

Understanding Stakeholders' Opinions and Preferences for Non-native Pet Trade Management in Florida

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Abstract

There is growing recognition of the link between the non-native pet trade and the introduction and establishment of invasive species due to the release and escape of non-native pets. However, it is unclear whether participants in the pet trade recognize the magnitude of this invasion risk. Successful mitigation of the pet trade invasion risk requires stakeholder support for, and participation in, regulations. We conducted 29 interviews in Florida to investigate key stakeholders' opinions about the pet trade invasion risk and the effectiveness of potential regulations to mitigate this risk. Respondents framed the effectiveness of regulations in terms of their feasibility. Respondents also identified lack of trust and the existence of an adversarial

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relationship among stakeholder groups as major barriers to managing the pet trade invasion risk.

Compliance with regulations may be improved if policymakers and managers utilize participatory decision-making to engage stakeholders in management of this risk.

Keywords: invasive species, regulations, trust, qualitative analysis, reptiles, amphibians, ecological impacts, economic impacts, human welfare risks

Introduction

Non-native, invasive species (hereafter, 'invasive species') are a major threat whose introductions cause, or are likely to cause, ecological, economic, and/or human health and safety harm (Beck et al., 2008). Within the natural sciences literature, there is increasing recognition of links among the trade in live animals (in particular, the pet trade), the establishment of invasive species, and global biodiversity loss (Krysko et al., 2016; Romagosa, Guyer, & Wooten, 2009; Townsend, Krysko, & Enge, 2003). The invasion risk associated with the pet trade is attributable to: (a) the deliberate release of unwanted pets by individual owners (Hardin, 2007; Krysko, Enge, Donlan, Seitz, & Golden, 2007; Townsend et al., 2003), (b) the deliberate release of animals by importers and commercial sellers (Hardin, 2007; Townsend et al., 2003), (c) accidental escapes from pet owners and sellers (Bilger, 2009; Hardin, 2007; Townsend et al., 2003); and (d) a lack of appropriate and effective pet trade regulations (Witmer, Keirn, Hawley, Martin, & Reaser, 2009).

In the United States, species that are largely unregulated (e.g., reptiles, amphibians) are traded in high volumes (Romagosa, 2014). Between 2001 and 2009, a total of 1,800 reptile and amphibian species, accounting for over 182 million live animals, were traded in the United States

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(Herrel & van der Meijden, 2014; Prestridge, Fitzgerald, & Hibbitts, 2011), in large part to supply the pet trade industry (Townsend et al., 2003). Four of the most frequently traded reptiles and three of the most commonly traded amphibians in the United States are invasive (Herrel & van der Meijden, 2014). The trade in non-native herpetofauna to supply the pet industry poses a considerable invasion risk.

Florida is particularly susceptible to the pet trade invasion risk because it is one of the main states through which the commercial trade in live animals flows (Engeman, Jacobson, Avery, & Meshaka, 2011). The subtropical climate of south Florida resembles the home range climate of many invasive species, which increases the probability that introduced non-native species will survive. As a result, Florida is currently host to the greatest number of established, non-native herpetofauna in the world (Kraus, 2009).

To mitigate the pet trade invasion risk in this state, the Florida Fish and Wildlife Conservation Commission (FWC) – the state agency responsible for managing wildlife in Florida – has established a Conditional Non-Native Species List and the Exotic Pet Amnesty Program. Individuals may not possess species on the Conditional Non-Native Species list (e.g., Burmese pythons) as personal pets. The objective of this list is to prevent ownership of species that pose a high invasion risk as pets. By contrast, the Exotic Pet Amnesty Program is intended to educate Florida residents about the pet trade invasion risk and to prevent pet owners releasing non-native animals into Florida's ecosystems. As part of this larger program, the FWC periodically hosts Exotic Pet Amnesty Days at various locations in the state during which pet owners may surrender their pets to approved adopters with no penalty.

