

Amphibian Consumer and Business Survey



Contributors: Kevin Cavasos, Neelam C. Poudyal, Matthew Gray, Alexa Warwick, Jesse Brunner, Jonah Piovio-Scott, Nina Fefferman, Molly Bletz, Julie Lockwood, Joshua Jones

Acknowledgements: This study was funded by the University of Tennessee One Health Initiative. Investigators thank industry partners Pet Industry Joint Advisory Council (PIJAC), Josh's Frogs, Reptiles by Mack, and their representatives.

Table of Contents

EXECUTIVE SUMMARY	5
INTRODUCTION	8
METHODOLOGY	8
RESULTS AND DISCUSSION	10
Respondent characteristics	10
Consumers/amphibian pet owners survey	10
Amphibian Acquisition and Ownership.....	10
Experience with amphibian health.....	17
Familiarity and Experience with Beneficial Microbes and Harmful Pathogens	21
Willingness to pay for pathogen free amphibian	24
Attitudes Toward Pathogen Transmission and Likelihood of Adopting Mitigating Actions	26
Amphibian Business Survey	32
Respondent Business Characteristics.....	32
Awareness of Pathogens and Adoption of Biosecurity Practices	38
Business willingness to pay for pathogen-free amphibian	43
Attitudes and Intentions Regarding Adoption of Mitigating Actions	46

Table of Figures

Figure 1. Respondent roles in the amphibian industry (n=469)	10
Figure 2. Type(s) of amphibians owned by respondents (n=393)	11
Figure 3. Other types of pets currently or previously owned by survey respondents (n=386)	11
Figure 4. Length of amphibian ownership (n=393)	12
Figure 5. Number of amphibians owned. (n=393)	12
Figure 6. Mode of acquisition of pet amphibian(s) (n=392).....	13
Figure 7. Sources of amphibian acquisition (n=387)	14
Figure 8. Cost of most recently acquired pet amphibian (n=387).....	14
Figure 9. Average monthly cost of pet amphibian care (n=385).....	15
Figure 10. Importance of various factors in amphibian pet ownership (From top: n1=380, n2=382, n3=380, n4=383, n5=379, n6=383, n7=379).....	16
Figure 11. Familiarity with various aspects of amphibians prior to reading survey. (From top: n1=384, n2=382, n3=383, n4=383).....	16
Figure 12. Percentage of owners forced to ever get rid of pet amphibian (n=385)	17
Figure 13. Reason(s) owners forced to get rid of pet amphibian(s). (n=37)	17
Figure 14. Method(s) used to dispose of animal(s) (n=37)	18
Figure 15. Sources of information for amphibian care (n=387)	19
Figure 16. Frequency of veterinary care and diagnostic tests. (n=385)	19
Figure 17. Percentage of amphibian pet owners who have had a pet amphibian in their care die (n=387)	20
Figure 18. Methods for disposing of deceased animal(s) (n=304)	20
Figure 19. Willingness to seek veterinary care or administer treatment at home if pet amphibian(s) show signs of illness. (n=387).....	21
Figure 20. Percentage of respondents aware of beneficial microbes, such as <i>Bacillus mycoides</i> , that can kill harmful microbes and increase disease resistance in amphibians (n=382)	21
Figure 21. Percentage of respondents who would consider administering treatment to your pet amphibian using “probiotics” such as <i>Bacillus mycoides</i> (n=382)	22
Figure 22. Percentage of respondents aware that the Bd, Bsal and Rv pathogens can be transmitted through pet trade (n=382).....	22
Figure 23. Level of concern that most recent amphibian purchase may have been infected with Bd, Bsal, or Rv prior to acquisition (n=380).....	23
Figure 24. Pathogens detected in respondent pet amphibians (n=378).....	24
Figure 25. Level of importance that an amphibian acquired in the future is free of the Bd, Bsal, and Rv pathogens (n=378).....	24
Figure 26. Willingness to pay more for an animal that is certified free of the Bd, Bsal, and Rv pathogens (n=379).....	25
Figure 27. Percent of respondents willing to pay extra for certified disease-free animal (n=364)	25
Figure 28. Reasons for unwillingness to pay extra for an animal certified free of Bd, Bsal and Rv compared to a non-certified animal (n=50)	26
Figure 29. Level of agreement and disagreement with statements related to Bd, Bsal and Rv transmission (From top: n1=358, n2=359, n3=356, n4=359, n5=359, n6=358, n7=358, n8=355, n9=359),	27
Figure 30. Likelihood of taking various steps to limit the spread of harmful pathogens (From top: n1=354, n2=350, n3=355, n4=353, n5=357, n6=356).....	28

Figure 31. Number of amphibians owned by years of ownership	28
Figure 32. Percent of consumers indicating they've had a pet amphibian die by years of amphibian ownership. (From top, n1=163, n2=59, n3=28, n4=137)	29
Figure 33. Amphibian ownership by respondents indicating they've acquired amphibians by collecting from the wild. (n=76).....	29
Figure 34. WTP for certified disease-free animal for respondents paying \$0 for most recently acquired amphibian (n=32).....	30
Figure 35. WTP for certified disease-free animal for respondents paying \$1-\$25 for most recently acquired amphibian (n=68)	30
Figure 36. WTP for certified disease-free animal for respondents paying \$26-\$75 for most recently acquired amphibian (n=161)	31
Figure 37. WTP for certified disease-free animal for respondents paying \$76-\$125 for most recently acquired amphibian (n=41)	31
Figure 38. WTP for certified disease-free animal for respondents paying over \$125 for most recently acquired amphibian (n=27)	31
Figure 39. Types of animals business deals with (n=122)	32
Figure 40. Where respondent businesses acquire amphibians (n=113).....	32
Figure 41. Parties business sells amphibians to (n=112)	33
Figure 42. Number of years in the amphibian business (n=111)	33
Figure 43. Annual sales of business (n=106).....	34
Figure 44. Percentage of total sales attributed to amphibians (n=106)	34
Figure 45. Number of employees at the responding businesses (n=106).....	35
Figure 46. Type of ownership of business (n=104).....	35
Figure 47. Geographic region of business location (n=104).....	36
Figure 48. Business with buyers and sellers outside of the United States (n=105)	36
Figure 49. Knowledge of businesses like respondents operating within same state as respondent	37
Figure 50. Mode of selling amphibians (n=101)	37
Figure 51. Importance of factors in making business decisions (From top: n1=100, n2=100, n3=100, n4=100, n5=100, n6=100, n7=100).....	38
Figure 52. Percentage of respondents aware of beneficial microbes like Bacillus mycoides prior to reading this survey.....	39
Figure 53. Percentage of respondents that would consider administering treatment to their pet amphibian using "probiotics" such as Bacillus mycoides (n=98).....	39
Figure 54. Percentage of respondents aware prior to reading survey that Bd, Bsal, and Rv can be transmitted through the pet trade (n=98)	40
Figure 55. Percentage of respondents that have detected pathogens at their facility (n=17)	40
Figure 56. Percentage of businesses that have had an amphibian die from illness or disease (n=75)	41
Figure 57. Level of concern transmission of pathogens through the trade network of pets or pet products may impact amphibians in respondent's facility (n=95)	41
Figure 58. Percentage of businesses taking various biosecurity precautions (n=92)	42
Figure 59. Level of importance placed on amphibians that are healthy and free of Bd, Bsal and Rv (n=92)	42
Figure 60. When introducing a new animal to their business, the percentage of respondents interested in acquiring an animal that is certified as free of the Bd, Bsal and Rv pathogens (n=91).....	43

Figure 61. Percentage of respondents according to their willing to pay more for an animal that is certified as free of the Bd, Bsal and Rv pathogens (n=91)	43
Figure 62. Percentage of respondents willing to pay various increases in price to acquire amphibian that is certified free of the Bd, Bsal, and Rv pathogens (n=83)	44
Figure 63. Percentage of respondents who believe they can improve biosecurity practices without increasing costs (n=91)	44
Figure 64. Respondents' perception of needed increase in price to ensure animal is free of Bd, Bsal, and Rv (n=67)	45
Figure 65. Maximum acceptable increase in operating costs to improve biosecurity practices (n=66)	45
Figure 66. Business attitudes toward biosecurity measures and pathogen transmission (From top: n1=81, n2=80, n3=80, n4=80, n5=80, n6=80, n7=80, n8=79, n9=79, n10=80)	46
Figure 67. Business attitudes toward adopting practices to mitigate pathogen transmission (From top: n1=75, n2=75, n3=74, n4=75, n5=75, n6= 75, n7=76).....	47
Figure 68. Barriers to adopting biosecurity practices (n=69)	47

EXECUTIVE SUMMARY

Overview: An online survey of amphibian pet owners and businesses engaged in amphibian trade and ownership was conducted from July 2021 to September 2021 to understand the size and structure of U.S. amphibian pet trade, the husbandry practices of amphibian pet dealers and owners, and the value they place on maintaining healthy amphibian populations in the wild. In partnership with PIJAC, Josh's Frogs and Reptiles by Mack, amphibian pet owners and businesses engaged in the amphibian pet trade were invited to complete the survey. Of the 478 respondents who initiated the survey, 392 finished the survey. Of the 469 respondents that responded to the question, 401 (85%) identified themselves as amphibian pet owners/consumers, 85 (18%) as amphibian breeders, 81 (17%) as retailers, 20 (4%) as wholesalers, and 7 (1%) as amphibian importers.

Ownership history: Ninety-five percent of consumers indicated they currently own or have previously owned a frog or toad, while 38% reported owning, or having owned a newt/salamander. Eighty-one percent of consumers reported also either currently or previously owning a reptile(s). Thirty-five percent indicated they had owned amphibians for over 10 years.

Acquisition: Ninety-two percent of all consumers indicated they had purchased their pet amphibians while 24% indicated they had rescued or found their pet amphibian and 19% reported they had collected their pet amphibian from the wild. The majority (59%) of consumers reported having purchased amphibian(s) from an "In-store retailer/pet store", while 49% reported having purchased from an online retailer. Almost half (49%) of consumers indicated they spent between \$26-\$75 for their most recently acquired amphibian. One-half (50%) of consumers reported paying \$1-\$25 per month to care for their pet.

Ownership importance: Consumers were presented with 7 factors potentially influencing their decision to own their most recently acquired amphibian. Religious significance, cultural significance, and family favorites were least important, while scientific or educational value, sense of companionship, and aesthetic and environmental values were relatively more important. Most consumers were at least

moderately familiar with general knowledge of amphibians, the role of amphibians in the environment, status/trends of amphibian populations, and benefits to humans from amphibians.

Care and disposal of amphibians: Consumers mainly acquired information about caring for their pet amphibian(s) from websites (92%), personal experience (87%), and scientific journals (61%). Ninety-one percent of consumers indicated they had never become unable to keep or been forced to get rid of a pet amphibian. Of those that had been forced to get rid of an amphibian, the most common reason (41%) was family relocation, followed by “unable to care for it” (22%). No consumers indicated they had released the animal into nature.

Sixty-three percent of consumers indicated using diagnostic tests as needed. Seventy-nine percent of consumers reported having had a pet amphibian die. The majority (61%) of those who had had an amphibian die buried the dead. Ninety-nine percent of consumers indicated a willingness to seek veterinary care or administer treatment at home if their pet amphibian showed signs of illness.

Awareness of and concerns regarding pathogens: Most consumers (63%) indicated that before reading the survey they were unaware of *Bacillus mycoides* or other beneficial microbes and their ability to kill harmful microbes and increase disease resistance in amphibians. Seventy percent of consumers indicated, prior to reading the survey, they were aware that the *Bd*, *Bsal*, and *Rv* pathogens can be transmitted through the pet trade. Most consumers (64%) indicated they were “Not at all concerned” when acquiring their most recent amphibian that the animal may have been previously infected with *Bd*, *Bsal*, or *Rv*, while 23% reported being “Very concerned”. Ninety-six percent of consumers reported having never detected harmful pathogens in their amphibians

Perception of threats: Most of the consumers indicated they believe the threat of transmission of harmful pathogens from pets to natural areas is serious, protecting natural populations is important, and that they have a role to play in protecting natural populations. However, time, knowledge, and financial constraints may be barriers preventing amphibian owners from further implementing biosecurity practices. Most consumers indicated they were extremely likely to take actions to mitigate the transmission of harmful pathogens.

Value of pathogen-free amphibians: Seventy-nine percent of consumers indicated it would be extremely or very important that the animal they acquire be free of the *Bd*, *Bsal*, and *Rv*. Seventy-six percent indicated they would be willing to pay more for an animal that is certified free of the *Bd*, *Bsal*, and *Rv* pathogens.

Business Survey

Business characteristics: Of the 143 businesses that responded to the question, 85 (59%) identified themselves as amphibian breeders, 81 (57%) as amphibian retailers, 20 (14%) as wholesalers, and 7 (5%) as amphibian importers. Seventy-five percent of businesses indicated they deal with both reptiles and amphibians, while 16% deal with amphibians only. Eighty-one percent of amphibian businesses reported obtaining their amphibians from breeders, followed by hobbyists (66%), wholesalers (60%), retailers (26%), importers (24%) and wild caught (14%). Eighty-four percent of business respondents indicated they sell to hobbyists, 67% to households, 29% to breeders, 26% to retailers and 11% to wholesalers. Almost a third (29%) of business respondents indicated they had been in the amphibian business for

over 20 years while 19% reported having been in business for 11-20 years. Another 19% indicated they had been in business for 6-10 years.

In terms of annual sales, 30% reported less than \$5,000, 20% reported annual over \$1,000,000. Of the remaining, 17% indicated \$5,000-\$50,000, 13% reported \$500,000-\$1,000,000, 11% reported \$200,000-\$500,000, and 8% reported \$50,000-\$200,000. The Midwest region of the country accounted for the most business respondents to the survey (33%), followed by the Southeast (20%), with respondents being relatively evenly distributed across the other regions of the country. Eighty-two percent of respondents indicated they only conducted business with buyers and sellers of amphibians in the United States.

Share of amphibian business: Approximately half (51%) of 106 amphibian businesses indicated that amphibian sales accounted for less than 10% of their total sales. Similarly, 23% reported 10%-25%, 12% reported 76%-100%, 8% reported 26%-50% and the remaining 6% reported amphibian sales accounted for 51%-75% of their total sales.

Factors important in business decisions: When asked to rate the importance of the factors in making business decisions, high level of importance was placed on issues of ethics, social concerns, and legal compliance.

Awareness of and concerns regarding pathogens: Most businesses (53%) indicated that before reading the survey they were unaware of beneficial microbes, such as *Bacillus mycooides*, that can kill harmful microbes and increase disease resistance in amphibians. Almost half (47%) of businesses indicated that they would definitely consider administering treatment to their pet amphibian(s) using “probiotics” such as *Bacillus mycooides*, while 53% indicated needing more information. Eighty-one percent of businesses indicated, prior to reading the survey, they were aware that the pathogens *Bd*, *Bsal*, *Rv* can be transmitted through the pet trade.

Perception of threats: More than half (55%) of businesses indicated they were very concerned that transmission of pathogens through the trade network of pets or pet products may impact the amphibian(s) in their facility.

Biosecurity practices: While most businesses indicated they use disinfectants to clean surfaces and tanks (92%), use gloves when handling animals (60%) and quarantine new animals in a separate room (66%), fewer businesses test new acquisitions for pathogens (18%), conduct testing to monitor for disease (22%), or treat recirculating water (23%) or wastewater (24%) prior to disposal.

Value of pathogen-free amphibian: Eighty-six percent of businesses indicated it was extremely or very important that an animal be healthy and free of the *Bd*, *Bsal*, and *Rv* pathogens when introducing it to their facility. Ninety-seven percent indicated they would be interested in acquiring an animal that is certified as free of the *Bd*, *Bsal*, and *Rv* pathogens and 59% indicated they would be willing to pay more for an animal that is certified. Of those willing to pay more, 22% indicated they would be willing to pay 1%-5% more, 36% indicated 6%-10% more, and 28% indicated 11%-20% more. Business responses indicated the mean loss resulting from the illness or death of an animal was \$939.80, with a minimum and maximum value of \$0 and \$20,000, respectively.

INTRODUCTION

With growing concerns over continuous decline of amphibian populations in recent decades, researchers and stakeholders in the wildlife trade network have become increasingly interested in developing a deeper understanding of the scope of the amphibian trade and the husbandry practices and potential for pathogen transfer and spillover at various stages of the supply chain. To fill this gap in knowledge, the need for conducting a comprehensive survey of all business types in the amphibian trade, including importers, breeders, retailers, wholesalers, and consumers (i.e., pet owners) was realized.

The University of Tennessee Institute of Agriculture (UTIA) collaborated with the Pet Industry Joint Advisory Council (PIJAC) and other partners to identify science-based solutions that promote and foster animal wellbeing and environmental stewardship, minimize revenue losses due to harmful pathogens, and decrease opportunities for microbial spillover from captive to wild populations. UTIA and PIJAC established a Memorandum-of-Understanding (MOU) and Memorandum-of-Agreement (MOA) in 2021 to guide this project, with financial support provided by the UT One Health Initiative. Other amphibian care community partners and collaborators include Josh's Frogs, Reptiles by Mack, Washington State University, Michigan State University, University of Massachusetts-Boston, and Rutgers University.

Information collected in the surveys will be used to identify potential opportunities and barriers to developing an industry-led healthy trade program that ensures animal well-being, reduces disease-related financial losses for businesses and increases customer satisfaction. Additionally, information will enable researchers to provide recommendations on best strategies to minimize the likelihood of spillover of harmful microbes from the pet trade to the wild.

The specific objectives of the study were to: 1) characterize the size and composition of the U.S. pet businesses that are engaged in the pet amphibian trade; 2) understand the awareness and attitudes that amphibian pet businesses and owners have with respect to harmful and beneficial microbes; 3) estimate the value businesses and owners place on amphibians free of pathogens such as *Bd*, *Bsal*, and *Rv*; and 4) characterize the current husbandry practices of amphibian pet dealers and owners and their willingness to engage in proactive strategies that promote beneficial microbes and reduce harmful microbes in their facilities and the broader amphibian pet trade.

METHODOLOGY

Data needed to meet the objectives of this project were collected by designing and administering an online survey of businesses and owners in the amphibian pet trade industry. In collaboration with the industry partners (PIJAC, Josh's Frogs, Reptiles by Mack), the investigators developed a semi-structured questionnaire survey that included questions addressing aspects of the amphibian trade ranging from awareness and knowledge of pathogens (*Bd*, *Bsal*, and *Rv*), current husbandry and disposal practices, agreement with statements regarding biosecurity practices, and attitudes and values (willingness-to purchase, willingness-to-pay etc.) regarding acquiring pathogen-free amphibians.

The anonymous and voluntary survey instrument and protocols were reviewed and approved by the UTK Institutional Review Board for human subjects' research (Approval#: UTK IRB-21-06494-XM). The survey questionnaire was then formatted and administered using the Qualtrics online survey platform.

The survey was initially launched in mid-July 2021 with an email message sent from our industry partners to businesses and consumers in their membership list and contacts within their business network. A link to complete the survey was also placed on the project website (<https://onehealth.tennessee.edu/pijac/>) located in the public domain of University of Tennessee. The first question on the survey was a screening question for respondents to identify their role or relationship with the amphibian trade network. Those who identified themselves as consumers or pet owners only were directed to a module specific to consumers only, whereas those identifying themselves as business only were sent to a separate module specific to amphibian businesses. Those who identified themselves as both consumer and business were given an opportunity to complete both modules.

This report presents the results from all the responses completed by September 10, 2021. Of the 478 respondents who initiated the survey, 392 finished the survey. Of the 469 respondents that responded to the question, 401 identified themselves as amphibian pet owners/consumers, 85 as amphibian breeders, 81 as retailers, 20 as wholesalers, and 7 as amphibian importers.

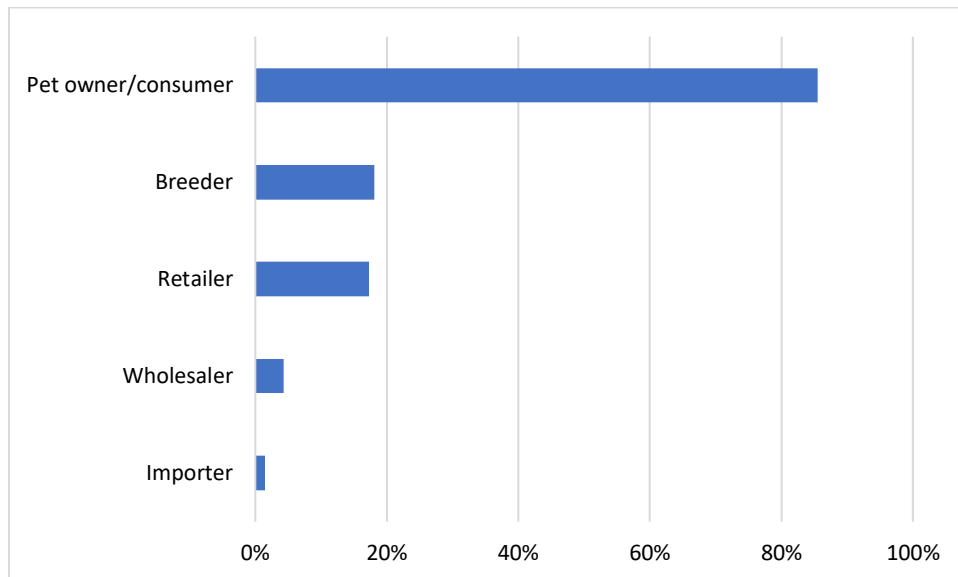
RESULTS AND DISCUSSION

Respondent characteristics

Of the 469 respondents that responded to the initial screening question “Which of the following best describes your role in the industry?”, 86% identified themselves as amphibian pet owners/consumers, 18% identified themselves as amphibian breeders, 17% as retailers, 4% as wholesalers, and 1% as amphibian importers (Fig. 1).

