suggests that understanding cultural beliefs can help inform more effective programming to promote conservation outcomes (Baker et al. 2014). Future efforts could survey more managers at a more local scale to see how they feel about these potential practices since our survey sample consisted of high-level state, regional, and federal managers. Local managers may also have additional ideas for low risk ways to practice life release that are specific to the areas in which they work.

We believe some of the variation in risk and acceptability rates might be explained by job classifications. For example, more respondents that had law enforcement or regulation development job duties considered some low risk potential life release practices to be unacceptable. This could be because these practices likely involve the release of live animals without a permit and would be against the law. As several noted in their open-ended comments at the end of the survey: the answers to some of the questions were influenced by our laws/regs.

With regards to assessments of acceptable/unacceptable, my responses are with regards to the regulations and what is allowed.

I will always defer to adherence with local laws.

However, if these activities meet the needs of the life release practice and are determined to have a low invasion risk, there could be an opportunity for permitting specific activities or providing species guidelines for this practice that could influence an activity that is likely hard to enforce from a practical standpoint.

Program managers tended to be most sure of their choices, perhaps due to their overall understanding of different parts of AIS programs. They also had more of a gap between risk and acceptance of behaviors potentially because they could be more comfortable making these tradeoffs in their management role. Outreach and education staff thought more activities were acceptable, perhaps because they believe they have an understanding of how these things could be done in a low risk manner through engagement with their communities. Researchers tended to find fewer activities acceptable even if they were believed to be low risk perhaps due to the belief that no risk of invasive species is acceptable. As two researchers responded:

If there is one thing we have learned from introductions it is that they are entirely unpredictable. The only safe standard is NO introductions.

I'm not sure there is a scenario in which it would be acceptable to release certain species, or individuals (disease risk).

Unfortunately, for most classifications we did not have a large number of respondents, which is likely a function of our sample of regional ANS panel members. The job duties of regional ANS panel members are diverse and some members may not believe that life release is enough of a part of their duties to respond. Additional effort to survey these classifications would be needed to explore this further.

Many respondents in our survey indicated that they needed more information to accurately assess how acceptable certain practices might be. This likely means that respondents just aren't familiar with some of these

practices and want to know more before they make any decisions. The details associated with these general potential practices could be important and impact the invasion risk associated with the activities. This could also suggest that options are location specific and what works in one place might not work in another. For example, we thought that it would be possible to modify rainbow trout releases to meet the needs of the life release practice due to the ubiquity of rainbow trout stocking programs across the United States. While that still could be the case, there was a group of respondents that indicated this would be of moderate risk. This could be because rainbow trout themselves can be invasive in areas and can negatively impact native trout species, so they believed this to have too high of a risk. Using a local, native trout species might alleviate these concerns, but these stocking programs differ enough across management jurisdictions that it would be difficult to suggest a standardized national approach for this option.

A better understanding of the distribution and locations of people that practice life release would be useful moving forward. While one report estimates people that identify as Buddhist are less than 1% of the population in any state (Pew Research Center 2014), survey methodology issues could be underestimating the number. However, since the practice can be just as much cultural as religious, working in culturally diverse areas will increase the probability of finding practitioners interested in partnering with AIS managers on methods of live release with low invasion risk.

While these results provide AIS managers with a starting point for how to help practitioners perform life release in lower risk ways, listening to the needs of the community will likely lead to better long-term success (Baker et al. 2014). As one respondent noted:

Wildlife rehabilitation I think is the best answer from a conservation standpoint but I think whether that is a good alternative should come from the community of practitioners.

If practitioners select their own low risk practices, finding a way to make those practices work could help them better retain those methods of practice. Engaging professionals from across job types can help generate new ideas on how the practice could occur while also better highlighting potential risks. Life release practitioners have indicated they are generally open to modifying their behaviors if it reduces the chance of harming the environment (Campbell et al. 2021). With this willingness to collaborate, there are likely ways to honor the spirit of this practice that minimizes invasion risk and potential environmental harm. This study provides a list of template practices with associated opinions from natural resource managers that can be used to guide practitioners towards lower risk and accepted practices for life release that can meet the needs of both communities. As noted by one respondent to our survey:

I am an invasive species biologist and a Buddhist. I have not taken part in life release ceremonies, but I do appreciate the sentiment. I am grateful that guidance is being developed to support an ecologically literate practice of this ritual.