Although both of these management interventions help to address the pet trade invasion risk in Florida, they do not target all pathways by which pet trade invasions occur. Ecologists

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have suggested additional management actions, which may prevent further introductions of non-native species; prevent species invasions through early detection, rapid response, and eradication (Simberloff et al., 2013); and manage introduced species in Florida (Table 1). These interventions include: (a) allowing trade in species that pose the smallest invasion risks (Keller, Lodge, & Finnoff, 2007; Springborn, Romagosa, & Keller, 2011; Springborn et al., 2015); (b) mandatory point-of-sale information, required training for pet owners, and 72-hour waiting periods to allow people to reconsider the purchase of non-native pets; (c) microchipping of all non-native pets that pose invasion risks combined with fines for pet owners who deliberately release pets or fail to report escaped pets (Perry & Farmer, 2011); (d) seller registration of all non-native animals sold; and (e) euthanization or the capture and resale of non-native species to remove these animals from the environment.

Table 1: Potential Management Actions to Prevent the Pet Trade Invasion Risk

Invasion Pathway	Management Action
Restrict trade in non-native animals with high invasion potential	Approved list (whitelist) of species for personal possession as pets
Impulse purchases of non-native animals by individuals who may release these animals	Point-of-sale information Mandatory training prior to purchase of a pet 72-hour waiting period prior to taking pet home
Deliberate release of non-native animals by pet owners	Require pet owners to microchip and register their pets Require pet sellers to record the sale of all pets, and who purchased the animal
Establishment of non-native animals	Capture and re-sale of wild-caught non-native animals Euthanasia of all wild-caught non-native animals

The effectiveness of current and potential management interventions to mitigate pet trade invasion risks in Florida depends on the support and participation of all relevant stakeholders, including pet owners, sellers and breeders, and members of the public (Bremner & Park, 2007; Frame, Gunton, & Day, 2004; Reed, 2008; Seymour, 2013; Stokes, Montgomery, Dick, Maggs,

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& McDonald, 2006; Witmer et al., 2009). Support for both regulatory and individual actions to mitigate invasion risks may be lacking because individuals are unaware of invasive species impacts (Sharp, Larson, & Green, 2011; Witmer et al., 2009), do not perceive actions to mitigate invasion risks as being effective (Selge, Fischer, & van der Wal, 2011), or lack trust in conservation authorities and/or other key stakeholders (Genovesi, 2008). Failure to comprehend the efficacy of management interventions coupled with low levels of political and institutional trust may further undermine support for, and compliance with, interventions, and may also result in conflicts among key stakeholders in invasive species management (Estévez, Anderson, Pizarro, & Burgman, 2015; Genovesi, 2008; Mackenzie & Larson, 2010; Stern, 2008). Participatory management and transparent decision-making processes may facilitate trust among stakeholders (Frame et al., 2004; Mackenzie & Larson, 2010; Stern, 2008). Education may also increase support for management and collaboration across stakeholders (Larson et al., 2011), and a mix of education and regulations can be critical in managing invasion risks (Teillac-Deschamps et al., 2009).

To understand different stakeholders' support and opposition toward current and potential interventions for managing invasion risks associated with the pet trade in Florida, we conducted interviews with key stakeholders in 2017. These interviews focused on their knowledge of and attitudes toward the non-native pet trade, understanding of links between the pet trade and invasive species, opinions of current and potential management actions, and opinions about who should be responsible for managing non-native and invasive species.