In terms of demographics, of 357 respondents, 48% reported being under the age of 35, 34% indicated they were 35-54 and 17% were over the age of 55. One-half (50%) of respondents were female, 40% male, 6% non-binary / third gender, and 3% preferred not to say. Eighty-eight percent of respondents identified themselves as White, 1% Asian, 1% Black or African American and 8% identified as “Other”.

In terms of education attained, of 356 respondents, 38% reported attending “Some college”, 31% reported having completed a bachelor’s degree, 18% completed a graduate degree, and 12% completed high school.



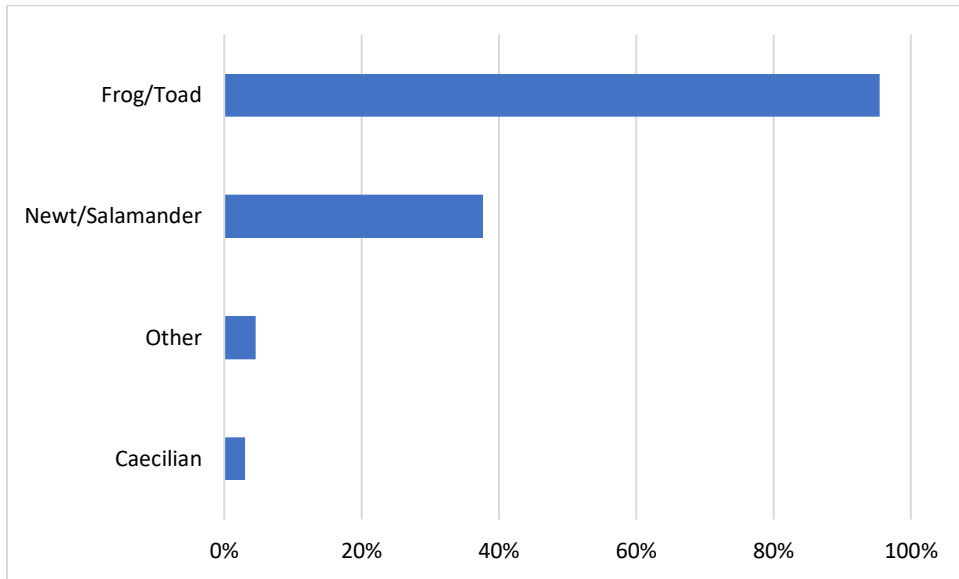
**Sum of percentages exceeds 100% as some respondents belong to multiple categories
Figure 1. Respondent roles in the amphibian industry (n=469)*

Consumers/amphibian pet owners survey

Amphibian Acquisition and Ownership

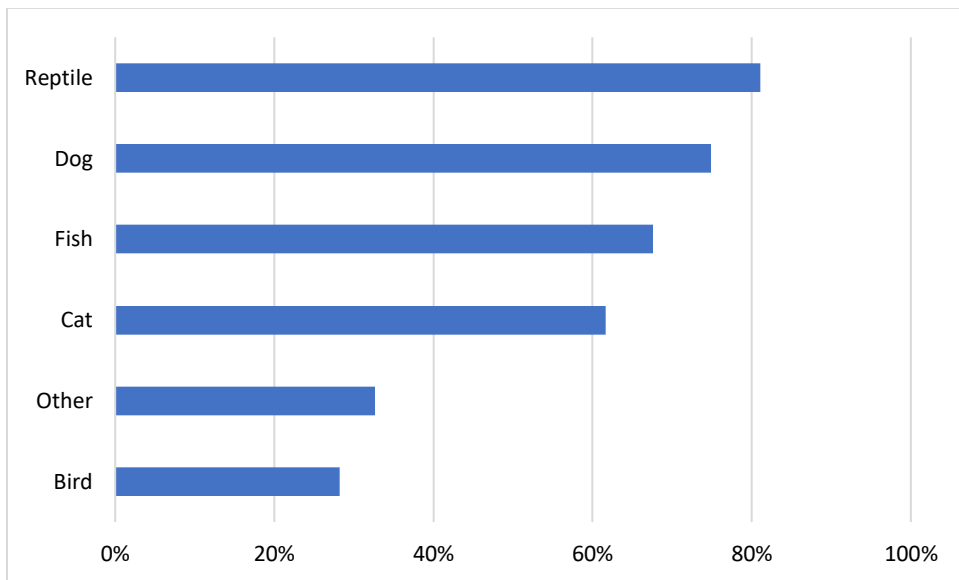
When asked about current or previous amphibian ownership, 95% of 393 respondents indicated they currently own or have previously owned a frog or toad, 38% own, or have owned, a newt/salamander,

3% own or have owned a caecilian, and 5% respondents indicated owning other types of amphibians (Fig. 2).



**Sum of percentages exceeds 100% as multiple responses may be selected by each respondent
Figure 2. Type(s) of amphibians owned by respondents (n=393)*

When asked about ownership of pets other than amphibians, 81% indicated they currently or had previously owned reptiles, 75% reported owning dogs, 62% reported owning cat (Fig. 3). Similarly, 68% reported fish, 28% birds, and 33% respondents indicated ownership of other types of pets.



**Sum of percentages exceeds 100% as multiple responses may be selected by each respondent
Figure 3. Other types of pets currently or previously owned by survey respondents (n=386)*

In terms of the duration of ownership, 42% of the respondents indicated they had owned amphibians for 1-4 years, 15% reported 5-7 years, 7% reported 8-10 years and the remaining 35% reported having owned amphibians for over 10 years (Fig. 4).

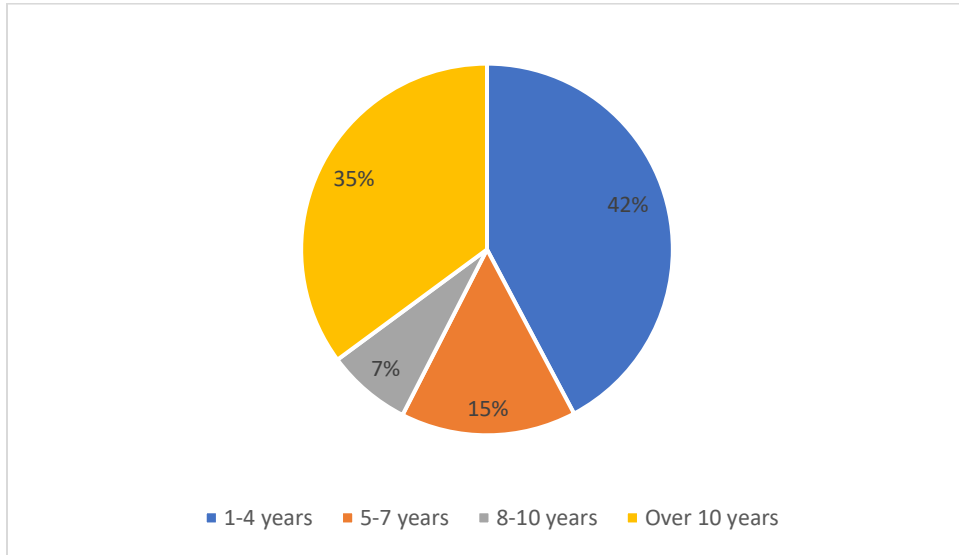


Figure 4. Length of amphibian ownership (n=393)

Regarding the total number of amphibians owned over the course of this duration, 37% reported having owned more than 10 amphibians, 27% indicated they had owned 2-4 amphibians, 18% have owned 5-7 amphibians, 10% have owned 8-10 amphibians and the remaining 9% of the respondents reported having owned only one amphibian (Fig. 5).

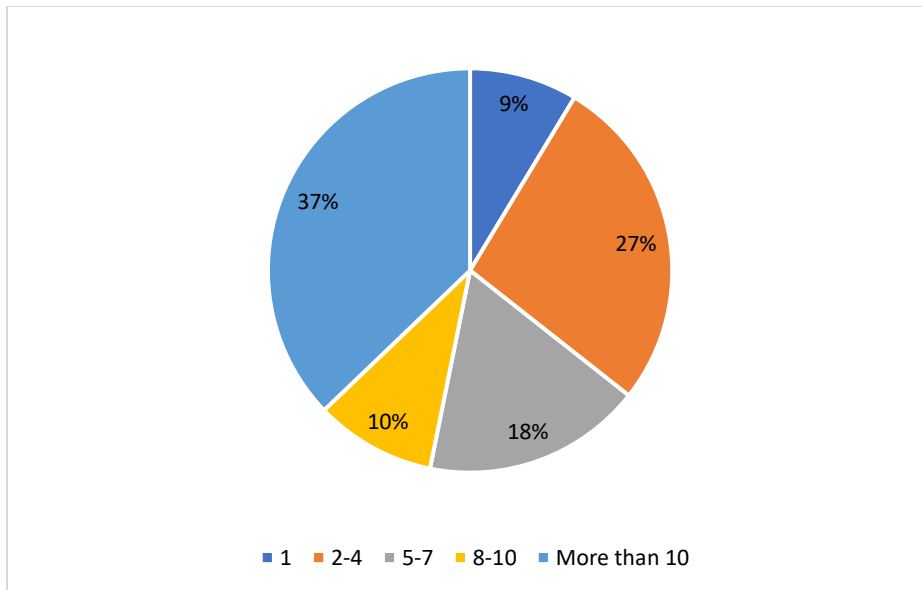
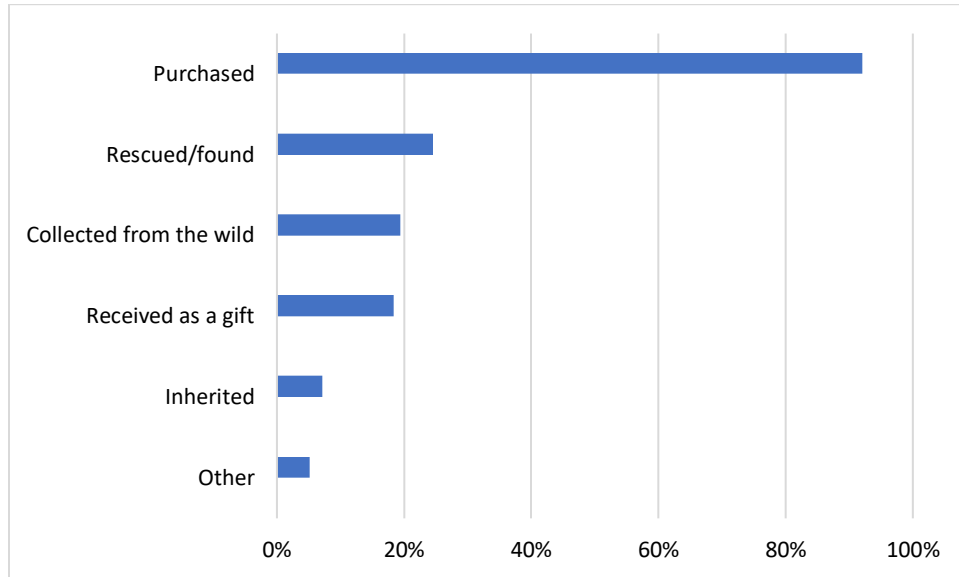


Figure 5. Number of amphibians owned. (n=393)

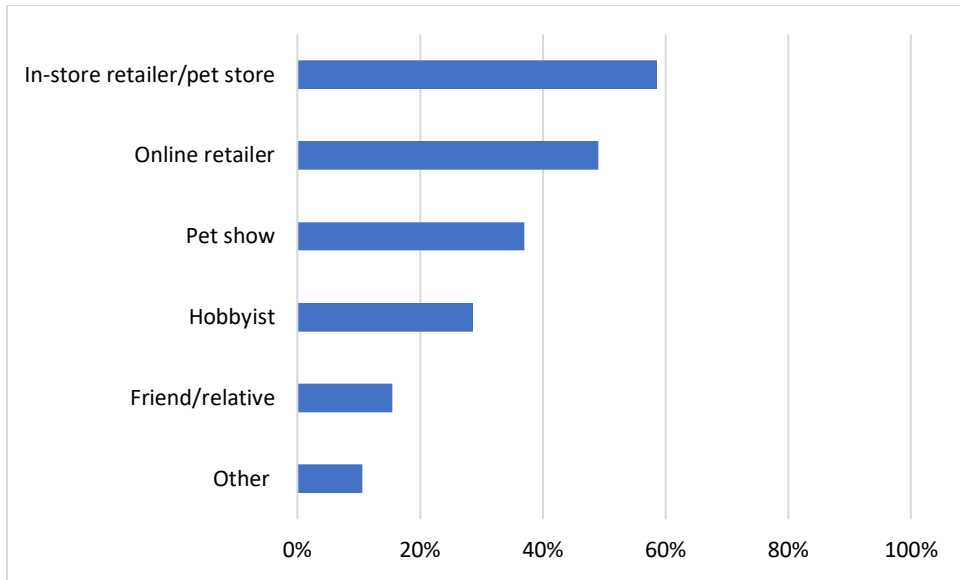
When asked about the sources from where they acquired their pet amphibians, 92% indicated they had purchased their pet amphibian, 24% indicated they rescued/found their amphibian(s), 19% collected them from the wild, 18% received them as a gift, 7% inherited their amphibians, and 5% respondents reported acquiring their amphibian(s) by other means (Fig. 6).



**Sum of percentages exceeds 100% as multiple responses may be selected by each respondent*

Figure 6. Mode of acquisition of pet amphibian(s) (n=392)

When asked where they acquired their amphibians(s), of 387 respondents, 59% indicated they had purchased their pet amphibian from an in-store retailer/pet store, 49% indicated they had purchased their pet amphibian from an on-line retailer, 37% from a pet show, 29% from a hobbyist, 16% from a friend/relative, and 11% from other sources, which included breeding at home, expos and trade shows.



*Sum of percentages exceeds 100% as multiple responses may be selected by each respondent
 Figure 7. Sources of amphibian acquisition (n=387)

When asked about the cost of their most recently acquired amphibian, 49% indicated they had paid \$26-\$75 for their most recently acquired pet amphibian, 21% reported paying \$1-\$25, 12% paid \$76-\$125, 10% paid nothing and the remaining 8% reported paying over \$125 (Fig. 8).

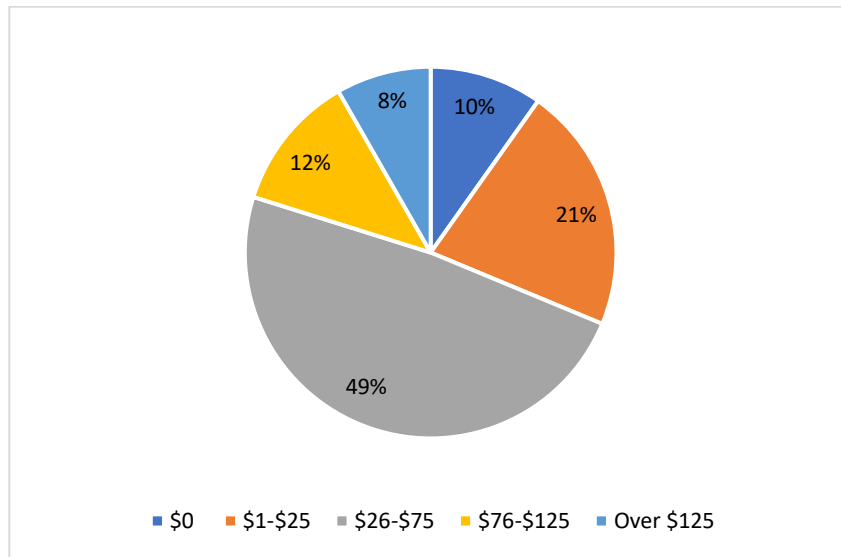


Figure 8. Cost of most recently acquired pet amphibian (n=387)

When asked to report the average monthly expense of care (feed, medical care, insurance, etc.) for their pet amphibian, 50% reported paying \$1-\$25 per month to care for their pet amphibian, 39% reported

paying \$26-\$75, 8% indicated they paid \$76-\$125 and 4% paid over \$125 per month to care for their pet amphibian (Fig. 9).

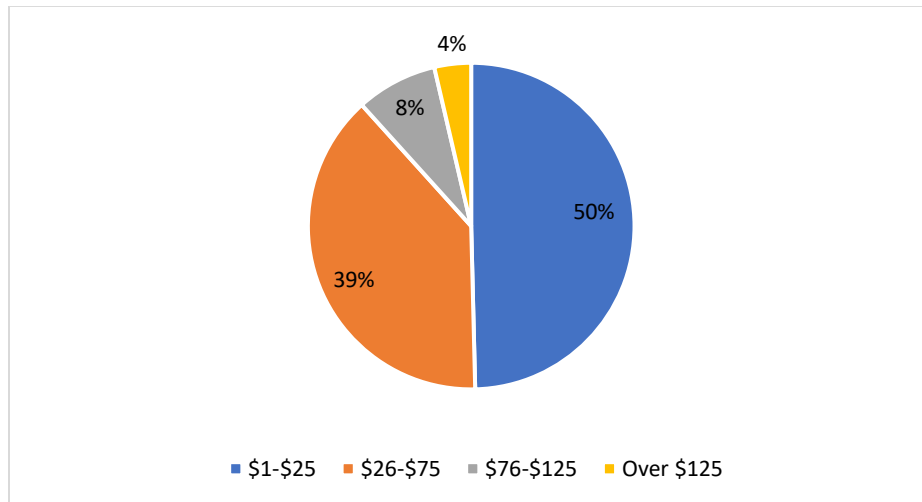


Figure 9. Average monthly cost of pet amphibian care (n=385)

Respondents were asked to indicate how important each of the following factors were in their decision to own their most recent pet amphibian. Religious significance, cultural significance and family favorite were clearly not very influential, while the influence of other factors on respondents' decisions to own their most recent pet amphibian was relatively evenly distributed (Fig. 10). Relatively more important

factors were scientific or educational value, sense of companionship, and aesthetic and environmental values.

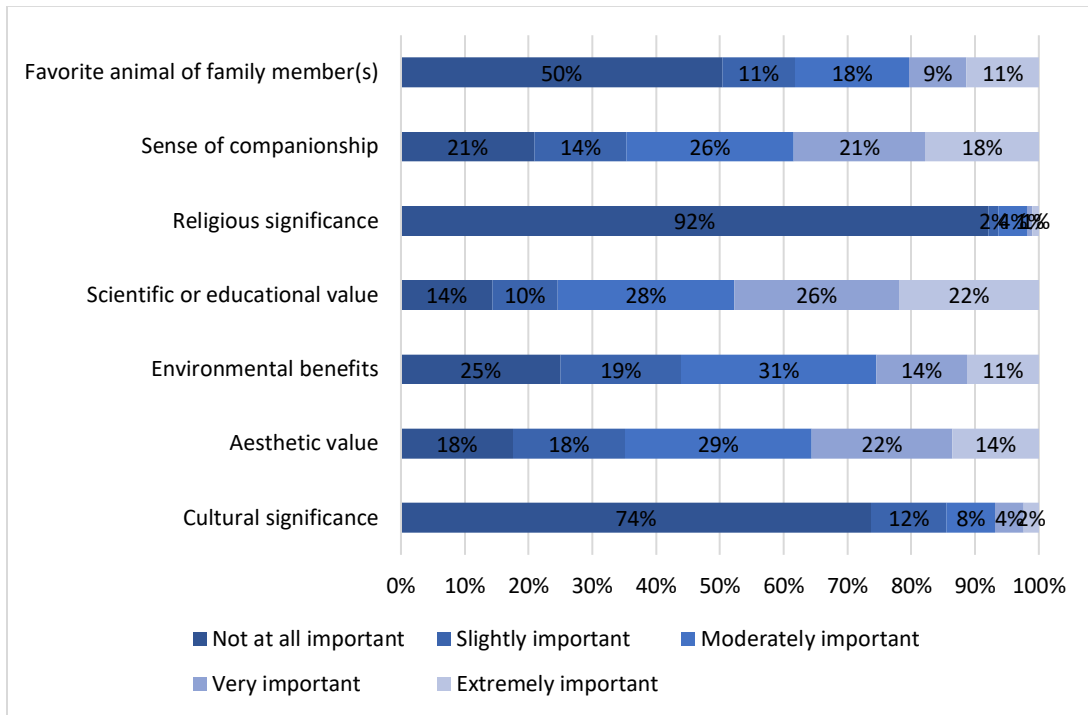


Figure 10. Importance of various factors in amphibian pet ownership (From top: n1=380, n2=382, n3=380, n4=383, n5=379, n6=383, n7=379)

Respondents were asked to indicate the extent to which they were familiar with various aspects of amphibians prior to reading the survey. In general, most respondents are at least moderately familiar with the aspects presented. For example, 84% indicated being at least moderately familiar with the status and trends of amphibian populations (Fig. 11).

