Appendix A. Data pooling of educator and visitor responses.

For the educator data the Non-metric Multidimensional Scaling (NMDS) run before the PERMANOVA resulted in a non-metric fit R^2 value of 0.970, a linear fit R^2 value of 0.874, and a stress value of 0.173. These values indicated a fair goodness of fit (stress value of 0.10-0.20). The PERMANOVA generated an F-statistic of 0.962, an R^2 value of 0.050, and a p-value of 0.470. For the visitor data the NMDS run before the PERMANOVA resulted in a non-metric fit R^2 value of 0.966, a linear fit R^2 value of 0.894, and a stress value of 0.186. These values indicated a fair goodness of fit. The PERMANOVA generated an F-statistic of 1.103, an R^2 value of 0.010, and a p-value of 0.338. Based on these tests, we concluded that responses provided by educators at different facilities were not significantly different, allowing us to pool the educator data. Similarly, we pooled the visitor data.

Appendix B. Creation of composite variables

We created the composite variable 'perceived effectiveness of communication about preventing species invasions' by combining responses to questions about how effectively visitors and educators perceived zoos presented information about actions that guests can take to help prevent the introduction of IAS, namely: 1) selecting a pet that can be properly cared for throughout its lifetime; 2) identifying and reporting non-native species; 3) selecting the right plants for a yard and garden; 4) cleaning recreational equipment; and 5) avoiding purchases that can transport non-native species to Florida (see Table A1). We also combined respondents' perceptions of how effectively facilities educated guests about the economic, ecological, and human welfare impacts of invasive species to create the composite variable 'perceived effectiveness of communication about invasive species impacts'. Lastly, we combined responses to binary questions about

whether or not facilities presented any information about how the pet trade, research industry, live food trade, live bait trade, medicinal industry, plant trade, and recreational activities (hiking, scuba diving, fishing, and boating) can be introduction pathways for non-native species, and labeled this score ‘information about introduction pathways’.

Table A1. Tests for whether individual survey items could be combined to generate composite variables that measured educators' and visitors' perceptions of the effectiveness of invasion education.

Variables and survey items	Educator data			Visitor Data		
	Factor loadings	**Eigenvalue**	**Cronbach's alpha**	**Factor loadings**	**Eigenvalue**	**Cronbach's alpha**
Perceived effectiveness of communication about actions the public can take to prevent species invasions:		2.045	0.750		4.359	0.971
Selecting a pet that you can provide proper care for throughout their lifetime	0.343			0.891		
Identifying and reporting non-native species that you see	0.798			0.948		
Selecting the right plants for your yard and garden	0.529			0.937		
Cleaning your recreational equipment	0.704			0.937		

Avoiding purchases that can transport non-native species to Florida	0.717			0.954		
Perceived effectiveness of communication about invasive species impacts:		2.134	0.886		2.487	0.940
Ecological impacts	0.707			0.949		
Economic impacts	0.918			0.941		
Human health and well-being impacts	0.890			0.838		

Appendix C: Characteristics of Educators and Visitors

Table A2. Characteristics of educators (n=44).

	Facility A		Facility B		Facility C		Aggregate	
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Gender:								
Female	9	75.0	15	68.2	5	50.0	29	65.9
Male	1	8.3	4	18.2	4	40.0	9	20.5
Prefer not to answer	0	0.0	1	4.5	0	0.0	1	2.3
No answer provided	2	16.7	2	9.1	1	10.0	5	11.4
Education:								
Less than high school	0	0.0	0	0.0	0	0.0	0	0.0
High school graduate or GED	0	0.0	0	0.0	1	10.0	1	2.3
Some college/associate or technical degree	0	0.0	8	36.4	3	30.0	11	25.0
Bachelor’s degree	7	58.3	8	36.4	4	40.0	19	43.2
Master’s degree	3	25.0	3	13.6	1	10.0	7	15.9
Doctoral degree (PhD)	0	0.0	1	4.5	0	0.0	1	2.3