Methods

Data Collection

We used qualitative research methods to obtain an understanding of stakeholders' opinions and experiences related to the pet trade invasion risk. From March to August 2017, we conducted 29 semi-structured interviews, either over the telephone or in person, with stakeholders in Florida's non-native pet trade, namely: (a) non-native pet owners or enthusiasts, (b) non-native pet sellers and breeders, (c) private trappers, (d) scientists or government agents with an invasion ecology background, and (e) conservation organizations. Multiple research participants belonged to more than one stakeholder group (e.g., some individuals were breeders, sellers, and pet owners). We recruited initial respondents from FWC's Exotic Pet Amnesty Day approved adopter list, which was obtained in accordance with Chapter 119 of the Florida Statutes and the Florida Sunshine Law. We randomly selected individuals from this list to participate in the study. We also recruited initial respondents from the following sources: (a) attendees at herpetological conferences, (b) vendors at non-native pet conventions, and (c) online searches of herpetological societies. We sent an initial e-mail and two follow-up emails inviting people to participate in this study. We used snowball sampling to recruit additional research participants. We continued data collection until we obtained no additional referrals and invited research participants failed to respond to invitations to participate in the study.

To minimize potential bias, we pre-tested our questions with five ecological and human dimensions experts. This included cognitive testing (Alaimo, Olson, & Frongillo, 1999; Dillman, Smyth, & Christian, 2014), during which respondents were invited to read the interview questions and provide unprompted and prompted feedback on the questions. We did this to

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ensure that questions were ecologically accurate and structured appropriately to invite open-ended discussions that did not encourage specific responses.

Interview Questions

We asked respondents knowledge-based questions pertaining to Florida non-native and invasive species. We also elicited respondents' opinions about: (a) whether the non-native pet trade contributes to the introduction of non-native species into Florida, (b) how and why these introductions occur, and (c) who they think is responsible for managing non-native species and the non-native pet trade in Florida. We asked each respondent their opinion about the effectiveness of current management actions to mitigate the pet trade invasion risk. If individuals were unaware of the Conditional Species List or the Pet Amnesty Program, we recorded that information and then gave them a brief summary of these management actions before asking how effective they consider the actions to be. We also asked respondents their opinions about the potential management actions listed in Table 1. Prior to asking about these specific actions, we asked respondents if they had any recommendations on additional actions for mitigating the pet trade invasion risk. Given the number of initial respondents who discussed education and the media portrayal of the non-native pet trade during their interviews, we added questions about these topics to the interviews.

Data Analysis

We used open coding to analyze the data (Strauss & Corbin, 1994). During the initial stages of coding, multiple codes were identified to capture as many ideas and topics as possible. We then reviewed and refined the codes (Berg, 2001). Codes that shared a commonality were grouped into categories (Graneheim & Lundman, 2004), after which the underlying meanings of multiple categories were linked together into overall themes. Two individuals analyzed the data

independently and discussed their findings to ensure there were no key differences between the coders in terms of how they generated themes. We transcribed the 29 recorded interviews for a total of 22 hours and 42 minutes of interview time. Interviews ranged from 24 minutes to two hours in duration, and averaged 47 minutes.

Results

Four main themes emerged from these semi-structured interviews: (a) lack of awareness about the economic and human welfare impacts of species invasions, (b) assigning responsibility for the pet trade invasion risk to a single pathway of introduction, (c) framing the effectiveness of management interventions in terms of their feasibility, and (d) lack of trust between and within stakeholder groups. We note that both our small sample size and the fact that research participants belonged to multiple stakeholder groups prevented comparisons across stakeholder groups regarding opinions about the pet trade invasion risk and support for management actions.

Theme 1: Lack of Awareness about Economic and Human Welfare Impacts of Species Invasions

The majority of respondents ($n = 24$) only identified the negative ecological impacts of invasive species. These individuals were unaware of the fact that invasive species may also generate negative economic and human welfare outcomes. When discussing ecological impacts, respondents most frequently recognized that invasive species compete with native species for resources ($n = 10$) and prey on native species ($n = 10$), such as:

- “[An invasive species] takes over and is a detriment to existing Florida species.”
- “An invasive species is a species that is thriving and breeding, becoming a threat to natural wildlife and other endangered species that are native.”