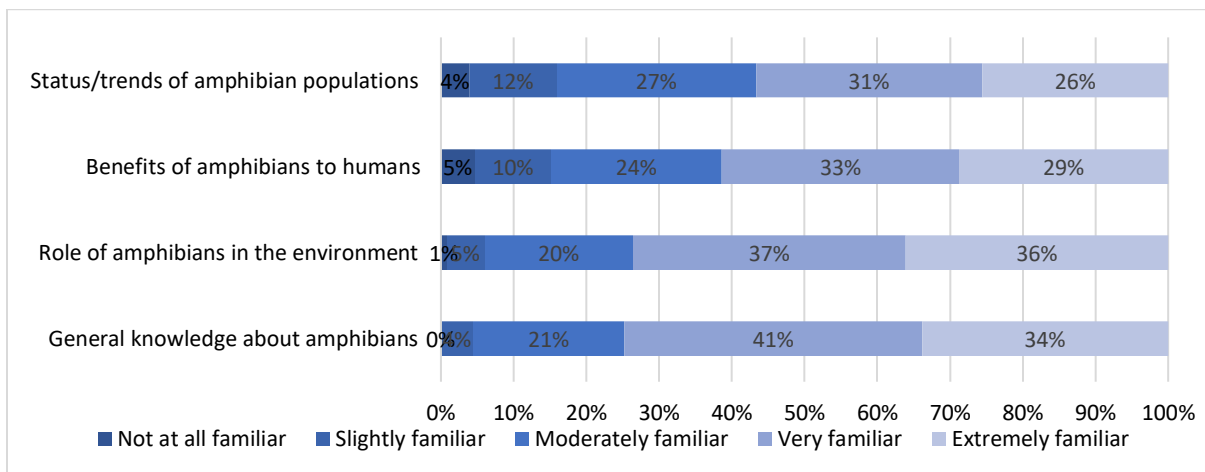


Figure 11. Familiarity with various aspects of amphibians prior to reading survey. (From top: n1=384, n2=382, n3=383, n4=383)

Experience with amphibian health

Respondents were asked if they had ever become unable to keep a pet amphibian or been forced to get rid of a pet amphibian for any reason. About 91% indicated they had never become unable to keep a pet amphibian or been forced to get rid of a pet amphibian for any reason, while the remaining 9% reported having been forced to get rid of a pet amphibian (Fig. 12).

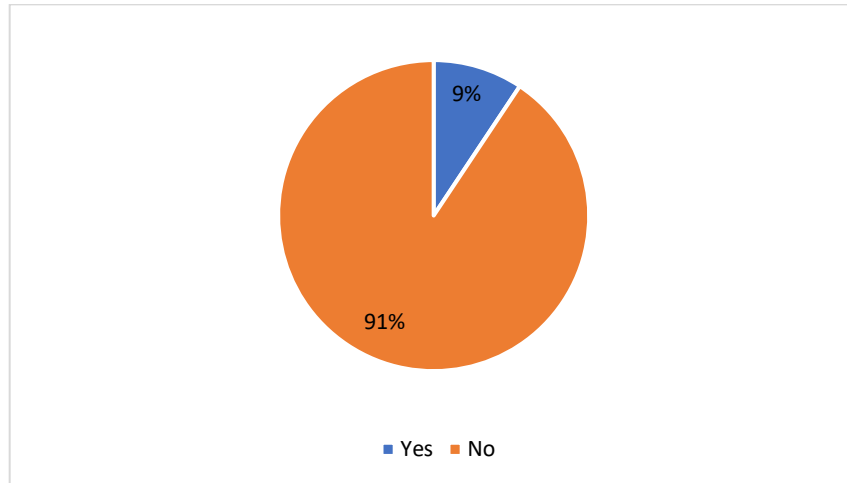
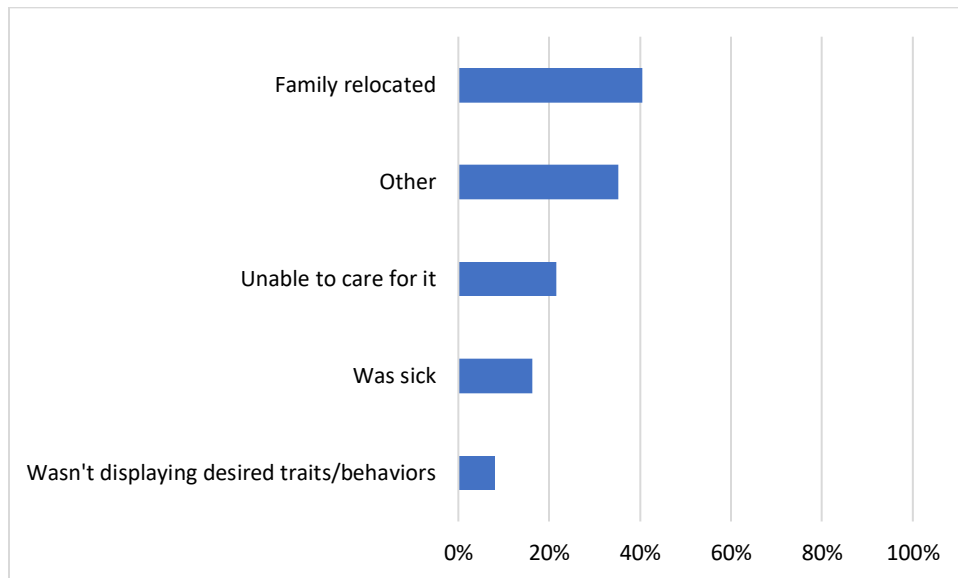


Figure 12. Percentage of owners forced to ever get rid of pet amphibian (n=385)

Respondents that reported having been forced to get rid of a pet amphibian were asked to indicate the reason. Forty-one percent indicated the reason they had been unable to keep a pet amphibian was family relocation, 22% indicated they were unable to care for the animal, 16% reported that the animal was sick, 8% indicated the animal was not displaying desired traits or behaviors and 35% respondents indicated having been forced to get rid of their pet amphibian for “other” reasons including family problems and conflicts with other animals (Fig. 13).



*Sum of percentages exceeds 100% as multiple responses may be selected by each respondent

Figure 13. Reason(s) owners forced to get rid of pet amphibian(s). (n=37)

Most (59%) of the respondents reported having been forced to get rid of a pet amphibian indicated they had given away or sold their animal (Fig. 14). Eight percent each indicated they had taken their animal to a rescue facility/pet amnesty event and returned to where it was acquired from. Similarly, 5% indicated to have euthanized the animal. No respondents reported having released their animal into nature.

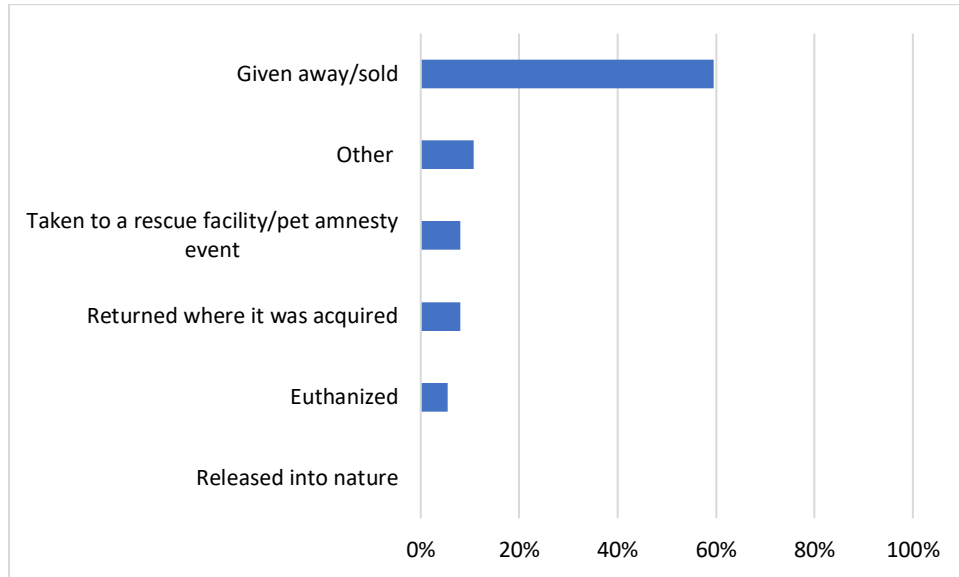
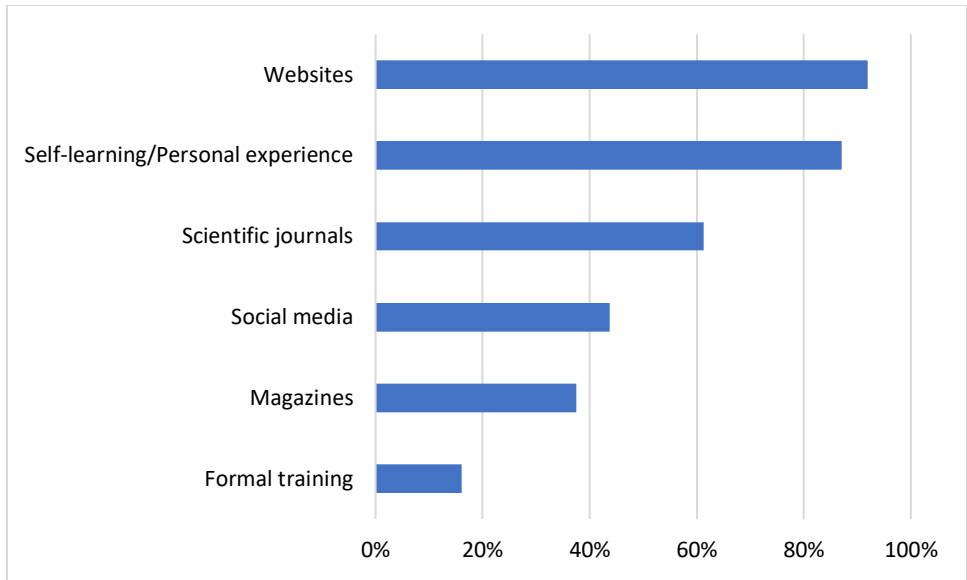


Figure 14. Method(s) used to dispose of animal(s) (n=37)

Respondents were asked to indicate from which of the following sources they typically acquire information about caring for their pet amphibian. Most (92%) of the respondents indicated they typically acquire information about caring for their pet amphibian(s) from websites, 87% cited self-learning/personal experience, 61% reported getting their information from scientific journals (Fig. 15). The other sources frequently mentioned were social media (44%), magazines (37%), and formal training (16%).



*Sum of percentages exceeds 100% as multiple responses may be selected by each respondent
 Figure 15. Sources of information for amphibian care (n=387)

When asked how frequently their pet amphibian(s) receive veterinary care, of 358 respondents, 63% indicated their amphibian(s) receive veterinary care or diagnostic tests as needed (Fig. 16). Similarly, 5% indicated regularly receiving care and test, 3% indicated occasionally, and 30% indicated reported never receiving care or tests. When asked if they had a death of amphibians in possession, nearly 80% of the respondents reported having had a pet amphibian die.

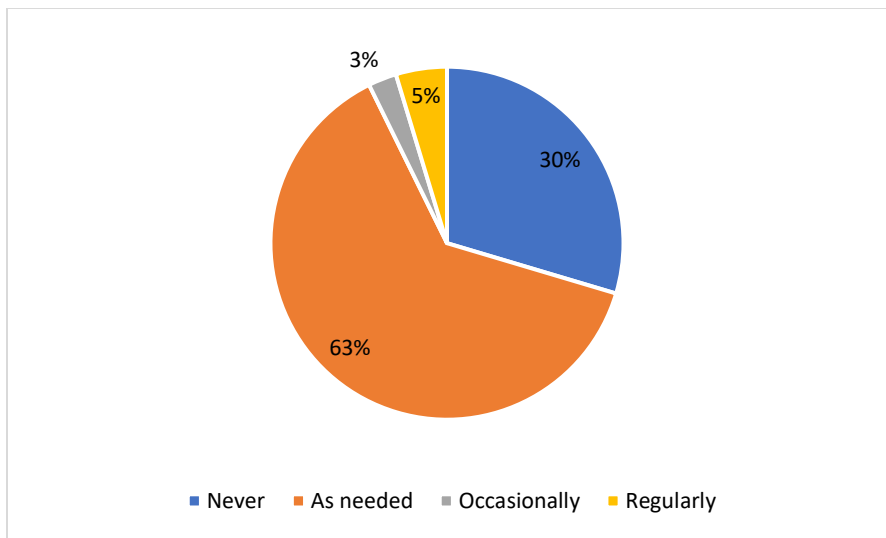


Figure 16. Frequency of veterinary care and diagnostic tests. (n=385)

Of 387 consumers responding, seventy-nine percent indicated they had had a pet amphibian in their care die.

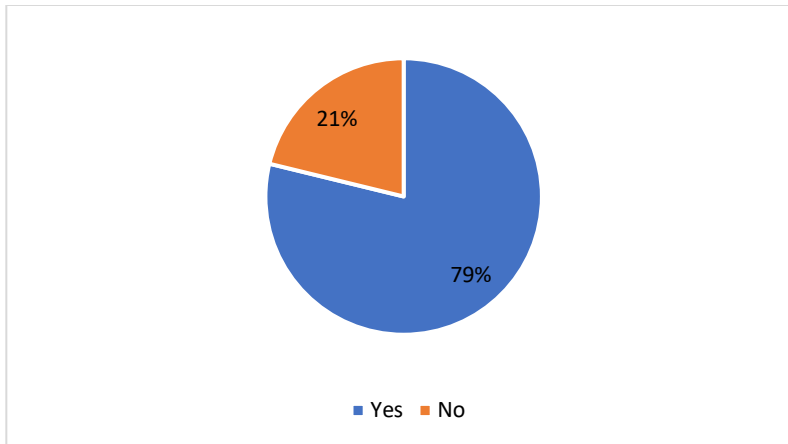
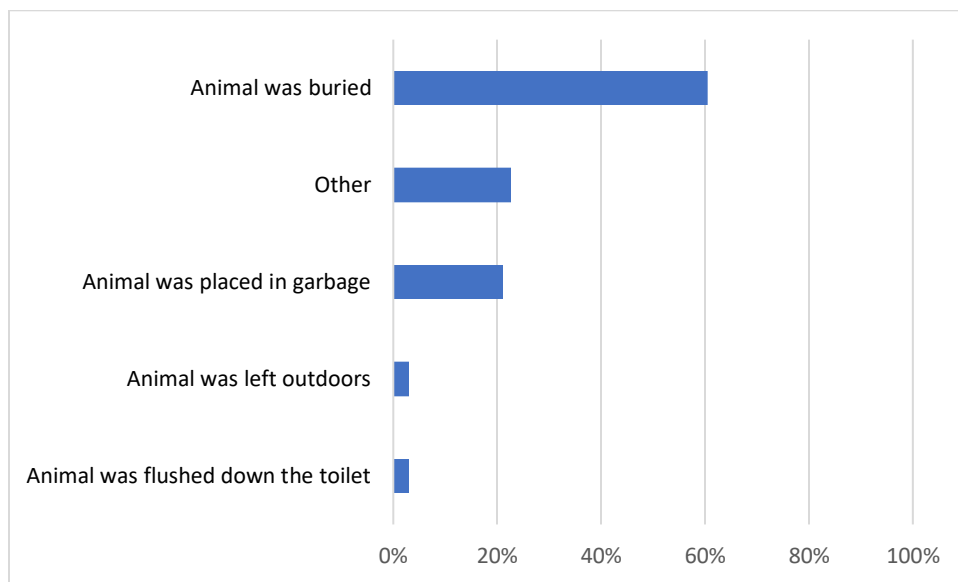


Figure 17. Percentage of amphibian pet owners who have had a pet amphibian in their care die (n=387)

Of 304 respondents reporting having had an amphibian die, 61% indicated the deceased animal was buried, 21% indicated the animal was placed in the garbage, 3% reporting flushing the animal down the toilet, 3% left the animal outdoors, and 23% respondents indicated the animal was disposed of through other means including cremation.



*Sum of percentages exceeds 100% as multiple responses may be selected by each respondent

Figure 18. Methods for disposing of deceased animal(s) (n=304)

When asked about their intention to seek veterinary care or administer treatment at home for animal showing signs of illness, 99% indicated, assuming costs were not a concern, they would be willing to seek veterinary care or administer treatment at home if their pet amphibian showed signs of illness (Fig. 19).

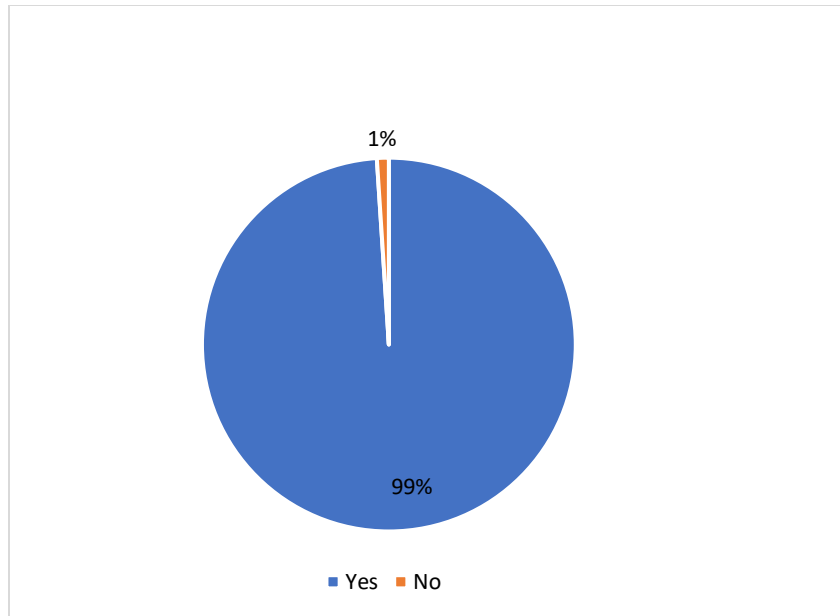


Figure 19. Willingness to seek veterinary care or administer treatment at home if pet amphibian(s) show signs of illness. (n=387)

Familiarity and Experience with Beneficial Microbes and Harmful Pathogens

Respondents were asked if, before reading the survey, they were aware of beneficial microbes, such as *Bacillus mycoides*, that can kill harmful microbes and increase disease resistance in amphibians. A majority (63%) reported that they were unaware of *Bacillus mycoides* or other beneficial microbes and their ability to kill harmful microbes and increase disease resistance in amphibians (Fig. 20).

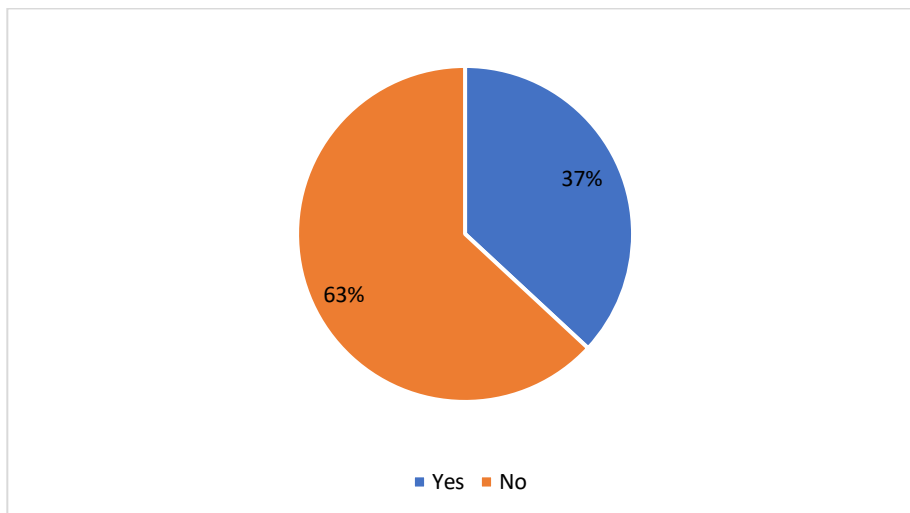


Figure 20. Percentage of respondents aware of beneficial microbes, such as *Bacillus mycoides*, that can kill harmful microbes and increase disease resistance in amphibians (n=382)

When asked whether they would consider administering treatment to their pet amphibian using “probiotics” such as *Bacillus mycooides*, 40% indicated “Definitely Yes”, and the other 60% indicated “Maybe, but I need more information” (Fig. 21). Only 1 respondent indicated “Definitely not”.