Professional Degree (i.e. JD,MD)	0	0.0	0	0.0	0	0.0	0	0.0
No answer provided	2	16.7	2	9.1	1	10.0	5	11.4
Ethnicity:								
Asian or Asian American	0	0.0	1	4.5	0	0.0	1	2.3
Black or African American	0	0.0	0	0.0	0	0.0	0	0.0
Hispanic or Latino/a	0	0.0	1	4.5	0	0.0	1	2.3
Mixed	0	0.0	1	4.5	0	0.0	1	2.3
Native American	0	0.0	0	0.0	0	0.0	0	0.0
Native Hawaiian or Pacific Islander	0	0.0	0	0.0	0	0.0	0	0.0
Other	0	0.0	0	0.0	0	0.0	0	0.0
White	10	83.3	17	77.3	9	90.0	36	81.8
No answer provided	2	16.7	2	9.1	1	10.0	5	11.4
Role:								
Employee	12	100.0	10	45.5	10	100.0	32	72.7
Volunteer	0	0.0	12	54.6	0	0.0	12	27.3
Intern	0	0.0	0	0.0	0	0.0	0	0.0

Time spent working at the facility:								
Less than a year	0	0.0	3	13.6	1	10.0	4	9.1
1-5 years	7	58.3	8	36.4	5	50.0	20	45.5
6-10 years	2	16.7	1	4.6	3	30.0	6	13.6
11-15 years	2	16.7	3	13.6	1	10.0	6	13.6
16-20 years	1	8.3	4	18.2	0	0.0	5	11.4
21 years or more	0	0.0	3	13.6	0	0.0	3	6.8
Total	12		22		10		44	

Table A3. Characteristics of visitors (n=221).

	Facility A		**Facility B**		**Facility C**		**Aggregate**	
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Gender:								
Female	61	64.2	39	55.7	33	58.9	133	60.2
Male	29	30.5	25	35.7	20	35.7	74	33.5
Prefer not to answer	1	1.1	0	0.0	1	1.8	2	0.9

No answer provided	4	4.2	6	8.6	2	3.6	12	5.4
Age:								
18-24	7	7.4	4	5.7	10	17.9	21	9.5
25-34	25	26.3	24	34.3	15	26.8	64	29.0
35-44	22	23.2	23	32.9	14	25.0	59	26.7
45-54	16	16.8	8	11.4	8	14.3	32	14.5
55-64	15	15.8	8	11.4	5	8.9	28	12.7
65+	10	10.5	3	4.3	4	7.1	17	7.7
Education:								
Less than high school	0	0.0	0	0.0	0	0.0	0	0.0
High school graduate or GED	8	8.4	10	14.3	7	12.5	25	11.3
Some college/associate or technical degree	22	23.2	26	37.1	20	35.7	68	30.8
Bachelor’s degree	37	38.9	16	22.9	15	26.8	68	30.8
Master’s degree	20	21.1	11	15.7	7	12.5	38	17.2
Doctoral degree (PhD)	2	2.1	2	2.9	1	1.8	5	2.3

Professional Degree (i.e. JD,MD)	3	3.2	1	1.4	1	1.8	5	2.3
No answer provided	3	3.2	4	5.7	5	8.9	12	5.4
Ethnicity:								
Asian or Asian American	3	3.2	1	1.4	0	0.0	4	1.8
Black or African American	2	2.1	0	0.0	3	5.4	5	2.3
Hispanic or Latino/a	8	8.4	4	5.7	0	0.0	12	5.4
Mixed	1	1.1	4	5.7	1	1.8	6	2.7
Native American	0	0.0	0	0.0	0	0.0	0	0.0
Native Hawaiian or Pacific Islander	0	0.0	0	0.0	0	0.0	0	0.0
Other	2	2.1	0	0.0	1	1.8	3	1.4
White	74	77.9	58	82.9	47	83.9	179	81.0
No answer provided	5	5.3	3	4.3	4	7.1	12	5.4
Hours spent at facility:								
Less than an hour	0	0.0	1	1.4	0	0.0	1	0.5
1 hour	5	5.3	2	2.9	4	7.1	11	5.0
2 hours (median)	33	34.7	32	45.7	18	32.1	83	38.6

3 hours	39	41.1	22	31.4	14	25.0	75	33.9
4 hours	14	14.7	5	7.1	15	26.8	34	15.4
5+ hours	4	4.2	7	10.0	5	8.9	16	7.2
No answer provided	0	0.0	1	1.4	0	0.0	1	0.5
Total	95		70		56		221	

Appendix D

Table A4. Educational methods that visitors (n=217) and educators (n=44) stated they would like to see more of throughout Florida zoos and aquariums.