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Given that we focused on non-native herpetofauna, when asked to give examples of invasive species of greatest concern, respondents most frequently listed pythons and tegus, specifically the Burmese python ($n = 20$) and the Argentine black and white tegu ($n = 12$). In most cases, these species were identified as a cause for concern because of the ecological harm they cause. Respondents were aware that pythons threaten the continued existence of native species. They were further concerned about the aggressive behavior of the tegu and its voracious, generalist diet that allows the tegu to outcompete native species for food and resources.

Theme 2: Assigning Responsibility for the Pet Trade Invasion Risk to a Single Pathway of Introduction

When asked their opinions about whether the pet trade contributes to non-native and invasive species introductions in Florida, respondents discussed three possible pathways of introduction: (a) accidental large-scale releases of animals due to natural disasters (e.g., hurricanes), (b) the role of pet owners in deliberately releasing individual pets, and (c) the role of pet sellers and breeders in facilitating large-scale releases of animals to establish breeding populations. Sixteen respondents expressed strong opinions that most of the pet trade invasion risk should be attributed to a single pathway of introduction.

Respondents who claimed that natural disasters are the main pathway for introduction of invasive species largely absolved the pet trade of responsibility for invasion risks, such as:

- “The media wants everyone to believe that Joe bought a baby Burmese python and it got too big and he let it out...and now there are 150,000 Burmese pythons in the Everglades, which just isn't the case... One of the hurricanes that came through and hit south Florida really hard devastated the buildings and the distributors, and that is how these animals got into the wild.”

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- “I mean, nobody can help a hurricane and pet stores being destroyed and things getting out. If you have a store with 100 to 200 animals and 50 get away, it definitely is more of a cause than one person letting one animal go.”

These respondents largely ascribed the pet trade invasion risk to the destruction of pet sellers' and breeders' storage facilities and outlets by hurricanes, specifically Hurricane Andrew in 1992.

Respondents who blamed the majority of introductions on the actions of individual pet owners specifically focused on uninformed consumers who do not understand what they are committing to when they purchase a non-native animal, and are then likely to release the pet rather than euthanizing it, or selling or giving the pet to another owner:

- “In Florida it is very easy for people to buy an exotic animal. A family goes into PetSmart or Petco, and here is this little tiny sulcata tortoise. There is nothing on the display that tells them that that tortoise will live 150 years and that it'll grow to the size of a coffee table... Those are the irresponsible pet owners that let the Burmese python out.”
- “I would think the most common vector is when pet owners who can't manage and who don't want to keep [the pet] just let them go rather than do something else that's undesirable (i.e., euthanize the pet).”

Respondents who ascribed the majority of introductions to the actions of pet sellers and breeders stated that these stakeholders deliberately engage in large-scale releases of animals to establish breeding populations from which they can collect animals to sell, such as:

- “What breeders will do, they'll release chameleons in secluded areas, and come back later and collect the babies... They're just basically reaping the benefits of selling them without having to put any money into them.”

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- “I personally know a reptile dealer... They moved from south Florida up to central Florida. And when they did that they collected as many Cuban knight anoles as they could... and let them loose in their backyard... That way they could go out and have a breeding population, and they could sell them.”

Although they mainly focused on deliberate releases of non-native animals, respondents also mentioned that pet breeders and sellers may not properly cage their animals, which may result in multiple accidental escapes of animals. These respondents did not ascribe large-scale releases to hurricane events, but rather to individuals' behaviors in terms of how they house animals.

Theme 3: Framing the Effectiveness of Management Interventions in Terms of Their Feasibility

When asked their opinion about the effectiveness of management actions, respondents routinely framed their responses in terms of the feasibility of the action, specifically whether: (a) the actions are practical, (b) interventions can be adequately enforced, and (c) stakeholders have the knowledge to effectively design, implement, or comply with interventions.