Acknowledgements

Thank you to the Mississippi River Basin Panel on Aquatic Nuisance Species, who supported this work through a grant to the authors. Additional thanks to the regional ANS panels for participating in this work and to the anonymous reviewers whose comments improved this manuscript. Lastly, a big thanks to fellow Wisconsin Sea Grant staff, Elizabeth White and Scott McComb, who edited and helped develop figures for the manuscript.

Authors' contribution

Research conceptualization, investigation and data collection, funding provision – TC and BS; sample design and methodology, data analysis and interpretation, ethics approval, roles/writing – original draft; writing – review and editing – TC, EH and BS.

Ethics and Permits

This work was performed under University of Wisconsin Madison Institutional Review Board Protocol ID #2020-0162.

References

- Baker LR, Olubode OS, Tanimola AA (2014) Role of local culture, religion, and human attitudes in the conservation of sacred populations of a threatened 'pest' species. *Biodiversity Conservation* 23: 1895–1909, <https://doi.org/10.1007/s10531-014-0694-6>
- Campbell T, Shaw B, Hammond E, Bao L, Yang S, Jurich P, Fox S (2021) Qualitative interviews of practitioners of Buddhist life release rituals residing in the United States: implications for reducing invasion risk. *Management of Biological Invasions* 12: 178–192, <https://doi.org/10.3391/mbi.2021.12.1.12>
- Liu X, McGarrity ME, Li Y (2012) The influence of traditional Buddhist wildlife release on biological invasions. *Conservation Letters* 5: 107–114, <https://doi.org/10.1111/j.1755-263X.2011.00215.x>
- Liu X, McGarrity ME, Bai C, Ke Z, Li Y (2013) Ecological knowledge reduces religious release of invasive species. *Ecosphere* 4: 1–12, <https://doi.org/10.1890/ES12-00368.1>
- Magellan K (2019) Prayer animal release: An understudied pathway for introduction of invasive aquatic species. *Aquatic Ecosystem Health & Management* 22: 452–461, <https://doi.org/10.1080/14634988.2019.1691433>
- Monroe MC, Adams DC (2012) Increasing response rates to web-based surveys. *Journal of Extension* 50(6): 6–7
- Nico LG, Ropick AJ, Killian JV, Harper M (2019) Asian swamp eels in North America linked to the live-food trade and prayer-release rituals. *Aquatic Invasions* 14: 775–814, <https://doi.org/10.3391/ai.2019.14.4.14>
- Wasserman RJ, Dick JT, Welch RJ, Dalu T, Magellan K (2019) Site and species selection for religious release of non-native fauna. *Conservation Biology* 33: 969–971, <https://doi.org/10.1111/cobi.13250>
- Zangpo S (2005) *Releasing Life: An Ancient Buddhist Practice in the Modern World*. The Corporate Body of the Buddha Educational Foundation. Taiwan, 127 pp

Web sites and online databases

- Awoyemi SM, Schaefer J, Baugh T, Chong KY, Gosler A, Landen E (2012) Society for Conservation Biology, "Religion and Conservation Research Collaborative (RCRC) of the Religion and Conservation Magellan / Aquatic Ecosystem Health and Management 22 (2019) 452–461 459 Biology Working Group (RCBWG) Society for Conservation Biology (SCB), Position on the Religious Practice of Releasing Captive Wildlife for Merit", <https://conbio.org/policy/prayer-animalrelease-can-embody-conservation-principles-a-call-to-action>
- Awoyemi SM, Kraus F, Li Y, Magellan K, Schaefer J (2016) Society for Conservation Biology, "Religion and Conservation Research Collaborative (RCRC) of the Religion and Conservation Biology Working Group (RCBWG) Society for Conservation Biology (SCB), Prayer Animal Release Can Embody Conservation Principles: A Call to Action",

- <https://conbio.org/policy/prayer-animal-release-can-embody-conservation-principles-a-call-to-action> (accessed 15 December 2018).
- Pew Research Center (2014) Religious Landscape Study: Buddhists <https://www.pewresearch.org/religion/religious-landscape-study/religious-tradition/buddhist/> (accessed 31 October 2022)
- USGS (2022) United States Geological Survey. Nonindigenous Aquatic Species database. <https://nas.er.usgs.gov/graphs/All.aspx> (accessed 7 July 2022)

Supplementary material

The following supplementary material is available for this article:

Appendix 1. Life Release Manager Survey Instrument.

This material is available as part of online article from:

http://www.reabic.net/journals/mbi/2023/Supplements/MBI_2023_Campbell_etal_SupplementaryMaterial.pdf