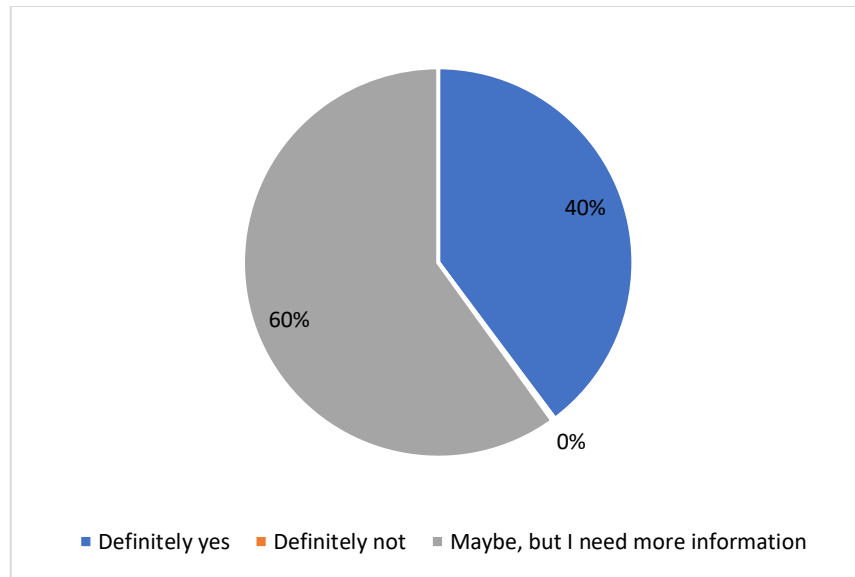


Figure 21. Percentage of respondents who would consider administering treatment to your pet amphibian using “probiotics” such as *Bacillus mycooides* (n=382)

When asked whether, before reading the survey, they were aware that the *Bd*, *Bsal* and *Rv* pathogens can be transmitted through pet trade, 70% indicated they were (Fig. 22). The remaining 30% were not aware that the *Bd*, *Bsal* and *Rv* pathogens can be transmitted through pet trade

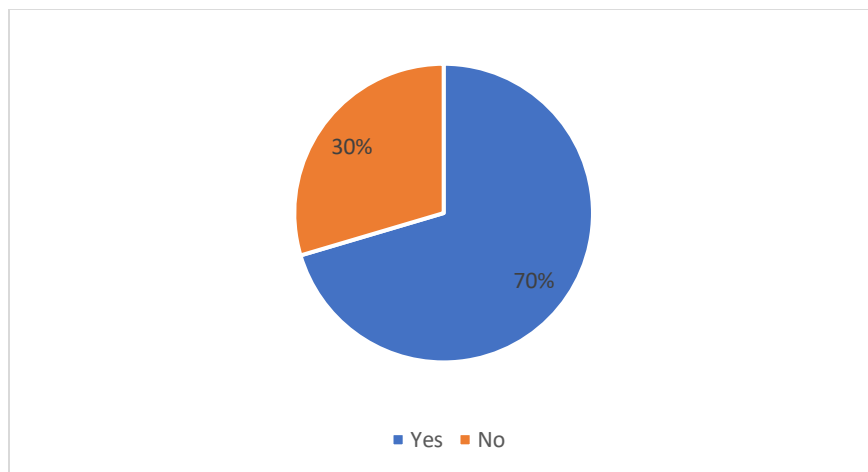


Figure 22. Percentage of respondents aware that the *Bd*, *Bsal* and *Rv* pathogens can be transmitted through pet trade (n=382)

When asked their level of concern when acquiring their most recent amphibian that the animal may have been infected with *Bd*, *Bsal* or *Rv*. Approximately two-third (64%) reported they were not at all

concerned whereas one-third (30%) were slightly concerned and the remaining 6% were very concerned (Fig. 23).

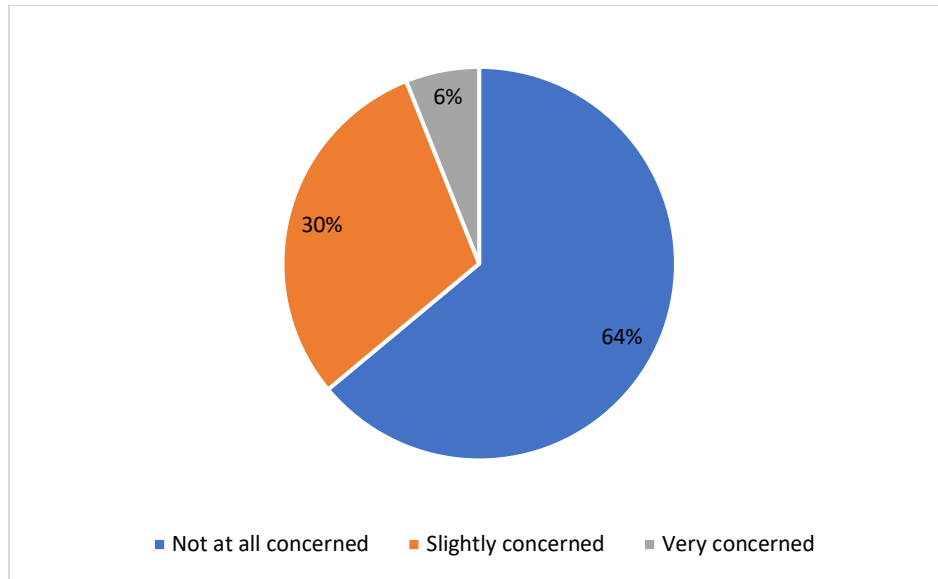
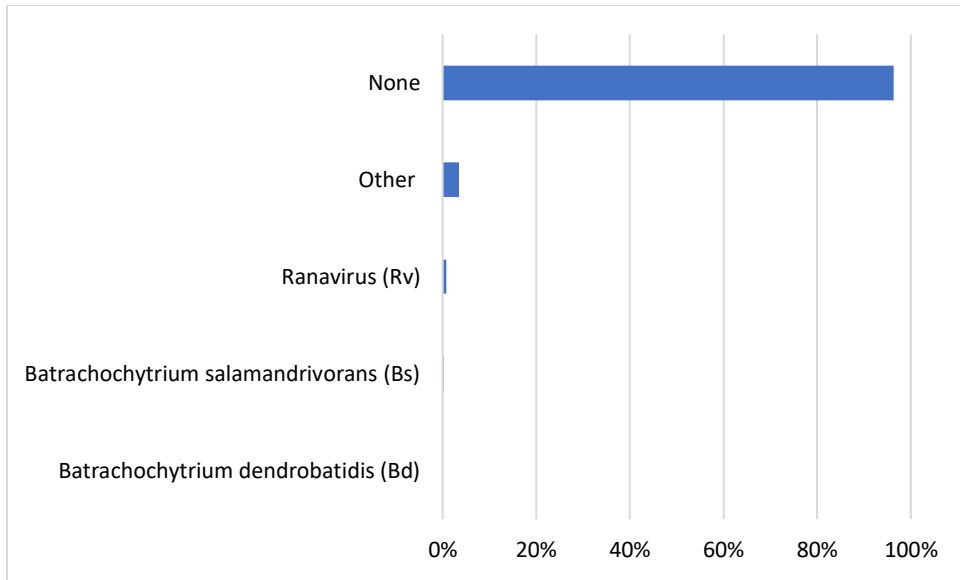


Figure 23. Level of concern that most recent amphibian purchase may have been infected with *Bd*, *Bsal*, or *Rv* prior to acquisition ($n=380$)

Nearly all (96%) respondents reported having never detected a pathogen in their pet amphibian(s) (Fig. 24). Less than 1% of consumers reported having detected either *Rv* or *Bsal*. Although about 3% respondents responded “other” pathogens had been detected in their pet amphibians, only three respondents specified actual illnesses or disease, which included “skin infection”, “Red leg disease in Pac-Man frogs”, and “reptiles with salmonella”.

While one consumer indicated the *Bsal* pathogen was detected in their amphibian(s), to date, *Bsal* is not known to have been found in North America in the wild or archived museum and DNA samples. However, requisite levels of surveys and monitoring have not yet been conducted in order to state conclusively that *Bsal* is not yet here, undetected (salamanderfungus.org).



*Sum of percentages exceeds 100% as multiple responses may be selected by each respondent
 Figure 24. Pathogens detected in respondent pet amphibians (n=378)

When asked if they were to acquire another pet amphibian in the future, how important it would be that the animal is free of the *Bd*, *Bsal*, *Rv* pathogens mentioned in the previous question, over half (52%) indicated it extremely important and another 27% indicated very important (Fig. 25). Only 2% indicated it to be not at all important.

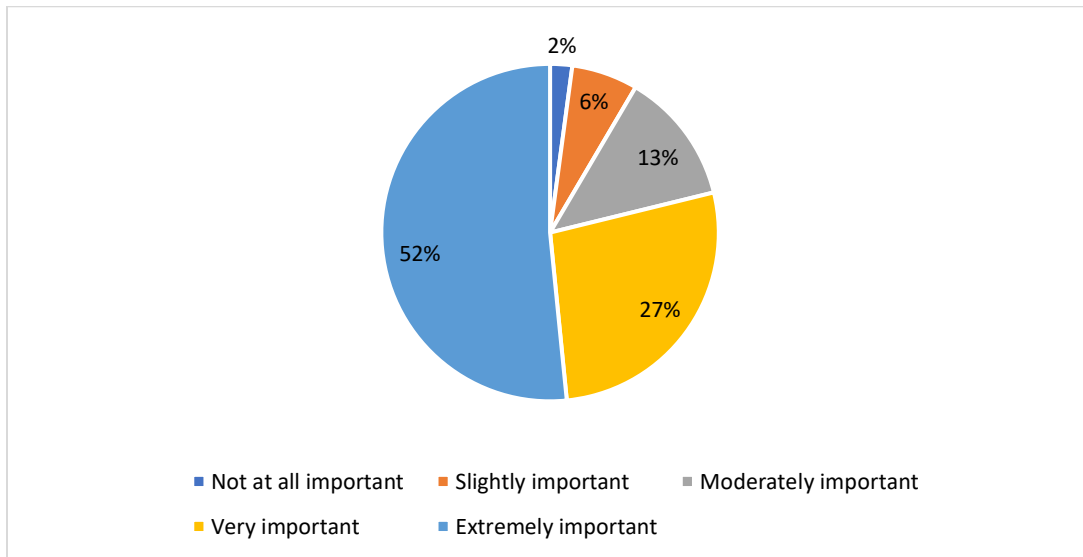


Figure 25. Level of importance that an amphibian acquired in the future is free of the *Bd*, *Bsal*, and *Rv* pathogens (n=378)

Willingness to pay for pathogen free amphibian

Three-quarters (76%) of the respondents indicated that, when acquiring an amphibian, they would be willing to pay more for an animal that is certified free of the *Bd*, *Bsal* and *Rv* pathogens (Fig. 26). About 20% indicated they were not sure about paying more whereas the remaining 4% were not willing to pay more.

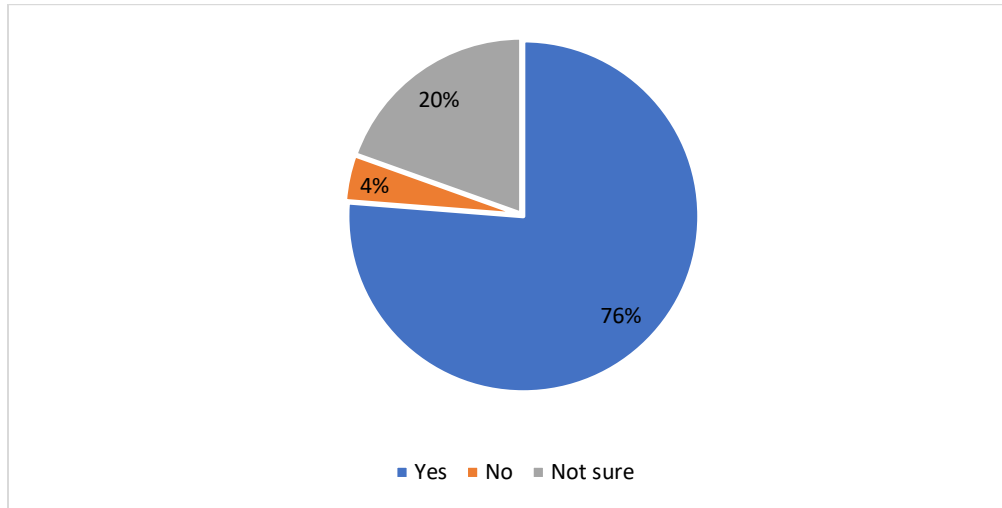


Figure 26. Willingness to pay more for an animal that is certified free of the *Bd*, *Bsal*, and *Rv* pathogens (n=379)

Respondents were presented with a randomly selected dollar amount (\$1, \$2, \$3, \$5, \$7, \$10, \$15, \$20, \$30, \$50) and asked whether they'd be willing to pay the presented amount extra to acquire an amphibian that is certified free of the *Bd*, *Bsal*, and *Rv* pathogens compared to the price for not certified or not confirmed to be free of these pathogens. Overall, ninety percent of respondents indicated they would be willing to pay the amount presented (Fig. 27).

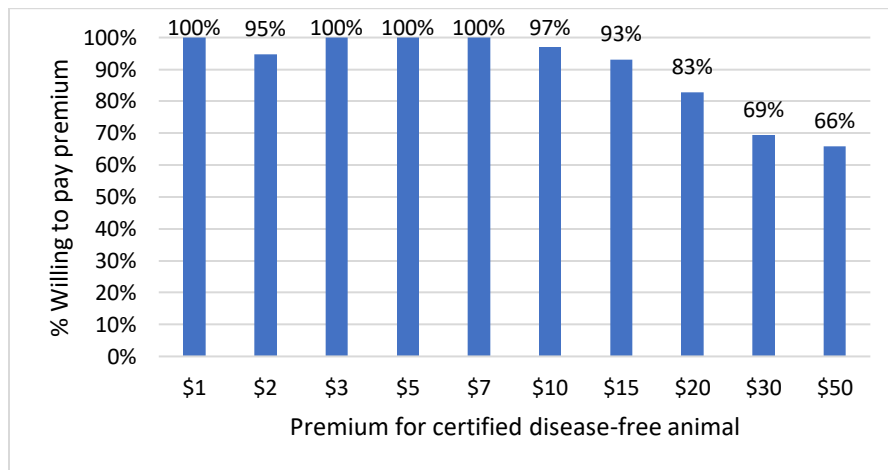


Figure 27. Percent of respondents willing to pay extra for certified disease-free animal (n=364)

Among the respondents who were not willing to consider paying extra for a certified animal compared to a non-certified animal, 38% indicated that they cannot afford to pay the extra amount being

proposed, 40% indicated they do not think they should be responsible for this expense and the remaining 22% indicated it is not worth paying (Fig. 28).

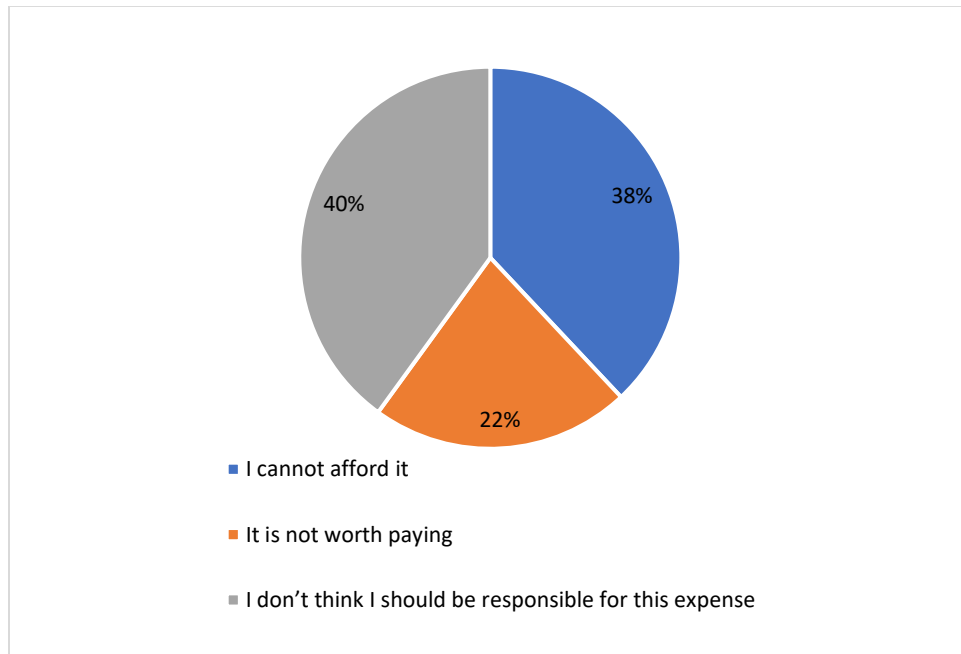


Figure 28. Reasons for unwillingness to pay extra for an animal certified free of Bd, Bsal and Rv compared to a non-certified animal (n=50)

Attitudes Toward Pathogen Transmission and Likelihood of Adopting Mitigating Actions

Respondents were asked to report their level of agreement with a series of statements pertaining to pathogen transmission in the pet trade (Fig. 29). Most of the respondents indicated they believe the threat of transmission of harmful pathogens from pets to natural areas is serious, protecting natural populations is important, and that they have a role to play in protecting natural populations. However, time, knowledge, and financial constraints may be barriers preventing amphibian owners from further implementing biosecurity practices.

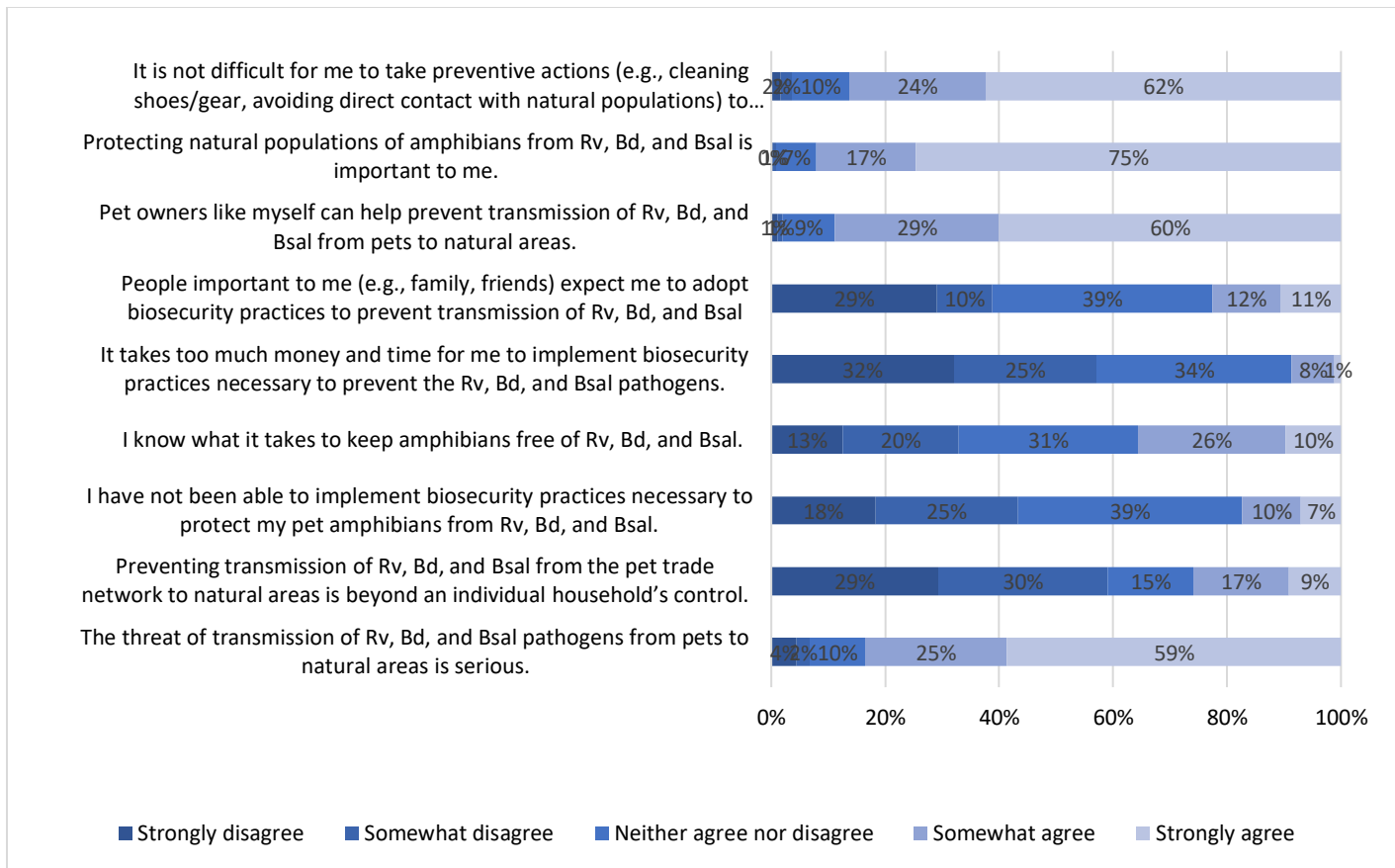


Figure 29. Level of agreement and disagreement with statements related to Bd, Bsal and Rv transmission (From top: n1=358, n2=359, n3=356, n4=359, n5=359, n6=358, n7=358, n8=355, n9=359),

When asked about the likelihood of taking various steps to limit the spread of harmful pathogens, most respondents indicated they were extremely likely to take the steps listed (Fig. 30).