Practicality of interventions. Fifteen respondents questioned whether interventions were practical. These respondents acknowledged that although microchips would be effective for larger species, several species cannot physically be microchipped. As one respondent said “a lot of these animals are not big enough to get a PITT tag in them. How do you PITT tag and register a dart frog? Or a dwarf chameleon? You're talking about an animal just a couple of grams in weight. It's not possible. You need to be very selective. You can't regulate everything.”

Respondents also recognized that required training for individuals who purchase “large constrictors,” “dangerous species,” and “animals that have the potential to survive and do damage in south Florida” would be beneficial. However, requiring training for all species would

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not be feasible due to time and money constraints. Respondents pointed out that requiring training for species that are not an invasion concern would be irrational and result in stakeholder and public opposition to the management intervention.

Respondents pointed out that eradicating all established non-native and invasive species from Florida's ecosystems is highly impractical, if not impossible. Instead, respondents focused on whether the population size and impact of established non-native and invasive species could be reduced. Example quotes included:

- "I think at this point it's more about trying to lessen the spread of those invasives rather than ever having the hope of completely eliminating them."
- "You'll never catch up to that population count, you'll never bring it anywhere near zero. At that point the idea is just like we treat rats, ants, 'roaches. It's just to control the population."

Enforcement of interventions. In addition to questioning the practicality of certain management interventions, respondents raised concerns about whether regulations are (or could be) adequately enforced. Twenty-five respondents expressed concerns about whether government agencies have sufficient financial resources and staff to enforce current regulations, let alone additional regulations or interventions. Example quotes included:

- "I don't think agencies are given the tools they need, by that I mean money, to pay enough people to enforce [regulations]. If there are only one or two wildlife conservation officers with FWC in a district but there are 600,000 people and who knows how many pets...I don't know they can enforce it all."
- "[Government staff] are never going to see the abuse. They're never going to look at your documentation to find out where these animals are coming from, or where they are going

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to...And it's not because they don't want to do their job. They are just totally understaffed for the enormity of the problem that we have in the state."

Lack of knowledge. Nineteen respondents recognized that lack of knowledge across stakeholder groups undermines the feasibility and effectiveness of management actions.

Respondents noted that some government agents lack the necessary skills to identify non-native species, which is required to enforce regulations. For example, one respondent claimed that "law enforcement can't even identify most of their native species correctly in the state of Florida."

Respondents also pointed out that politicians lack the necessary understanding to create appropriate legislation that can be effectively implemented, such as: "Some lawmaker in Tallahassee thinks it's a great idea to [require inspections for permits], but he has no idea that [the relevant agency] doesn't have anywhere near enough people to accommodate the number of permit applications that they receive."

Respondents recognized that both pet owners' lack of knowledge about the species they purchase and the failure of pet sellers to appropriately inform consumers undermine the effectiveness of management actions. These respondents advocated for additional education to improve compliance with actions to manage the pet trade invasion risk, such as:

- "People don't know. They aren't educated on what happens after they buy one of these exotic animals because a lot of them do require a lot of care and attention."
- "The seller of the animal should provide education. People impulse buy. They say, 'Oh, look at this little snake and before they know it, the pet is huge, and they didn't know. And that actually promotes somebody to possibly release it.'"

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- “You can educate people at the seller... Pet amnesty programs might help. I think that the reason why people release [pets] is because they don't want to kill them. Having an alternative would be helpful.”

Theme 4: Lack of Trust Between and Within Stakeholder Groups

Respondents raised the issue of trust, both between stakeholder groups (e.g., between the pet trade and the government) and within stakeholder groups (e.g., between breeders and sellers in the pet trade), as contributing to invasion risks.