Question	Response	Educators		Visitors	
		No.	%	No.	%
Which of the [following would you like to see more of throughout Florida zoos and aquariums]?	Exhibits with species invasive to Florida	29	65.9	134	61.8
	Signs and interactive displays about invasive species	24	54.5	118	54.4
	Opportunities to discuss invasive species with an educator	32	72.3	106	48.8
	Shows and presentations with messages about invasive species	27	61.4	116	53.5
	Printed materials with information about invasive species	13	29.5	77	35.5
	None of the above	0	0.0	4	1.8

No answer provided	1	2.3	2	0.9

Appendix E

Table A5. Correlation analysis of educator composite variable data using Spearman's rank correlation coefficient.

Composite Dependent Variable	Independent Variable	No.	R_s	p
Perceived effectiveness of how AZA facilities communicate about prevention of species invasions				
	Of [the guests you have conversations with during the work week], how many do you speak with about invasive species in Florida?	36	0.107	0.535
	Of [the guests you have conversations with during the weekend], how many do you speak with about invasive species in Florida?	35	0.289	0.093
	Information about introduction pathways presented at the AZA facilities	35	0.474	0.004

Perceived effectiveness of how invasive species impacts are communicated:				
	Of [the guests you have conversations with during the work week], how many do you speak with about invasive species in Florida?	37	0.341	0.039
	Of [the guests you have conversations with during the weekend], how many do you speak with about invasive species in Florida?	36	0.304	0.072

Table A6. Correlation analysis of visitor composite variable data using Spearman's rank correlation coefficient.

Composite Dependent Variable	Independent Variable	No.	R_s	p
Perceived effectiveness of how the AZA facility visited communicates about prevention of species invasions:				

	Information about introduction pathways presented at the AZA facilities	180	0.457	<0.001
	Time at facility (hours)	194	0.033	0.651
	Number of visit	195	0.085	0.238
	Education (years)	190	-0.143	0.049
Perceived effectiveness of how invasive species impacts are communicated:				
	Time at facility (hours)	202	-0.025	0.727
	Number of visits	203	0.100	0.157
	Education (years)	200	-0.201	0.004

Table A7. Kruskal-Wallis comparison test assessing educators' perceptions of how effectively their zoo communicated actions to prevent species invasions based on what different educational methods the educator stated were used to communicate invasive alien species information ($\chi 2(1)=9.63$; $p=0.141$).

Educational Method(s)	n	Mean	SD	Rank sum
Only conversations with visitors about IAS	8	14.25	± 2.92	183.5
Conversations with visitors about IAS and exhibits featuring IAS	8	9.63	± 4.03	83.0
Conversations with visitors about IAS and shows/presentations with information about IAS	3	12.33	± 1.53	46.0

Conversations with visitors about IAS, exhibits featuring IAS, and signs with information about IAS	3	12.67	± 6.03	53.5
Conversations with visitors about IAS, exhibits featuring IAS, signs with information about IAS, and shows/presentations with information about IAS	5	15.00	± 2.45	124.0
Conversations with visitors about IAS, signs with information about IAS, and shows/presentations with information about IAS	3	15.33	± 3.51	75.0
Conversations with visitors about IAS, exhibits featuring IAS, and shows/presentations with information about IAS	6	13.00	± 3.16	101.0

Table A8. Kruskal-Wallis comparison test assessing educator' perceptions of how effectively their zoo communicated invasive alien species (IAS) impacts based on what different educational methods the educator stated were used to communicate IAS information ($\chi 2(1)=10.51$; $p=0.105$).