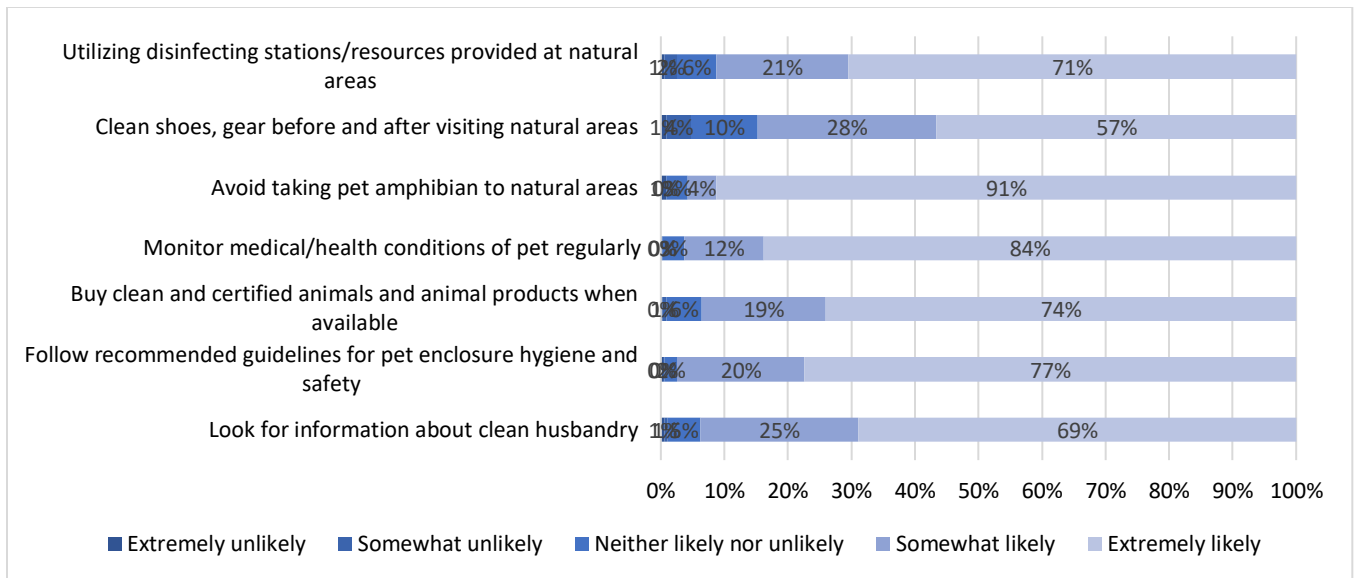


Figure 30. Likelihood of taking various steps to limit the spread of harmful pathogens (From top: n1=354, n2=350, n3=355, n4=353, n5=357, n6=356)

Correlations between responses

Results suggest a positive relationship between length of amphibian ownership and number of amphibians owned with 68% of respondents that have owned amphibians for over 10 years indicating they have owned more than 10 amphibians, while only 17% of respondents who have owned amphibians for 1-4 years reported owning more than 10 amphibians (Fig. 31).

Years owned amphibians	Number of amphibians owned				
	1	2-4	5-7	8-10	More than 10
1-4 years	16%	40%	19%	8%	17%
5-7 years	2%	30%	22%	15%	32%
8-10 years	0%	14%	28%	10%	48%
Over 10 Years	1%	7%	14%	10%	68%

Figure 31. Number of amphibians owned by years of ownership

Overall, seventy-nine percent of all consumer respondents (305) indicated they had had an amphibian in their care die. Ninety-five percent of consumers that had owned amphibians for more than 10 years had had a pet amphibian die, 89% of those owning amphibians for 8-10 years had had an amphibian die, 86% of those owning 5-7 years and 61% of those owning amphibians owning 1-4 years (Fig. 32).

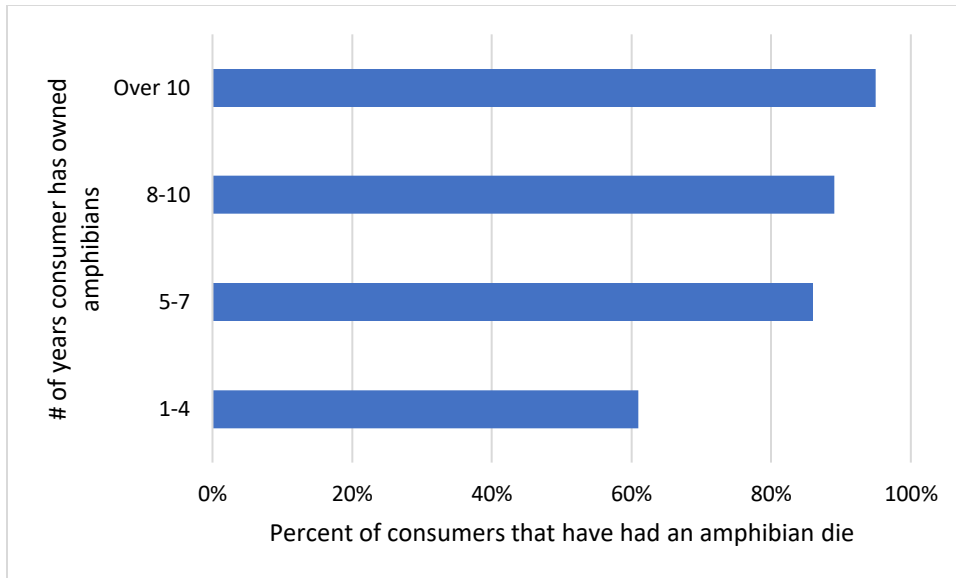
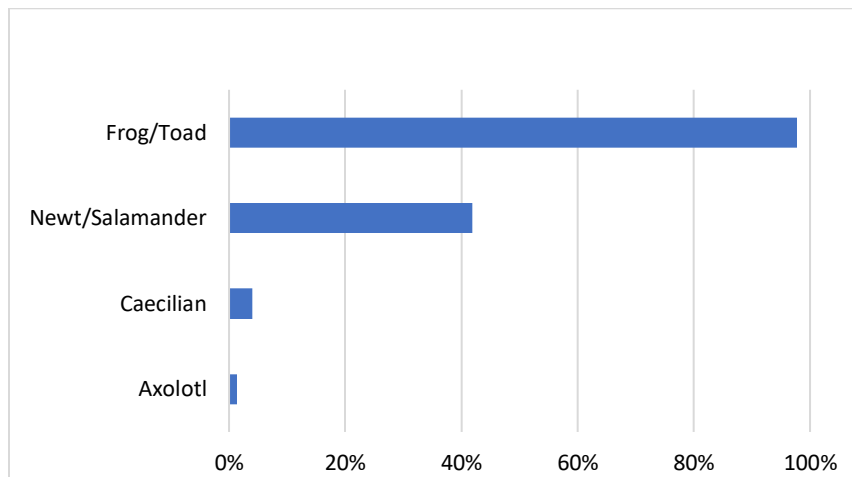


Figure 32. Percent of consumers indicating they've had a pet amphibian die by years of amphibian ownership. (From top, n1=163, n2=59, n3=28, n4=137)

Of the 19% (76) consumers indicating they had collected an amphibian from the wild, 98% indicated they had collected a frog or toad, 42% a newt or salamander, 4% a Caecilian, and 1% indicated they had collected an axolotl (Fig. 33).



*Sum of percentages exceeds 100% as multiple responses may be selected by each respondent

Figure 33. Amphibian ownership by respondents indicating they've acquired amphibians by collecting from the wild. (n=76)

Tables 34-38 report the additional amounts of money consumer respondents indicated they would be willing to pay for an amphibian certified to be free of *Bsal*, *Bd* and *Rv* by the amount the consumer paid for their most recently acquired amphibian.

Respondents that paid \$0 for their amphibian	
Premium for certified animal (\$)	Consumers WTP premium (%)
1	19%
2	3%
3	13%
5	6%
7	19%
10	9%
15	6%
20	16%
30	3%
50	6%

Figure 34. WTP for certified disease-free animal for respondents paying \$0 for most recently acquired amphibian (n=32)

Respondents that paid \$1-\$25 for their amphibian	
Premium for certified animal (\$)	Consumers WTP premium (%)
1	13%
2	12%
3	13%
5	10%
7	7%
10	10%
15	12%
20	6%
30	7%
50	9%

Figure 35. WTP for certified disease-free animal for respondents paying \$1-\$25 for most recently acquired amphibian (n=68)

Respondents that paid \$26-\$75 for their amphibian	
Premium for certified animal (\$)	Consumers WTP premium (%)
1	12%
2	12%
3	9%
5	11%
7	12%
10	11%

15	9%
20	7%
30	9%
50	7%

Figure 36. WTP for certified disease-free animal for respondents paying \$26-\$75 for most recently acquired amphibian (n=161)

Respondents that paid \$76-\$125 for their amphibian	
Premium for certified animal (\$)	Consumers WTP premium (%)
1	7%
2	12%
3	17%
5	17%
7	15%
10	5%
15	5%
20	10%
30	5%
50	7%

Figure 37. WTP for certified disease-free animal for respondents paying \$76-\$125 for most recently acquired amphibian (n=41)

Respondents that paid over \$125 for their amphibian	
WTP Amount (\$)	% Of respondents WTP
1	7%
2	11%
3	7%
5	15%
7	11%
10	11%
15	4%
20	15%
30	11%
50	7%

Figure 38. WTP for certified disease-free animal for respondents paying over \$125 for most recently acquired amphibian (n=27)

Amphibian Business Survey

Respondent Business Characteristics

Of 122 amphibian businesses responding to the survey, 75% reported dealing with amphibians and reptiles, 16% indicated they deal with amphibians only, and the remaining 8% deal with reptiles only (Fig. 39).

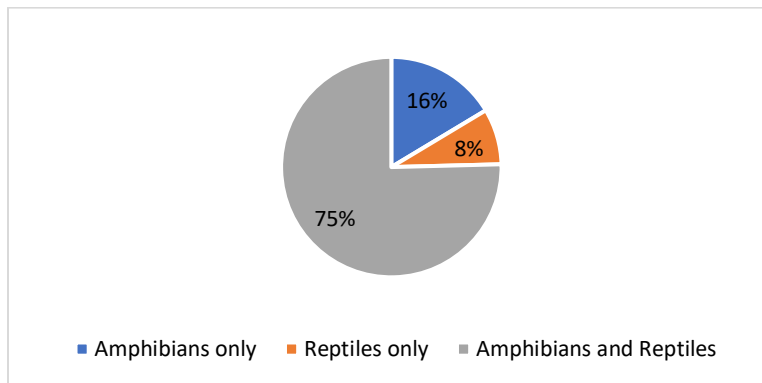
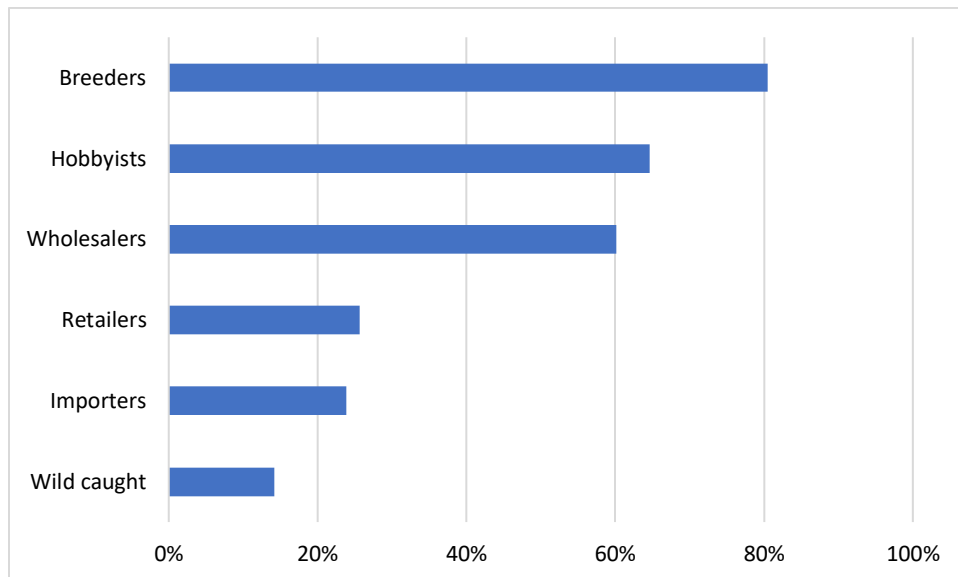


Figure 39. Types of animals business deals with (n=122)

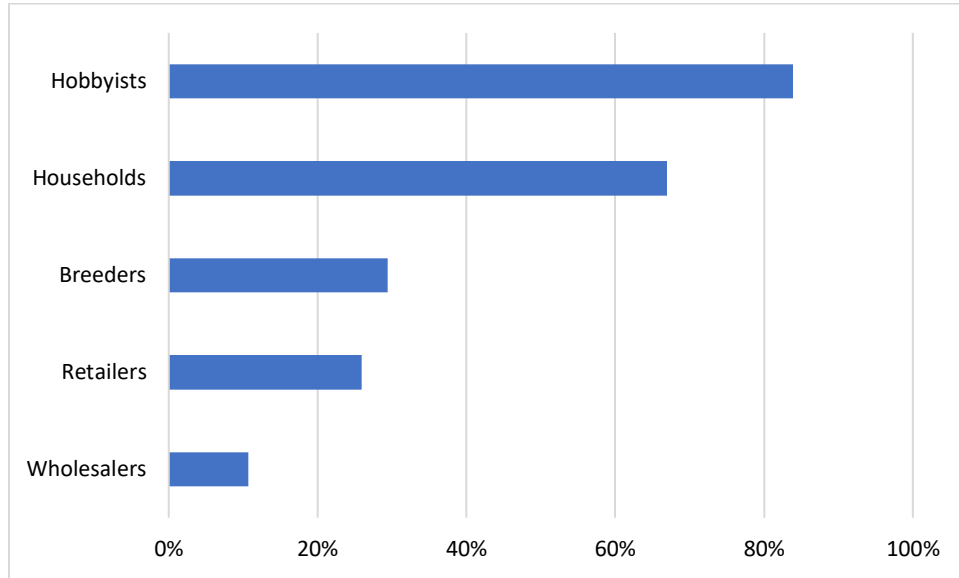
Of 113 amphibian businesses, 81% indicated the most used source for obtaining their amphibians is breeders, followed by hobbyists (76%), wholesalers (60%), retailers (26%), importers (24%), and wild caught (14%) (Fig 40).



*Sum of percentages exceeds 100% as multiple responses may be selected by each respondent

Figure 40. Where respondent businesses acquire amphibians (n=113)

Amphibian businesses reported the most common purchasers of their amphibians are hobbyists, with 84% of businesses selling to hobbyists, followed by households (67%), breeders (29%), Retailers (26%), and wholesalers (11%) (Fig. 41).



**Sum of percentages exceeds 100% as multiple responses may be selected by each respondent
Figure 41. Parties business sells amphibians to (n=112)*

About 29% of the businesses responding indicated to have been in the amphibian business over 20 years, whereas the other 26% indicated being in the business for 1 to 5 years only (Fig. 42).

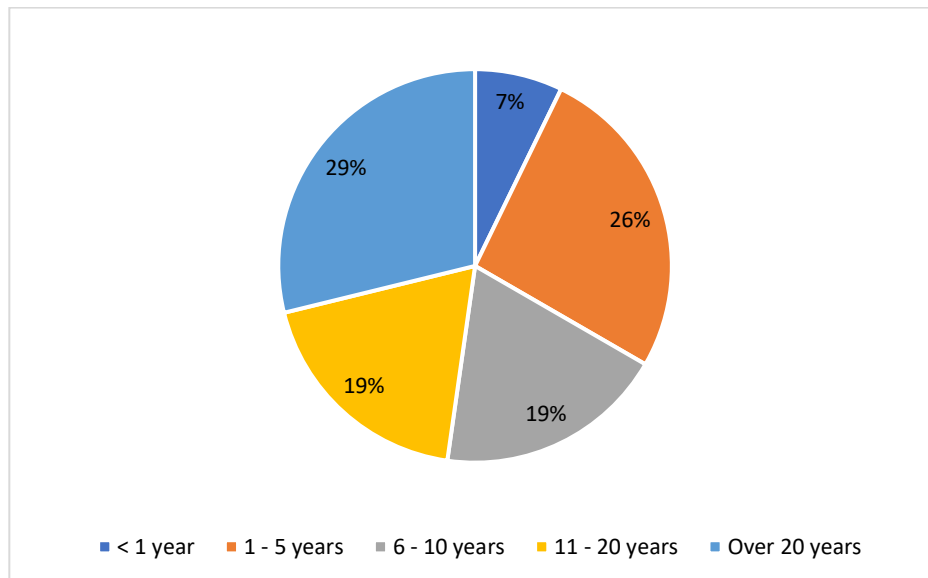


Figure 42. Number of years in the amphibian business (n=111)

In terms of the annual sales volume, approximately one-third reported less than \$5,000 and another one-third (36%) indicated somewhere between \$5,000 and \$500,000). The remaining one-third (33%) indicated over \$500,000 of annual sales (Fig. 43).

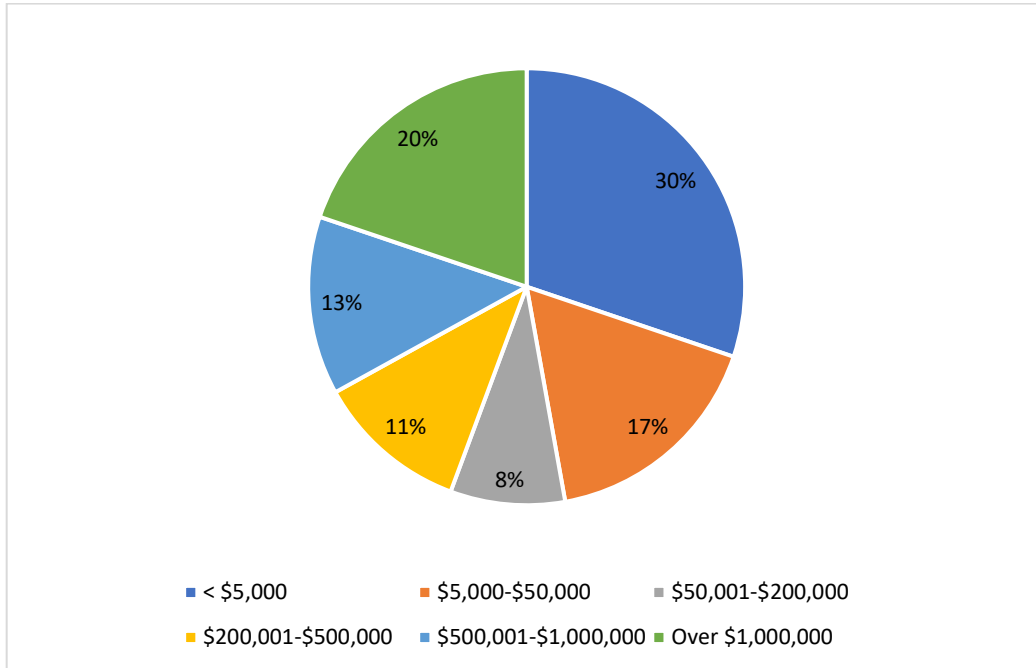


Figure 43. Annual sales of business (n=106)

Approximately half (51%) of amphibian businesses responding indicated that amphibian sales accounted for less than 10% of their total sales. Twenty-three percent reported amphibian sales accounted for 10%-25% of total sales, 14% businesses reported 26%-75%. The remaining 12% reported amphibian sales accounted for 76%-100% of their total sales (Fig. 44).