Trust in government. Thirteen respondents noted that there are substantial political constraints to successfully addressing the invasion risks associated with the pet trade. However, they differed in their perceptions of these constraints. Some respondents perceived that agencies and political decision-makers do not put sufficient bans on the pet trade and do not adequately educate the public about the negative impacts of the pet trade because the industry is lucrative and politically powerful. Example quotes included:

- “There are some loopholes where [the FWC] will qualify people to get permits for certain animals. I'm aware that they are trying to balance all the stakeholders...but I think that their opinions and their influence gets dominated by the pet trade over everybody else.”
- “I'm not sure about the will of the politicians, the leaders, whoever makes those decisions, to make those hard-pressed decisions against the pet industry”

In contrast, other respondents noted that severe regulations would likely stimulate the illegal pet trade: “I don't think bans work...Making it an outright illegal act to own one of these animals just moves [the trade] underground and all of a sudden [non-native animals] become more valuable financially. The risks are higher, but so are the rewards.”

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Respondents also questioned why the government exclusively focuses on managing certain species and whether this is an effective approach. Respondents were “surprised” by agencies’ focus on larger reptiles when iguanas are more abundant, and speculated that agencies are focusing on managing species (such as the python and lionfish) because they can demonstrate results to the public. Other respondents argued that the FWC python hunts (a public incentivized program to remove Burmese pythons from south Florida public lands, which was hosted by the FWC in 2013 and 2016) were public relations exercises rather than an effective management action. For example, one respondent claimed: “I know the python hunts have been ... I wouldn’t say unsuccessful because they have removed snakes, but it’s not the solution. It’s PR to raise awareness.”

Trust in the pet industry and pet owners. Sixteen respondents articulated distrust of individuals within the pet industry. Respondents perceived that government restrictions on the pet industry were necessary due to the actions of irresponsible owners and sellers, such as:

- “Florida has enacted new laws prohibiting the interstate transfer of certain animals...Not that I disagree with the permits because there are a lot of irresponsible people that house those animals.”
- “I think [new management actions] would be helpful, but I don’t think introductions would stop altogether because people are still going to not comply with the law and cause trouble.”

A major concern expressed by respondents was that pet sellers prioritize profits over responsible behavior and will not comply with additional management interventions (e.g., mandatory point-of-sale education for consumers) to mitigate invasion risks. These individuals expressed the desire for the pet trade industry to engage in more self-regulation: “If people are

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breaking the law [or engaging in irresponsible behaviors] they need to be punished for it and they need to be ousted not by some undercover bust. They need to be ousted by their peers.”

Lack of trust between the government and the pet industry. Ten respondents discussed adversarial relationships between the government and the pet industry, and stressed the need for collaboration between government and the pet trade to effectively manage invasion risks. Example quotes included:

- “Blaming every species on the exotic pet trade is not a good thing, which I see done a lot by academics and by FWC.”
- “Florida agencies, especially FWC, they get a bad rap [from pet owners and the pet industry] when they start putting limitations on species that people can have as pets.”
- “There’s a lot of the general adversarial feel on both sides (government and the pet industry), but especially on the industry side. I think if there was a better flow of communication and [people] were on the same page we could get more progress.”
- “Stakeholders and agencies [should] work together to come up with a sound policy for best management practices ... so those [policies] are implemented and complied with.”

Trust in the media. A total of 19 respondents discussed the media portrayal of invasive species and the pet trade. The most common opinion held by respondents ($n = 17$) was that the media sensationalized the issue of non-native species in Florida and the impacts of the pet trade to scare people and get higher ratings. Example quotes included:

- “[The media] blows everything out of proportion. They fear monger everything... They twist people’s words. They make-up numbers... They say ‘Oh, there’s hundreds of thousands of man-eating Burmese pythons out in the Everglades’, when if there really were that many they couldn’t hide very long.”

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- “The media is not an objective [information] source. It’s entertainment, and they’re there to get ratings...So, they sensationalize what they think is going to captivate the most viewers.”