Educational Method(s)	n	Mean	SD	Rank sum
Only conversations with visitors about IAS	9	6.78	± 2.73	130.0
Conversations with visitors about IAS and exhibits featuring IAS	8	6.88	± 2.30	116.5
Conversations with visitors about IAS and shows/presentations with information about IAS	3	7.33	± 0.58	48.0

Conversations with visitors about IAS, exhibits featuring IAS, and signs with information about IAS	3	7.00	± 6.08	44.5
Conversations with visitors about IAS, exhibits featuring IAS, signs with information about IAS, and shows/presentations with information about IAS	5	10.80	± 1.64	148.0
Conversations with visitors about IAS, signs with information about IAS, and shows/presentations with information about IAS	3	9.67	± 3.06	73.5
Conversations with visitors about IAS, exhibits featuring IAS, and shows/presentations with information about IAS	6	9.33	± 2.58	142.5

Table A9. Kruskal-Wallis comparison test ($\chi^2(1)= 30.81$; $p<0.001$) with Dunn's post-hoc analysis test assessing visitors' perceptions of how effectively the zoo they visited communicated actions to prevent species invasions depending on the number of educational methods they encountered during their visit (n=195).

Number of Educational Methods Visitor Reported Encountering	Zero	One	Two	Three
One	$\chi^2(1) = -3.60$ $p<0.001$	-	-	-
Two	$\chi^2(1) = -4.20$ $p<0.001$	$\chi^2(1) = -0.83$ $p= 0.203$	-	-
Three	$\chi^2(1) = -6.39$ $p<0.001$	$\chi^2(1) = -3.44$ $p< 0.001$	$\chi^2(1) = -2.59$ $p= 0.005$	-
Four	$\chi^2(1) = -5.25$ $p<0.001$	$\chi^2(1) = -3.22$ $p= 0.001$	$\chi^2(1) = -2.67$ $p= 0.004$	$\chi^2(1) = -0.81$ $p= 0.208$

Table A10. Kruskal-Wallis comparison test ($\chi^2(1)= 55.87$; $p<0.001$) with Dunn's post-hoc analysis test assessing visitors' perceptions of how effectively the zoo they visited communicated invasive alien species (IAS) impacts depending on the number of educational methods they encountered during their visit (n=195).

Number of Educational Methods Visitor Reported Encountering	Zero	One	Two	Three
One	$\chi^2(1) = -3.60$ $p<0.001$	-	-	-
Two	$\chi^2(1) = -4.20$ $p<0.001$	$\chi^2(1) = -0.83$ $p= 0.203$	-	-
Three	$\chi^2(1) = -6.39$ $p<0.001$	$\chi^2(1) = -3.44$ $p< 0.001$	$\chi^2(1) = -2.59$ $p= 0.005$	-
Four	$\chi^2(1) = -5.25$ $p<0.001$	$\chi^2(1) = -3.22$ $p= 0.001$	$\chi^2(1) = -2.67$ $p= 0.004$	$\chi^2(1) = -0.81$ $p= 0.208$

Table A11. Mann-Whitney comparison tests assessing visitors' perceptions of the effectiveness of how the zoo they visited communicated actions to prevent species invasions depending on the educational methods the visitor recalled from their visit.

Question	Responses	n	Mean Comparison (± SD)	z	p
During your trip today, do you remember seeing any species invasive to Florida on exhibit?					
	Yes	103	12.41 ± 6.17	-2.31	0.021
	No	92	10.71 ± 6.55		
During your visit to the zoo, did you see any signs or interactive displays with information on species invasive to Florida?					
	Yes	91	13.47 ± 6.38	-3.95	<0.001
	No	104	9.98 ± 5.97		
During your visit to the zoo, did you speak					

with any employees or volunteers about species invasive to Florida?					
	Yes	54	14.98 ± 6.31	-4.57	<0.001
	No	141	10.32 ± 5.96		
During your visit to the zoo, did you see any shows or presentations with information about species invasive to Florida?					
	Yes	28	15.54 ± 7.34	-2.99	0.003
	No	166	10.92 ± 6.07		

Table A12. Mann-Whitney comparison tests assessing visitors' perceptions of the effectiveness of how the zoo they visited communicated invasive alien species impacts depending on the educational methods the visitor recalled from their visit.

Group 1 vs. Group 2	n	Mean Comparison (± SD)	z	p
During your trip today, do you remember seeing any species invasive to Florida on exhibit?				