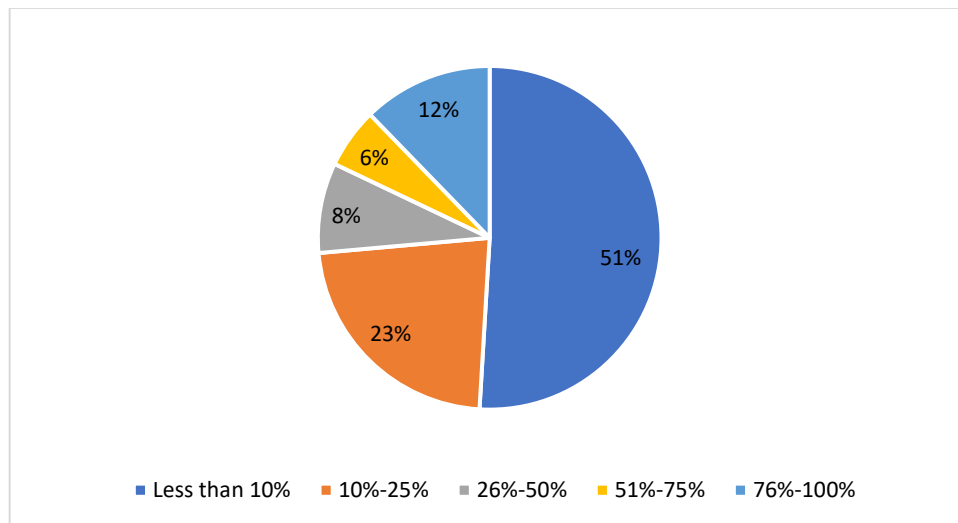


Figure 44. Percentage of total sales attributed to amphibians (n=106)

In terms of the employee size of the businesses responding to the survey, 45% reported having 1-2 employees, 17% had 3-5 employees, 25% had 6-20 employees, and the remaining 12% reported having more than 20 employees (Fig. 45). Nearly half of the responding businesses reported being operated as sole proprietorship (Fig. 46).

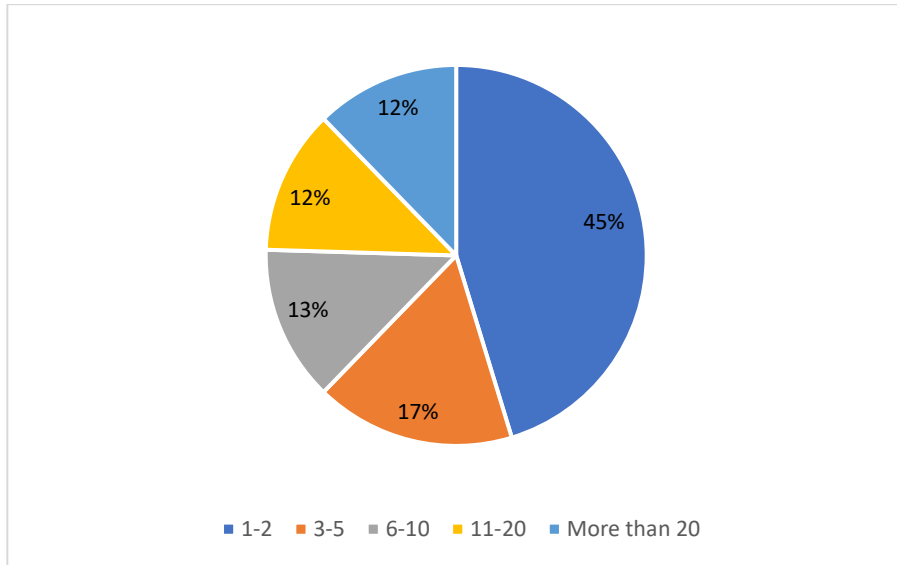


Figure 45. Number of employees at the responding businesses (n=106)

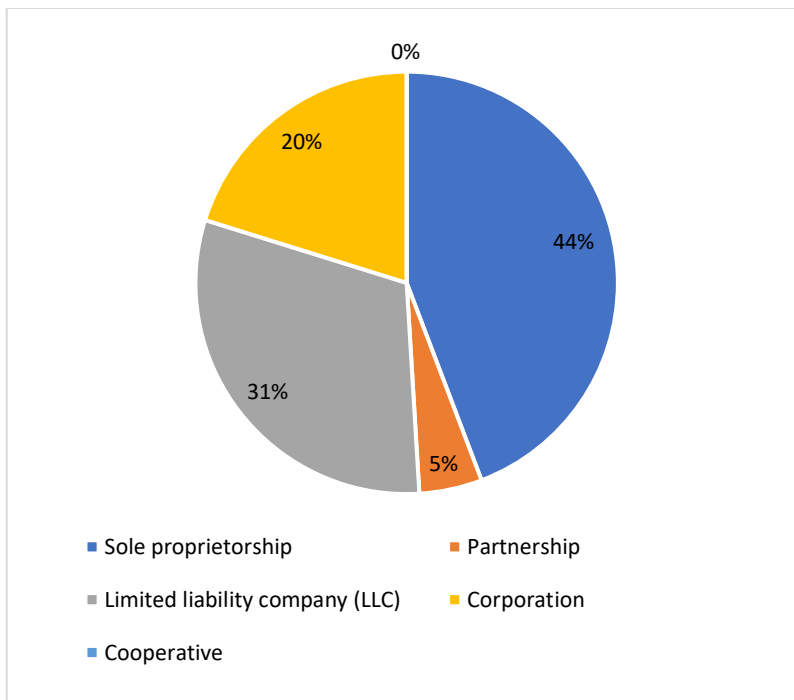


Figure 46. Type of ownership of business (n=104)

One-third of the responding businesses indicated they are in the Midwest, 20% indicated they are in the Southeast, 13% indicated they were in each of the Northeast, Southwest, and Pacific Northwest regions (Fig. 47). The final 8 % reported being in the Rocky Mountain region.

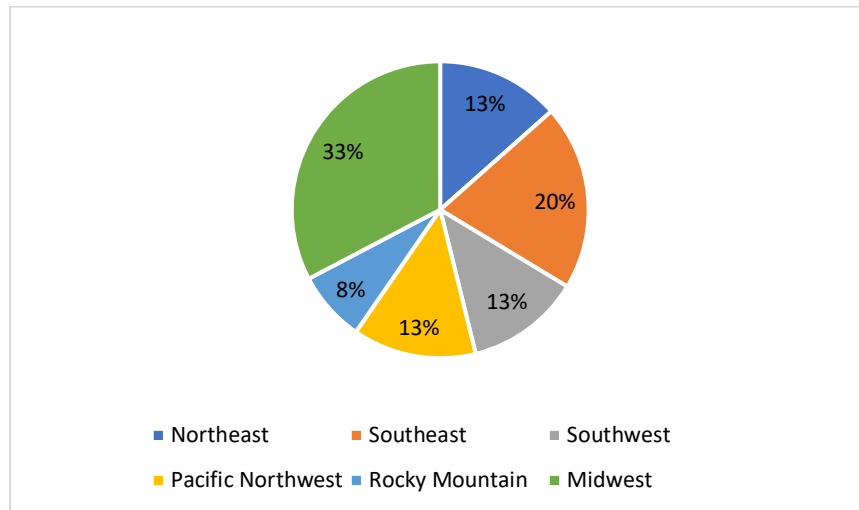


Figure 47. Geographic region of business location (n=104)

When asked whether their organization conducts business with buyers or sellers of amphibians outside the country, 82% responding businesses indicated “No” and the other 10% responded they do business with buyers and sellers outside the country. The remaining 8% indicated did not know (Fig. 48).

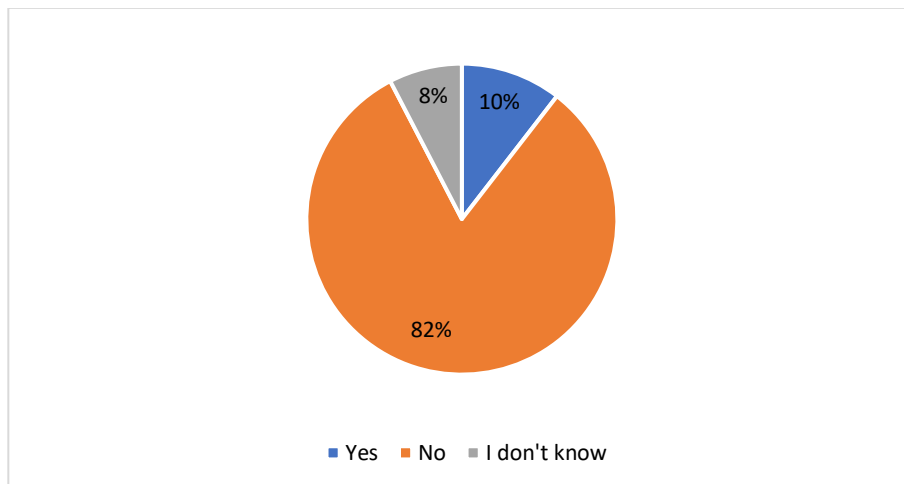


Figure 48. Business with buyers and sellers outside of the United States (n=105)

Fifty-eight percent of the responding businesses indicated that there were, to their knowledge, other businesses, or organizations similar to theirs currently operating within the same state Fig. 49). Similarly,

38% indicated they were not sure, while the remaining 4% indicated they were not aware of other businesses in the state.

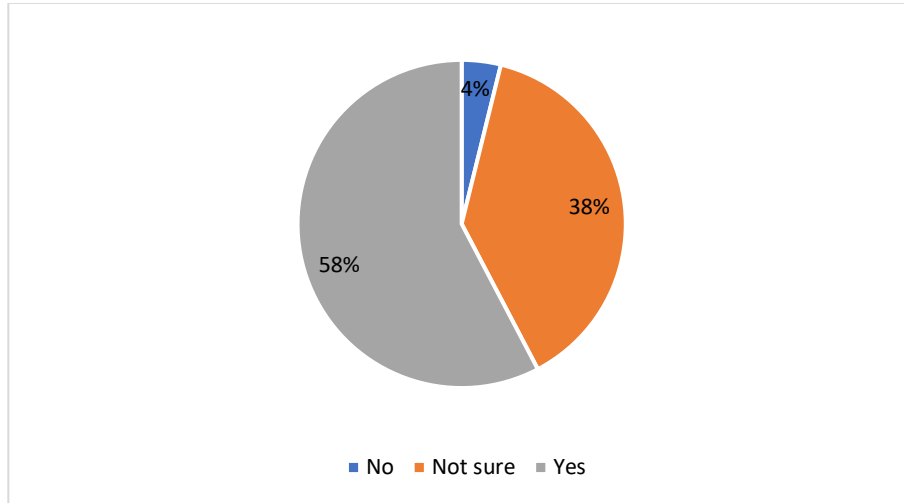
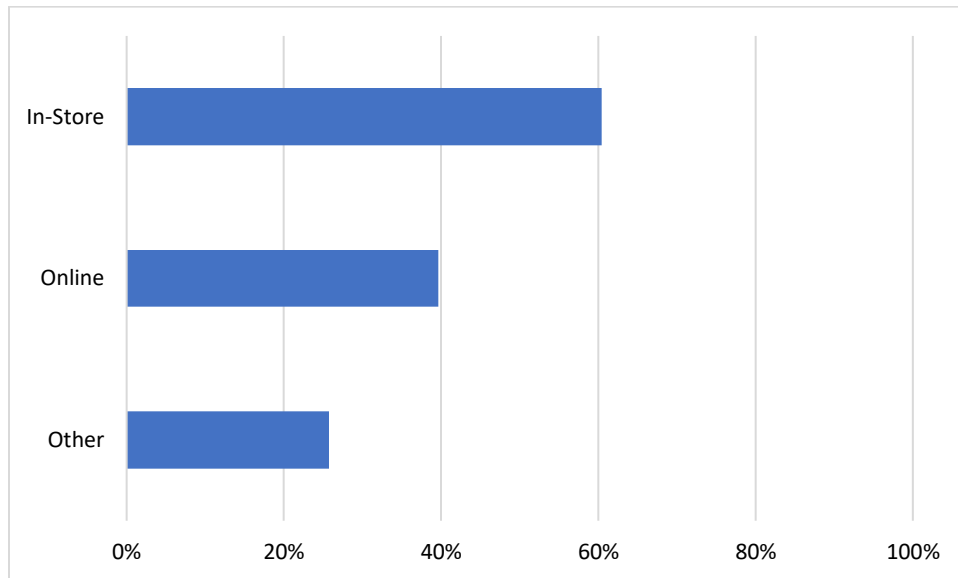


Figure 49. Knowledge of businesses like respondents operating within same state as respondent

Regarding the mode of sales operation of their business, in-store operation was reported by the majority (60%) of respondents and online operation was indicated by less than half (40%). About 26% reported selling/supplying amphibians by other means including expos and trade shows (Fig. 50).



Sum of percentages exceeds 100% as multiple responses may be selected by each respondent
Figure 50. Mode of selling amphibians (n=101)

Businesses were asked to rate the importance of the following factors in making business decisions. Relatively high level of importance was placed on following ethical business practice, legal compliance, improving public image and profit, and responding to issues of social concerns (Fig. 51).

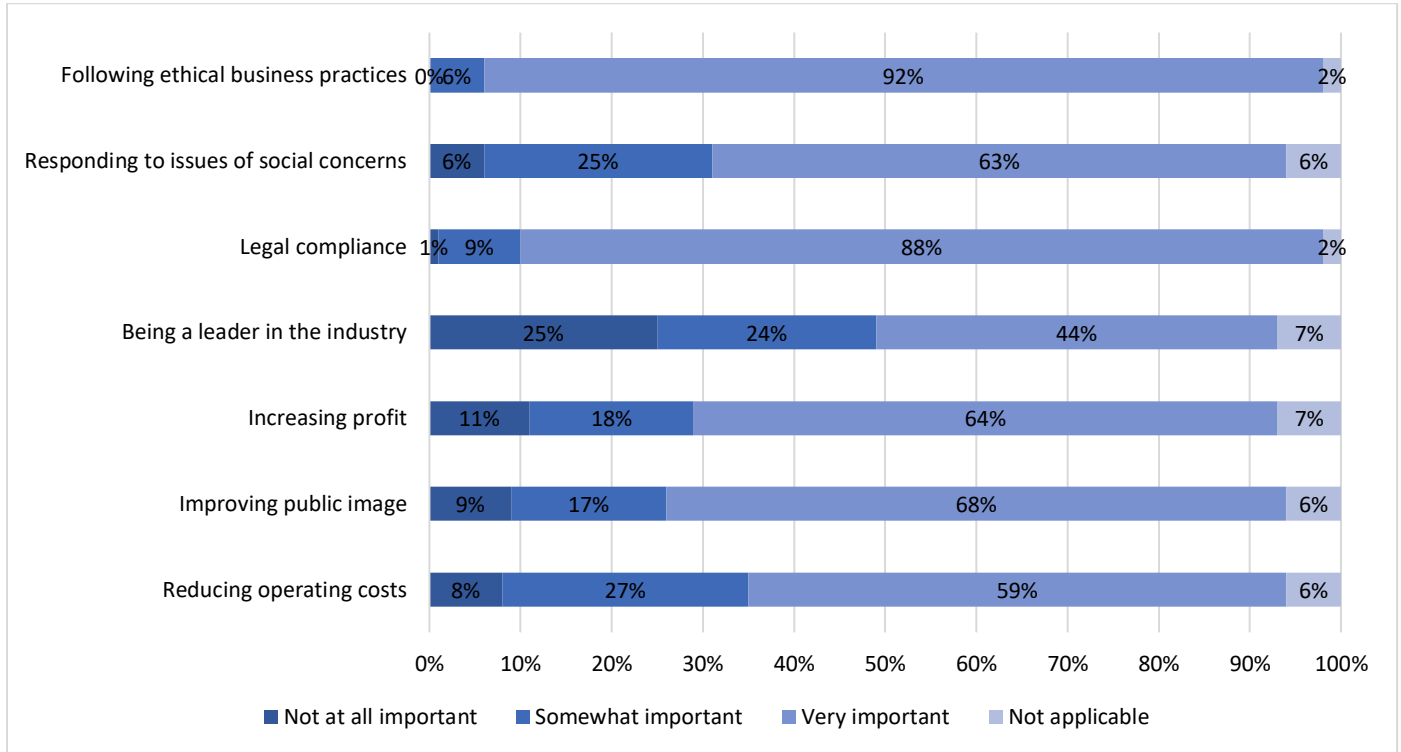


Figure 51. Importance of factors in making business decisions (From top: n1=100, n2=100, n3=100, n4=100, n5=100, n6=100, n7=100)

Awareness of Pathogens and Adoption of Biosecurity Practices

Slightly less than half (47%) indicated that before reading the survey they were unaware of beneficial microbes, such as *Bacillus mycooides*, that can kill harmful microbes and increase disease resistance in amphibians (Fig. 52). When asked if they would consider administering treatment to their pet amphibian using “probiotics” such as *Bacillus mycooides*, 47% indicated they will definitely do so, whereas the remaining 53% indicated they may be interested but need more information (Fig. 53).

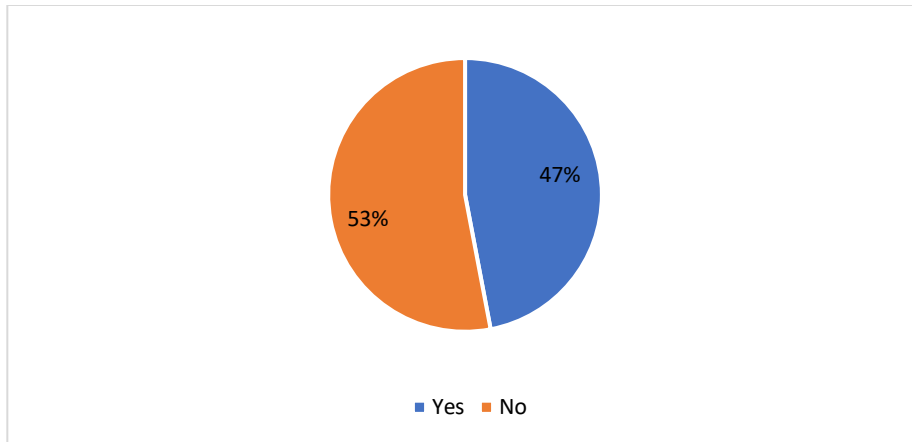


Figure 52. Percentage of respondents aware of beneficial microbes like *Bacillus mycoides* prior to reading this survey

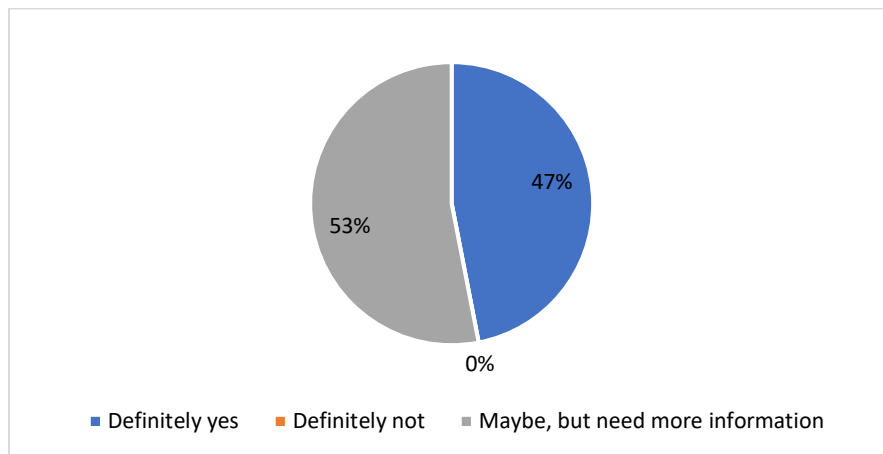


Figure 53. Percentage of respondents that would consider administering treatment to their pet amphibian using "probiotics" such as *Bacillus mycoides* (n=98)

Prior to reading the survey, 81% were aware that the pathogens *Bd*, *Bsal*, *Rv* can be transmitted through the pet trade, while the remaining 19% indicated they were not (Fig. 54).