Discussion

Managing the pet trade invasion risk is inherently difficult. There is no single solution or management intervention that will disrupt the multiple pathways by which non-native and invasive species are introduced into Florida. Effective management of the pet trade invasion risk requires a suite of interventions that target: (a) the import of non-native and invasive species into Florida; (b) the distribution of these species once they have entered the state; (c) how animals are housed to prevent accidental escapes, especially during hurricane events; (d) deliberate mass releases by breeders and sellers; (e) deliberate individual releases by pet owners; and (f) management of non-native and invasive species populations that are established in Florida (see also Bilger, 2009; Hardin, 2007; Krysko et al., 2007; Townsend et al., 2003; Witmer et al., 2009).

In considering which interventions might effectively mitigate the pet trade invasion risk, we recognized that the purchase, sale, breeding, and release of non-native and invasive species are private behaviors that are often difficult to monitor. Although agencies, such as the FWC, may be able to monitor the trade in non-native and invasive species at pet stores and online, this does not encompass the full spectrum of means by which animals are traded or distributed across Florida. Given the size and scale of the pet trade, the FWC and other agencies are also unlikely to have the resources to effectively manage the trade without voluntary compliance by the industry. This issue was raised by our respondents when they spoke about the limited financial resources and staff that agencies are able to allocate to managing the pet trade. Respondents also raised concerns about whether the staff of relevant agencies have the knowledge and training to appropriately manage the pet trade invasion risk. This is a particular concern at points of entry.

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As noted, Florida is one of the main states through which the trade in non-native animals flows (Engeman et al., 2011). If customs agents cannot determine whether animals included in a shipment match the customs paperwork, then there is potential for restricted species to enter Florida, despite regulations such as the Conditional Species List. Although trade bans were suggested by several respondents to prevent further acquisition of non-native and invasive species as pets, Rivalan et al. (2007) pointed out that bans are politically untenable and are likely to stimulate illegal trade – an issue that was raised by respondents (pet owners, ecologists). Bans would also fail to prevent the release of species that have already entered Florida.

It is unreasonable to expect government agencies to effectively manage the pet trade invasion risk without the support of the pet industry, political decision-makers, and the public. Respondents recognized this issue, although they framed this problem in various ways. Most frequently, respondents discussed lack of trust among different stakeholder groups as undermining the effectiveness of both current and potential management actions in addressing the pet trade invasion risk (see also Estévez et al., 2015; Genovesi, 2008; Mackenzie & Larson, 2010; Stern, 2008). Respondents expressed concerns that the adversarial relationships among stakeholder groups will continue to undermine voluntary compliance with regulations and support for management interventions, even if stakeholders recognize the need for these actions. Lack of trust within stakeholder groups (based on individuals' knowledge of irresponsible behaviors by other group members) likely also undermines support for management, especially if this raises the concern that more stringent regulations will be implemented if other people's irresponsible actions are revealed.

One of the solutions suggested by respondents was to increase self-regulation by the pet trade to establish and enforce norms of responsible behavior (see also Ostrom, 2000; Prinbeck,

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Lach, & Chan, 2011; St. John et al., 2011). Although self-regulation by the pet trade is a critical component for managing the pet trade invasion risk, respondents had no clear suggestions on how this could be accomplished. Efforts to encourage self-regulation should take into account the number of individuals involved in the trade, the range of different sizes of operations (from individual breeders to large corporate entities), and the different motivations and objectives of these individuals and operations. With regards to this latter point, we note that multiple respondents who are part of the trade in live animals chose to attribute invasion risks to other groups (pet owners, breeders, or sellers) or hurricane events. For self-regulation to be successful, all groups must take accountability for their share of the pet trade invasion risk to ensure that appropriate precautionary actions are implemented at all levels.