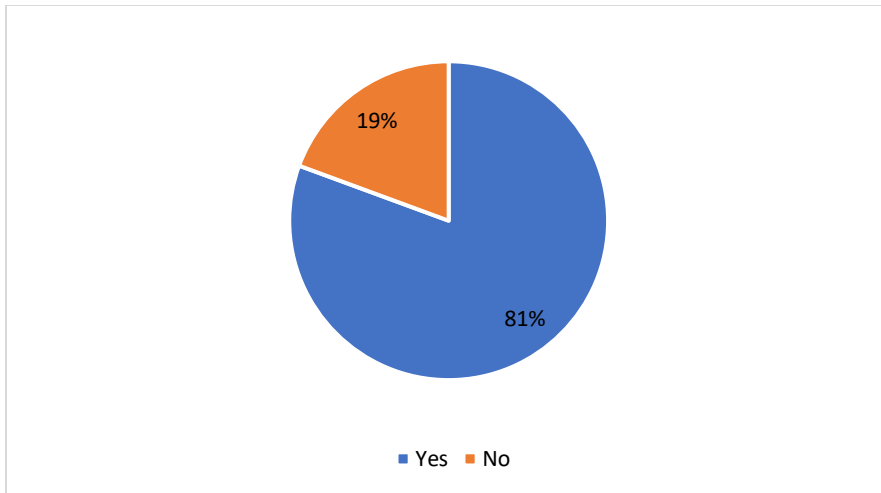
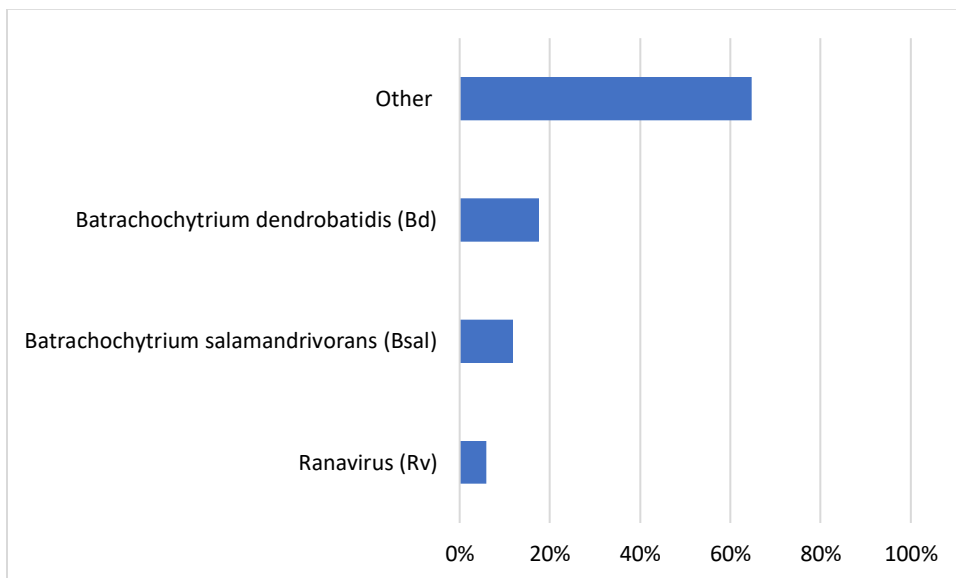


Figure 54. Percentage of respondents aware prior to reading survey that *Bd*, *Bsal*, and *Rv* can be transmitted through the pet trade (n=98)

Seventeen businesses indicated a pathogen had been detected in amphibians at their facility. Of those, 18% percent indicated *Bd* had been detected, 12% (2 businesses) indicated *Bsal* had been detected, 6% indicated *Ranavirus* had been detected and 65% reported the detection of another type of pathogen (Fig. 55).

To date, *Bsal* is not known to have been detected in North America in the wild or archived museum and DNA samples. However, requisite levels of surveys and monitoring have not yet been conducted in order to state conclusively that *Bsal* is not yet here, undetected (salamanderfungus.org).



Sum of percentages exceeds 100% as multiple responses may be selected by each respondent
 Figure 55. Percentage of respondents that have detected pathogens at their facility (n=17)

Sixty-three percent of businesses indicated they had had an amphibian die from illness or disease in their business facilities, while 37% indicated they had not (Fig. 56). Businesses indicated the average value of total loss resulting from the illness or death of an animal at their business facility was \$145, with minimum and maximum values of \$5 and \$700, respectively.

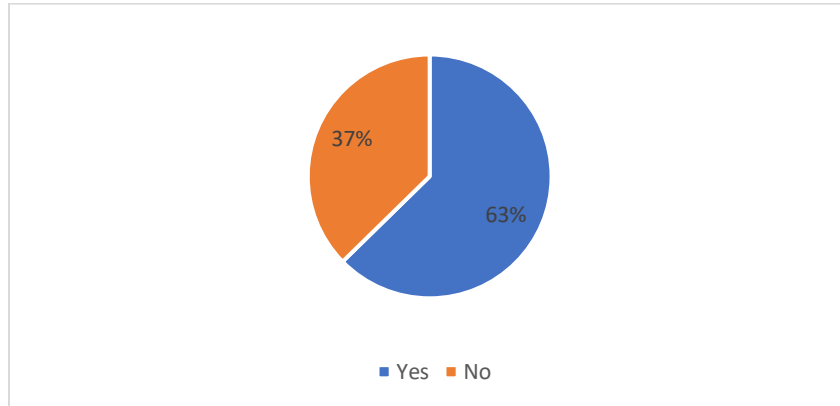


Figure 56. Percentage of businesses that have had an amphibian die from illness or disease (n=75)

Fifty-five percent of the responding businesses indicated they were very concerned that transmission of pathogens through the trade network of pets or pet products may impact the amphibian(s) in their facility. Thirty-one indicated being slightly concerned and the remaining 13% were not concerned (Fig. 57)

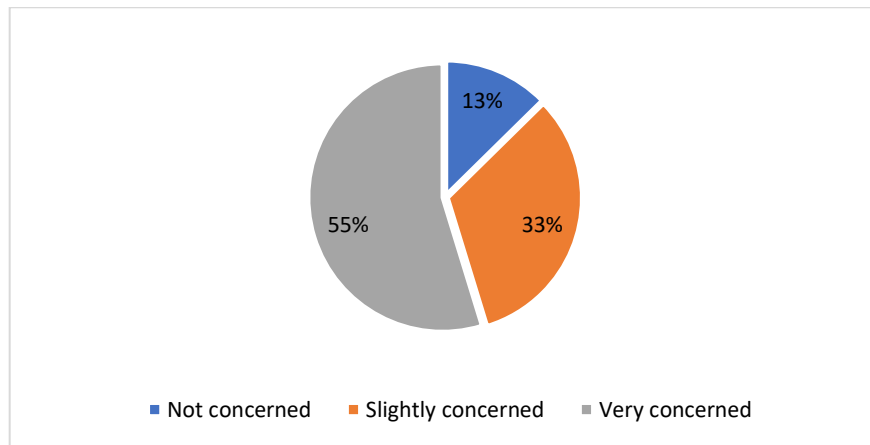
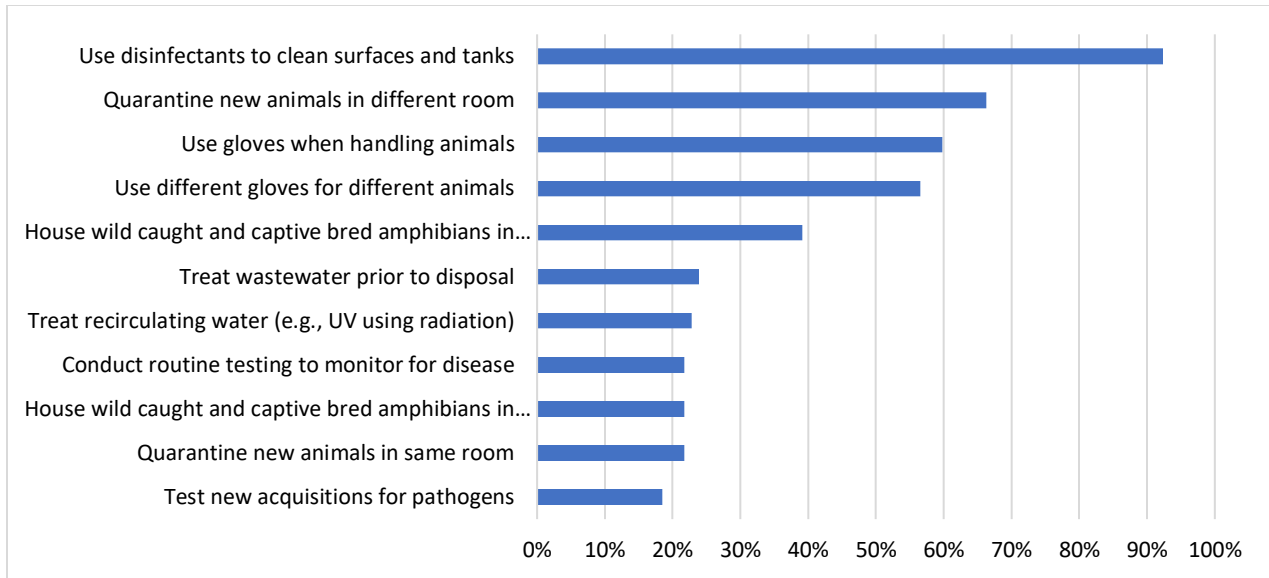


Figure 57. Level of concern transmission of pathogens through the trade network of pets or pet products may impact amphibians in respondent's facility (n=95)

Businesses were asked whether they took the following biosecurity measures at their facility. While most businesses indicated they use disinfectants to clean surfaces and tanks, use gloves for different animals and quarantine new animals in a separate room, few businesses test new acquisitions for pathogens, conduct testing to monitor for disease, or treat recirculating water or wastewater prior to disposal (Fig. 58).



Sum of percentages exceeds 100% as multiple responses may be selected by each respondent
 Figure 58. Percentage of businesses taking various biosecurity precautions (n=92)

When asked about the importance of amphibian health, 54% indicated it was extremely important to them that an animal be healthy and free of the *Bd*, *Bsal*, and *Rv* pathogens when introducing it to their facility, 32% indicated it is very important (Fig. 59).

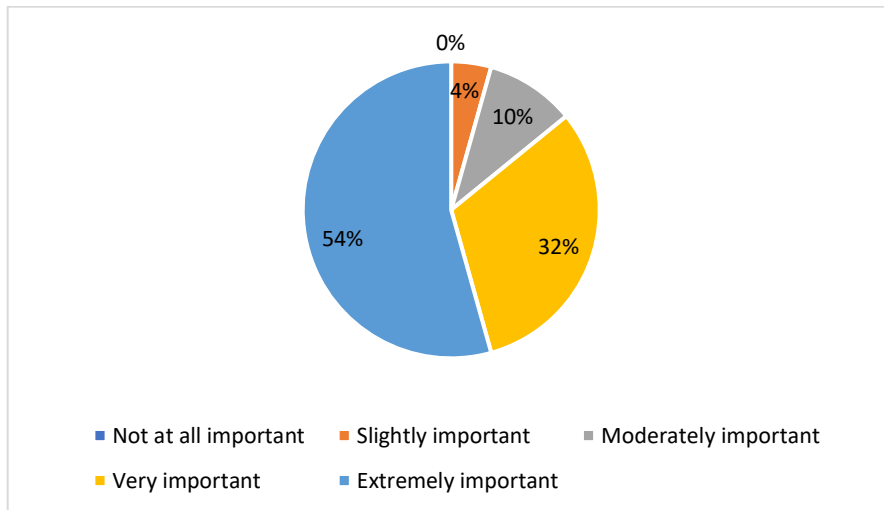


Figure 59. Level of importance placed on amphibians that are healthy and free of *Bd*, *Bsal* and *Rv* (n=92)

Business willingness to pay for pathogen-free amphibian

Nearly all (97%) of the businesses responding this survey indicated that, when introducing a new pet amphibian to their business, they would be interested in acquiring an animal that is certified as free of the *Bd*, *Bsal*, and *Rv* pathogens (Fig. 60).

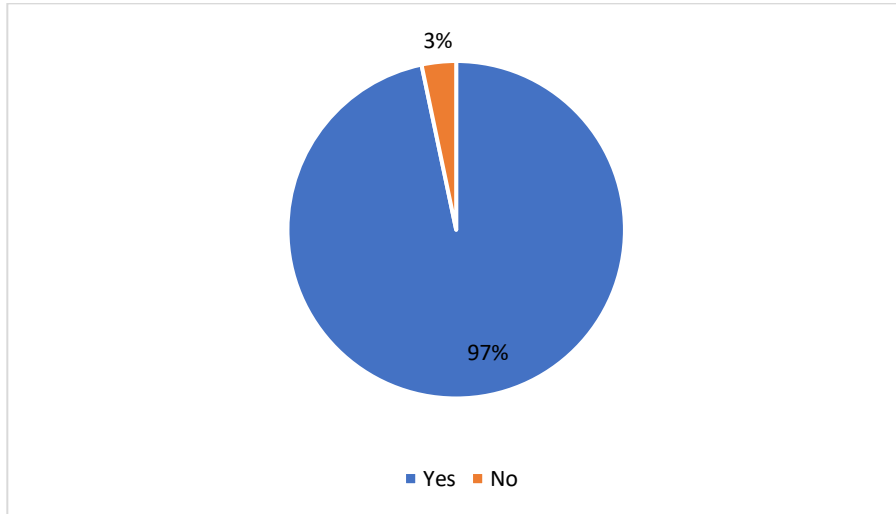


Figure 60. When introducing a new animal to their business, the percentage of respondents interested in acquiring an animal that is certified as free of the *Bd*, *Bsal* and *Rv* pathogens (n=91)

When asked if they would be willing to pay more for healthy animal, 59% indicated they would be willing to pay more for an animal that is certified as free of the *Bd*, *Bsal*, and *Rv* pathogens, while 35% indicated they were not sure (Fig. 61). Only 5% declined to pay more for an animal that is certified as pathogen free.

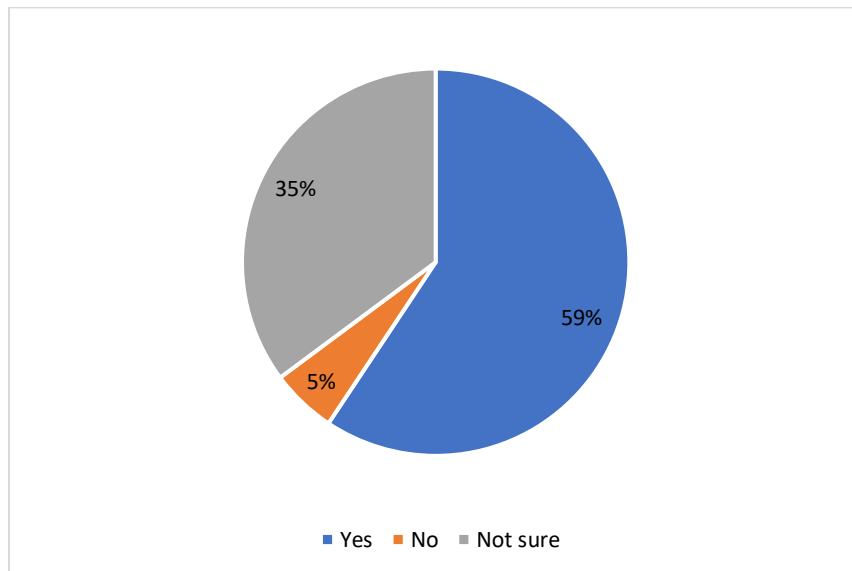


Figure 61. Percentage of respondents according to their willing to pay more for an animal that is certified as free of the *Bd*, *Bsal* and *Rv* pathogens (n=91)

The respondents who were willing to pay more for a certified animal were asked the approximate amount they would be willing to pay in addition to the price for non-certified animal. About 22% indicated they would be willing to pay 1-5% more, 36% indicated 6-10% more, and 28% indicated they would be willing to pay 11-20% more (Fig. 62). Similarly, 9% indicated a willingness to pay somewhere between 21-100% more and the remaining 5% indicated a willingness to pay over 100% more than the price of an animal that is not certified free of the *Bd*, *Bsal*, and *Rv* pathogens.

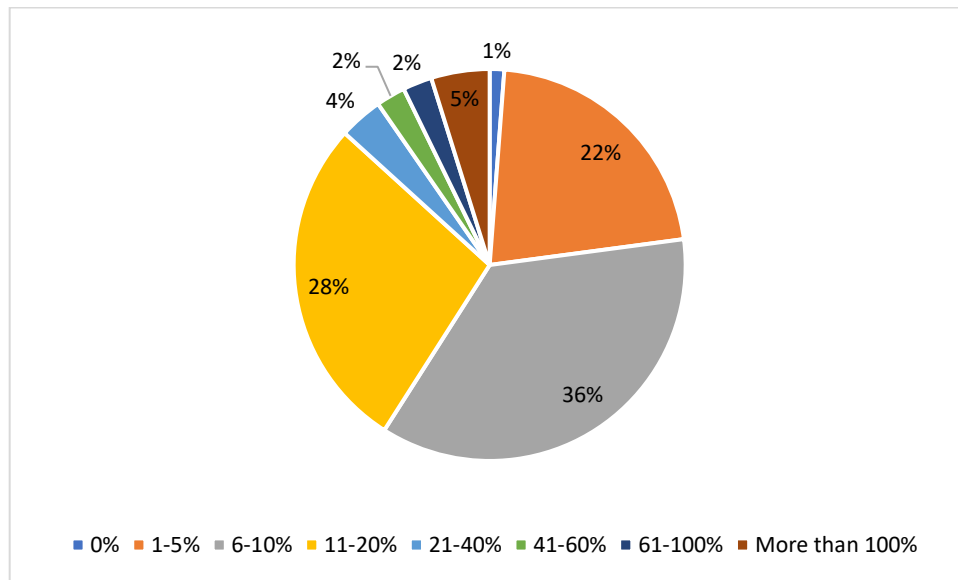


Figure 62. Percentage of respondents willing to pay various increases in price to acquire amphibian that is certified free of the *Bd*, *Bsal*, and *Rv* pathogens (n=83)

Respondents were asked about their perceived ability to improve the biosecurity at their facility without increasing the sales price. Slightly less than half (46%) indicated they were not sure but 25% indicated they can do so without increasing the selling price to their consumers. The remaining 29% indicated they cannot do so (Fig. 63).

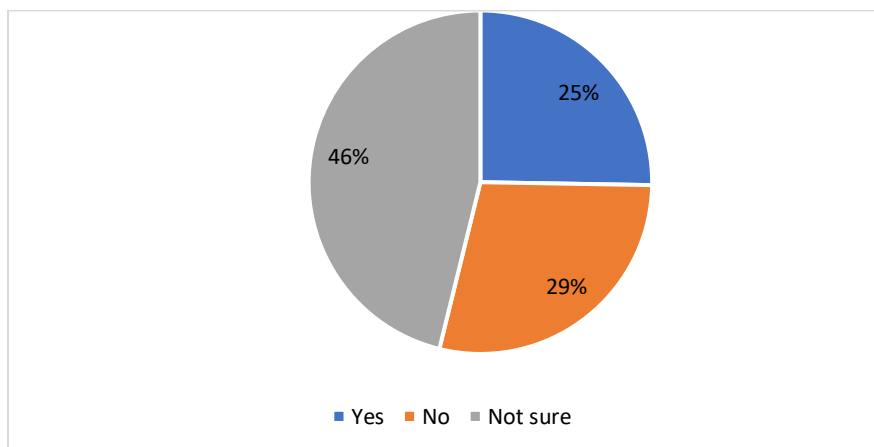


Figure 63. Percentage of respondents who believe they can improve biosecurity practices without increasing costs (n=91)

When businesses were asked how much they would expect the average amphibian sales price to increase if they were to ensure the animal was free of *Bd*, *Bsal*, and *Rv*, 27% indicated “Not sure”, 27% indicated 11-20%, and 24% indicated 6-10% (Fig. 64).

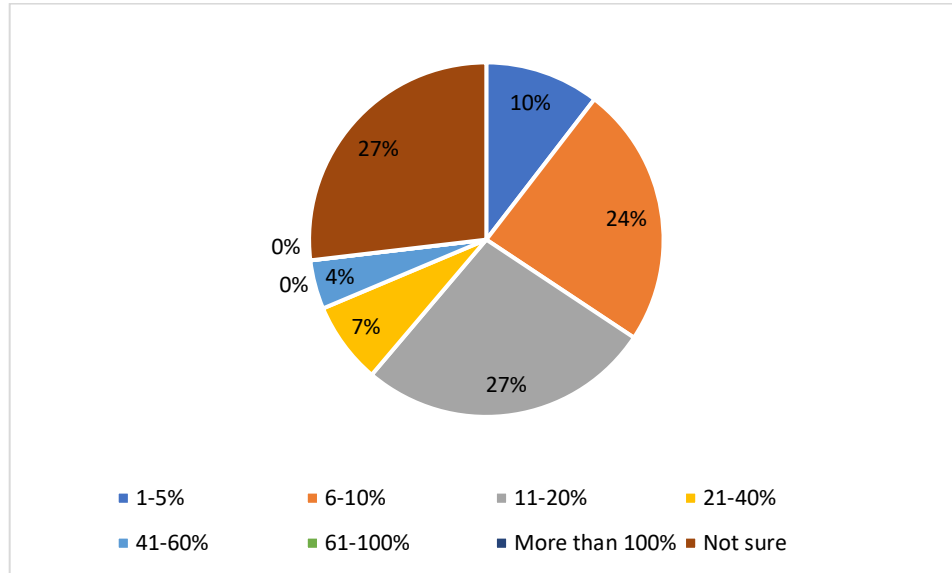


Figure 64. Respondents' perception of needed increase in price to ensure animal is free of *Bd*, *Bsal*, and *Rv* (n=67)

When asked if increasing sales price is not an option, what the maximum increase in operating cost their organization may be willing to accept and still adopt improved biosecurity practices to keep the amphibians in their facility free of the *Bd*, *Bsal*, and *Rv* pathogens, 30% indicated “Not sure”, 24% indicated 6-10%, and 21% indicated 1-5% (Fig. 65).

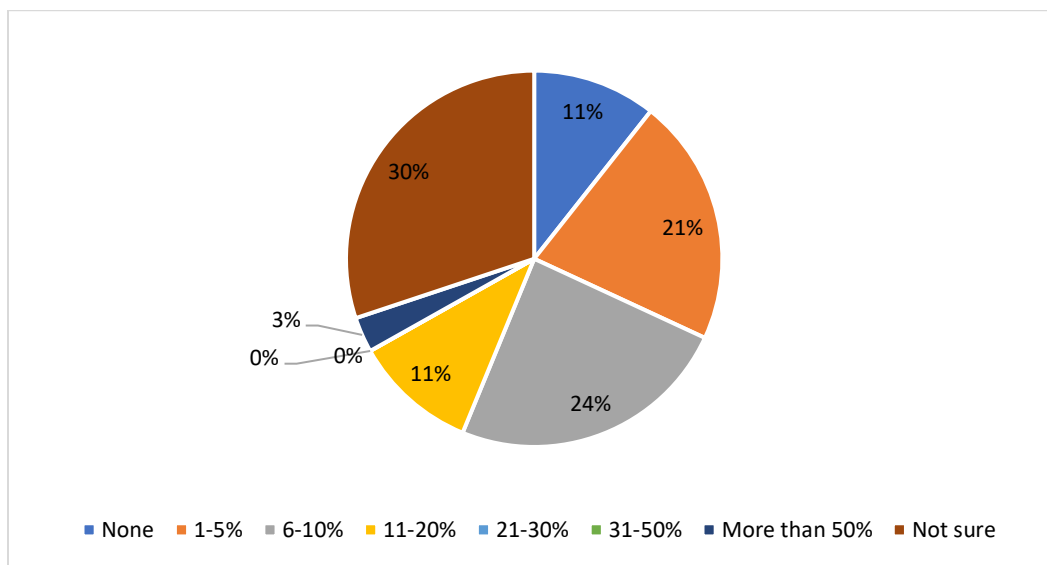


Figure 65. Maximum acceptable increase in operating costs to improve biosecurity practices (n=66)

Attitudes and Intentions Regarding Adoption of Mitigating Actions

Overall, the majority (85%) of responding businesses indicated they believe the threat of the spread of *Bd*, *Bsal*, and *Rv* is serious (Fig. 58). Also, respondents have a responsibility to mitigate their spread to protect natural amphibian populations, and 90% believe that businesses should take part in preventing the transmission of those pathogens in the trade network (Fig. 66).

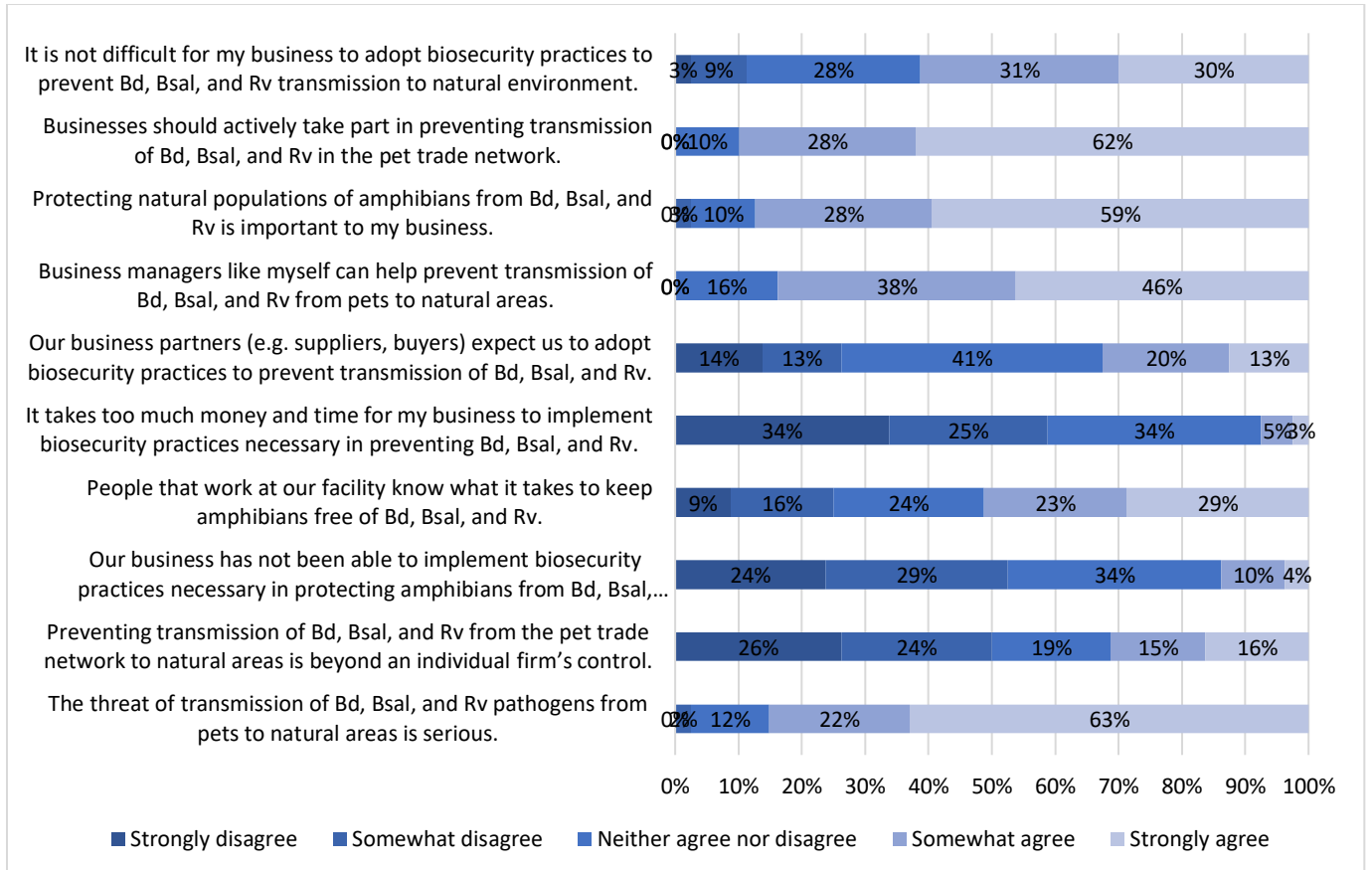


Figure 66. Business attitudes toward biosecurity measures and pathogen transmission (From top: n1=81, n2=80, n3=80, n4=80, n5=80, n6=80, n7=80, n8=79, n9=79, n10=80)

Overall, businesses indicated they believe they will benefit from adopting biosecurity practices to mitigate the spread of harmful pathogens, with the majority (68%) indicating they intend to implement practices at their facility to contain *Bd*, *Bsal*, and *Rv* (Fig. 67). While more than three-quarters (82%) agreed that keeping their facility free of pathogens will enhance the public image, just over half (52%) agreed it will impact their profit.

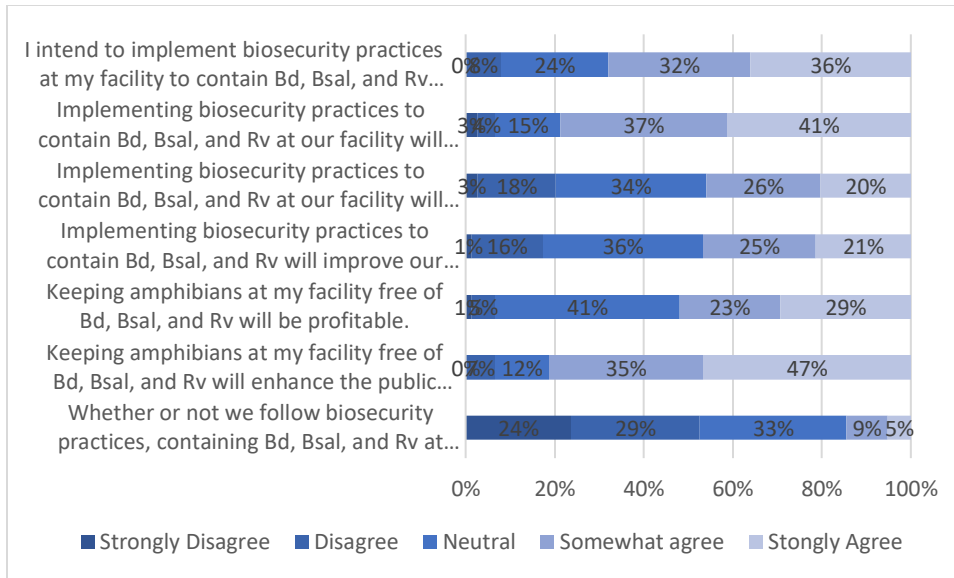
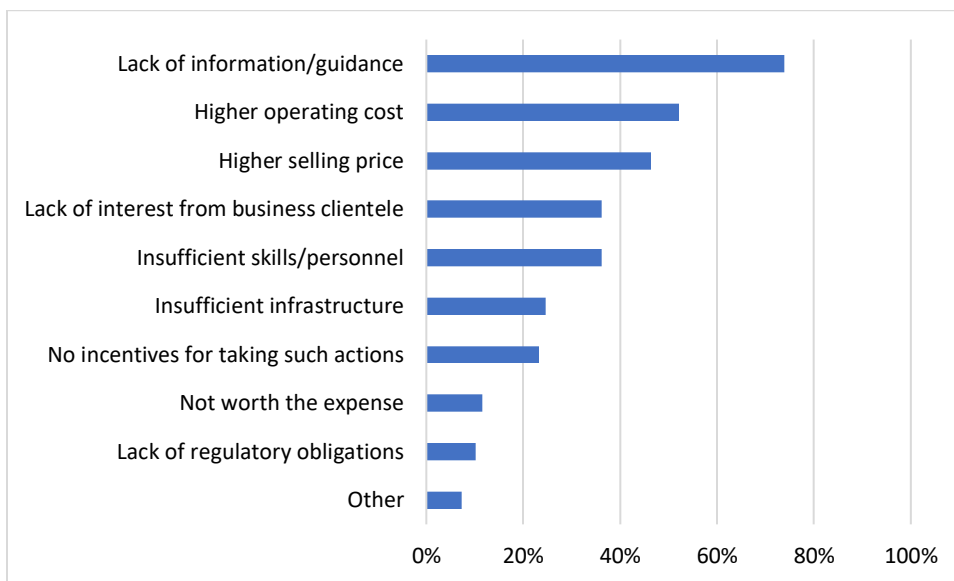


Figure 67. Business attitudes toward adopting practices to mitigate pathogen transmission (From top: n1=75, n2=75, n3=74, n4=75, n5=75, n6= 75, n7=76)

When asked which of the following, if any, would be considered barriers to adopting biosecurity practices to prevent or contain *Bd*, *Bsal*, and *Rv* in their facility, the most frequently cited barriers were lack of information/guidance (74%), higher operating cost (52%), and higher selling price (46%) (Fig. 68). About one-third (36%) also cited lack of interest from their business clientele and insufficient skills/personnel, whereas about one-quarter mentioned lack of infrastructure and lack of incentives for taking such actions.



*Sum of percentages exceeds 100% as multiple responses may be selected by each respondent
Figure 68. Barriers to adopting biosecurity practices (n=69)

APPENDIX

Text responses provided to survey questions with “Other” as an answer choice.

What other type of amphibian(s) do you currently own or have you previously owned?

Tortoise

Axolotl

gecko

Turtle

Gecko

Axolotl

Mourning geckos

Snake, lizards

Axolotl

Veil chameleon

Snakes

axolotl

Siren

Bearded dragon

Axolotl

I mostly do lizards (reptiles) I just have a slight scattering of amphibians, mostly from my local region.

Axolotl

What other type(s) of pet(s) currently resides or previously resided in your household?

tarantulas, vinegaroon, and copepods

Opossums

Invertebrates

several invertebrates

Invertebrates

Hedgehog

Shrimp

invertebrate

Rabbits, hamsters, gerbils, guinea pigs

Rabbit, tarantula (5)

Tarantulas

Equine

Spiders

Arachnids

squirrels

Alpacas, chinchilla, hedgehogs, lizards snakes

Sugar Gliders

Snail, spider, crayfish

Rodents, hedgehogs, insects, and tarantulas

sugar glider

coral
Ferret
Rats, hamsters, mouse and gerbil
Hermit crabs, wolf spider, isopods
Gerbils
Spiders/Mantis/Millipedes
pill bugs and ant colonies
Bugs
rabbit, chinchilla
arachnid
chickens
Skink
Guinea pig
Horses, gerbils, guinea pigs
Hamster
Guinea pig
Rats
scorpion
tarantulas
Arthropod
Coral
Hedgehog, hamster
Pigs, rabbits, rats, mice, chickens, axolotls and tortoises
Rabbit, Guinea pig, invertebrates
Snails and tarantula
Chinchilla, Rabbit, Hamster
Rabbit, Chinchilla, Hamster
Axolotl
Rabbit
Rats, Guinea Pigs, Mice, Hamsters, Hedgehogs, Rabbits
Rabbit
Chickens
Horse, goats, chickens, ducks
Axolotls
Invertebrates
Tarantulas
Horse, cattle
Large farm animals, chinchillas, rabbits, rodents
Gecko
Arachnids, shrimp and isopods
Tarantulas
Rats
Isopods spiders scorpions and mantids
Rat
Chickens, pheasants, quail, rabbit
Isopods, tarantulas, scorpion
Invertebrates
small animals

invertebrate
small mammal
Skunk, sugar gliders
Various small animals/rodents
scorpion, tarantula
Horse
Rodents
Arthropods (tarantula, insects, etc.)
Hedgehog
Rabbit
Guinea pigs, rabbits
Skunk
Rabbit
inverts and small mammals
Ferret, Crabs
Praying mantis and hermit crab
Arachnid
Rabbit, hamster
tarantula, snails
hamster
Hermit crabs, bugs
Rabbit
Invertebrates
Small mammals
Rabbits
Ferret
Centipede
gerbils, hamsters, rats, mice, guinea pigs, rabbits
Various invertebrates
Insect
Rat, Invertebrate
Isopods - and the birds are livestock and outside 99% of the time.
Rodents (Guinea pigs)
Gerbils
Small mammals
Arachnids
Pig
inverts
Hamster,
Tarantula
Tarantulas, scorpions
Chinchilla, Rabbit, Guinea Pig, Rat
Rabbit
Tarantula
Pig, rabbits, hamsters
Tarantula
dormice, pygmy mice, many inverts
Hamster, guinea pigs, chinchilla

Snails, slugs, spiders of all kinds
small mammal
Arachnid
Invertebrates
Isopods and spiders
Rodent & marsupial
scorpion
Inverts
Sulcate tortoise

How did you acquire your amphibian(s)?

reproduced on site
Accidentally bred
acquired tadpoles from a fish hatchery
Bred my own
From State Facility
Reptile show
Traded with friends who keep and breed
reptile fair from breeder
Reptile Shows
From a frog specific stores like Josh's frogs
Reptile expo
zoo employee
they just come to my pond
Took in when prior owners were unable to care for.
Purchased through Craigslist ad
traded
Most of my amphibians were caught by my small children in the area - I have no clue what all they have been exposed to, so I don't release them back usually.
Breeders
Expo

Which of the following best describes from where you acquired your pet amphibian?

Wholesaler
Daughter's biology group project
Collected
In our yard
wild/ rescue
fish hatchery... rescue
Someone selling tadpoles online locally, salamander from bait shop
Bait shop
student
Irresponsible pet owner
Captive Breeder

reptile shows
At a public park
Backyard pool
School
Professional Breeder
Rehomed
Wild
outside invasive species
Wild
field collected, wholesalers
they just come to my pond
Wild
Wild
rescued a baby toad that was drowning in a swimming pool
Wild
Yard
Rescue
Breeder
under a pile of yard wastes; at the bottom of a stairwell that had to be cleaned out
Rescue
Young students - I use to teach middle school science. I have an unknown frog species which was donated to my classroom, and I bought a poison dart frog once for fun.
Yard
Bait shop
Pool
Set up small pond for breeding natives outside.
Craigslist

Which of the following best describes the reason you were unable to keep your pet amphibian?

Someone else wanted it
Laws changed
Needed money
Too many babies
Bred axolotls, placed offspring in new homes
left zoo job
grew too large to keep in the setup we had
1st one I was very young and my parents wouldn't let me keep it--unable to care for it; Second time I had them, I was wintering them over because when I found them, it was too far into winter for them to survive long enough to build a burrow to hibernate.
Kept at work, employer decided to have fish tanks instead of axolotl tank
my house caught fire
conflicts with other animals

Family problems

It began starving itself, and a friend thought he could get it to eat (larval tiger salamander)

Which best describes what was done with the animal?

Moved to specialized caretaker and quarantinable area

Adoption

First time I released it into a similar type of habitat. Second time, once spring sprung, I release them into the exact same area where I found them...but the woods, not the bottom of the stairwell.

a friend took care of them for me

Placed on display.....not for sale

Which of the following best describes what happened to the animal? Follow-up to: Have you ever had a pet amphibian die?

Disease

taxidermy preservation

Buried in indoor plants

animal was left in vivarium and biologically absorbed

stored in formalin sent to university

DE fleshed and skeleton kept

Drowned in water bowl

Wild caught and thought it was captive bred

We returned one to our yard

Bad husbandry

Old age

Buried in plant pot

Natural cause

Sent to vet for necropsy

Frozen for several days then placed in garbage inside sealed bag. I did not want to spread parasites.

I do not know, it happened when I was out of town.

Animal was burned/ cremated

Animal was frozen for a week then disposed of in the garbage in a sealed bag

Decomposed in enclosure

Disposed of by Veterinarian

Frozen

Put into a vivarium for natural decomposition

Frozen for 1 week prior to disposal in trash

Animal was buried in an bioactive terrarium that housed only plants and invertebrates.

had 6 tadpoles and 1 was a salamander and it ate all the frogs.

Contained in a separate freezer until a necropsy could be performed

Animals were taxidermized

Composted/feed to CUC

for study

frozen

Frozen

Put it in the freezer

Animal was fed to isopod colony

Animal was accessioned into teaching collection at UCF

dried
Cremation after Euthanasia
Euthanized and then buried
Cremated
Frozen
old age
preservation/taxidermy
necropsied for cause
Cremated
Cremated and ashes spread
Necropsy
drowned
placed in freezer after death
Dried out due to lack of humidity
Gave back to pet store
Let our invertebrate clean up crew
escape
After dying, was fed to captive bred isopod colony.
Shadow box memorial
preserved
Incinerated
Preserved as wet specimen in formalin
Frozen and incinerated to keep novel pathogens from entering the environment.
Not exactly sure what happened - was a poison dart frog - humidity was slightly off, parts of cage were still wet, but it was in a dry area and had dehydrated. I dispose of any of my amphibians and reptiles as biological waste carefully.
Was eaten by tank mate
tumors and full of unfertilized eggs
Frozen after death and then placed in garbage
Preserved as a wet specimen
Dried
Frozen, then disposed of in trash
Cremation

Have any of the following pathogens ever been detected in your pet amphibians?

not that I know of
based on symptoms I suspected Bd so I treated for it and then tested after treatment was done and it came back negative.
Never had them tested so I don't know
Unknown
Skin infection multiple pathogens as tested by a vet
Parasite; unsure which one
Lead from paint on aquarium plastic plants
Don't know
Never tested
They were wild rescues that were released as soon as possible.
Not for any of my amphibians, but there is no exotic vets within a days travel of where I live. I have had reptiles with salmonella

Other bacterial infection unable to identify
Red leg disease in Pac-Man frogs

To your knowledge, are there other businesses or organizations similar to yours that are currently operating within your state? Please specify the number.

20
100-1000
5
lots
5
20
Many
50
5
10
10+
100+
12
At least 10
15
50
50
50+
5
3
?
2
4
10
8
more than 20
50
12?
50
100
20
Many pet Stores
Several hobbyists
10000
5
1
Unsure
2
25
50
not sure Gish ??
1

20
10
6
30

Which of the following describes the mode of your business operation in selling/supplying amphibians?

wholesale

Phone sales

Reptile Show

Shows

I am not in the business per say, but I would sell the long-toed salamanders that breed in my yard to reputable hobbyists or businesses.

Selling to friends

In person

Trade show

Reptile/amphibian shows

Reptile Expos

Peer to peer, social media

Expos

word of mouth

Expositions

wholesale

At expos

Contracts

Face to face

Expos

Advertise locally, sell to local pet stores.

Expos

wholesale

Reptile shows

Distribution to wholesalers and retailers

Local sales

Person to person

Have you ever detected any of the following pathogens in amphibians at your facility?

No

none

na

N/A

none

No

None

None

None

No

none

What is the estimated approximate value of total loss resulting from the illness or death of an animal at your business facility? (Including cost incurred in treatment, care and disposal, if any)?

100

10

100

500

65

120

500

80

500

65

20

60

50

200

0.25

50

20

10

50

5

400

40

100

500

200

50

0

25

20

1000

20000

50

10000

15

1

30

75

700

Mean 939.8

Min. 0

Max. 20000