Another potential solution to improve trust among stakeholder groups, increase compliance with regulations, and motivate self-regulation by the pet trade is to facilitate transparent, inclusive, and participatory decision-making (see also Frame et al., 2004; Mackenzie & Larson, 2010; Stern, 2008). This decision-making process should include government agencies, members of the pet trade who represent different groups (importers, breeders, wholesalers, retailers, owners) and different scales of operation size, invasion ecologists, and experts in policy and program design and implementation. Participatory decision-making may help to address multiple sources of concern and distrust, including respondents' perceptions that: (a) government agencies prioritize politically expedient rather than effective interventions; (b) government agencies do not have the expertise, knowledge, or resources to fairly and appropriately manage the pet trade invasion risk; (c) the pet trade does not adequately manage irresponsible operators; and (d) different groups within the pet trade do not acknowledge how they contribute to the pet trade invasion risk. A participatory decision-making process would

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provide the pet trade with the opportunity to demonstrate that they recognize the need for management, and to help develop interventions that members are more likely to adopt. This process would also provide agencies with the opportunity to demonstrate that they possess the necessary expertise to work with key stakeholders to manage the pet trade invasion risk.

Our results also suggest that there is a lack of support for improved management of the pet trade invasion risk, or that support is misaligned with the management issues to be addressed. This lack of support likely stems from incomplete understanding of the range and magnitude of negative impacts associated with species invasions (see also Sharp et al., 2011; Witmer et al., 2009). Even though we interviewed key stakeholders in the live animal trade (who are presumably better informed about non-native and invasive species), most individuals only discussed the ecological impacts of invasive species (see similar findings by Selge et al., 2011; Sharp et al., 2011). In part, this may be attributable to insufficient research on the economic and human welfare impacts of species invasions because these studies are difficult, time-consuming, and costly to conduct. Nonetheless, these studies are needed. A 2005 study estimated the annual economic losses associated with invasive species in the United States at \$120 billion (Pimentel, Zuniga, & Morrison, 2005). Updated research on the economic and human health and safety impacts of the live animal trade may provide the necessary political impetus for decision-makers to support the management of the pet trade invasion risk. These studies may also provide the necessary information to solicit political and financial support from the public for appropriate management interventions (see also Sharp et al., 2011; Witmer et al., 2009).

Finally, respondents indicated a clear need to better inform pet owners about the species they are purchasing and the implications of releasing these species into Florida's ecosystems. Point-of-sale information and improved outreach on the magnitude and impacts of species

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invasions in Florida could form part of a mixed-methods approach for managing the pet trade invasion risk (see similar recommendations by Larson et al., 2011; Teillac-Deschamps et al., 2009). When considering how outreach and education should be conducted, it is important to note that multiple respondents distrusted the media. Based on our interviews, caution should be exercised when using the media to disseminate messages because there was a strong perception that the media sensationalizes issues and is inherently biased. Communications and education experts should be involved in the design of messaging and outreach about the need to manage the pet trade invasion risk.

Although we implemented best practices in conducting this research, there are important limitations to our study. We conducted an exploratory study with a small sample of stakeholders in the live animal trade. Given our small sample size, we were unable to make comparisons across stakeholder groups in terms of their perceptions of the pet trade invasion risk and support for management actions. We also focused on the trade in live herpetofauna in a single state. As such, we caution against generalizing our findings to the larger population of non-native pet trade stakeholders in the United States or abroad. Our suggestions on how the pet trade invasion risk might be mitigated should be rigorously tested using quantitative or experimental studies.

Conclusion

Understanding stakeholders' perceptions about the effectiveness of management actions and potential obstacles to stakeholder support for, and compliance with, regulations is critical for reducing the pet trade invasion risk. We found that support for different management actions depends on the perceived effectiveness of these actions, in particular whether they are practical and may be adequately enforced. Obstacles to the effective management of the pet trade invasion risk include: (a) incomplete understanding of the magnitude of the risks associated with species

invasions, (b) failure by key stakeholders in the pet trade to acknowledge how members of their stakeholder group contribute to the invasion risk, and (c) lack of institutional trust. Transparent and participatory decision-making, self-regulation by the pet industry, and improved outreach and education about the invasion risks associated with the live animal trade are likely needed for effectively addressing the pet trade invasion risk.

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