Yes	109	8.26 ± 3.00	-4.31	<0.001
No	94	6.40 ± 3.67		
During your visit to the zoo, did you see any signs or interactive displays with information on species invasive to Florida?				
Yes	92	8.65 ± 3.23	-4.86	<0.001
No	111	6.36 ± 3.28		
During your visit to the zoo, did you speak with any employees or volunteers about species invasive to Florida?				
Yes	55	9.45 ± 3.54	-5.06	<0.001
No	147	6.60 ± 3.06		
During your visit to the zoo, did you see any shows or presentations with information about species invasive to Florida?				
Yes	29	10.83 ± 3.05	-5.75	<0.001
No	173	6.81 ± 3.17		

Table A13. Kruskal-Wallis comparison test assessing visitors' perceptions of how effectively the zoo they visited communicated actions to prevent species invasions based on

what different educational methods the visitor stated were used to communicate invasive alien species information during their visit ($\chi 2(1)=40.63$; $p<0.001$).

Educational Method(s)	n	Mean	SD	Rank sum
None	55	8.40	± 5.61	3671.0
Only seeing IAS on exhibit	30	10.83	± 5.40	2848.0
Only reading signs about IAS	16	11.44	± 5.80	1551.5
Only speaking with educators about IAS	9	14.89	± 5.18	1195.5
Seeing IAS on exhibit and reading signs about IAS	35	11.60	± 5.89	3508.0
Seeing IAS on exhibit and speaking with educators about IAS	6	12.00	± 6.87	590.0
Seeing IAS on exhibit and watching shows/presentations about IAS	2	7.50	± 3.54	125.5
Seeing IAS on exhibit, reading signs about IAS, and speaking with educators about IAS	18	15.00	± 6.15	2317.5
Seeing IAS on exhibit, reading signs about IAS, speaking with educators about IAS, and watching shows/presentations about IAS	11	15.91	± 7.46	1421.5
Reading signs about IAS and speaking with educators about IAS	3	13.33	± 5.77	358.5
Reading signs about IAS and watching shows/presentations about IAS	3	21.33	± 5.51	503.5
Reading signs about IAS, speaking with educators about IAS, and watching shows/presentations about IAS	4	18.25	± 4.99	606.5

Speaking with educators about IAS and watching shows/presentations about IAS	2	15.00	± 14.14	218.0

Table A14. Kruskal-Wallis comparison test assessing visitors' perceptions of how effectively the zoo they visited communicated invasive alien species (IAS) impacts based on what different educational methods the visitor stated were used to communicate IAS information during their visit ($\chi 2(1)=62.54$; $p<0.001$).

Educational Method(s)	n	Mean	SD	Rank sum
None	57	5.16	± 3.14	3526.0
Only seeing IAS on exhibit	35	7.26	± 2.41	3612.5
Only reading signs about IAS	17	7.12	± 2.69	1670.5
Only speaking with educators about IAS	7	7.29	± 4.11	657.0
Seeing IAS on exhibit and reading signs about IAS	33	7.45	± 2.62	3441.0
Seeing IAS on exhibit and speaking with educators about IAS	8	8.88	± 3.00	1021.0
Seeing IAS on exhibit and watching shows/presentations about IAS	2	9.00	± 0.00	268.0
Seeing IAS on exhibit, reading signs about IAS, and speaking with educators about IAS	18	9.28	± 3.29	2398.5
Seeing IAS on exhibit, reading signs about IAS, speaking with educators about IAS, and watching shows/presentations about IAS	11	11.09	± 3.48	1773.0

Reading signs about IAS and speaking with educators about IAS	3	6.67	± 0.58	267.0
Reading signs about IAS and watching shows/presentations about IAS	3	12.33	± 2.52	541.0
Reading signs about IAS, speaking with educators about IAS, and watching shows/presentations about IAS	5	12.20	± 1.48	904.5
Speaking with educators about IAS and watching shows/presentations about IAS	2	9.00	± 8.49	220.5

Table A15. Mann-Whitney comparison tests assessing visitors' perceptions of the effectiveness of different educational methods for presenting information about invasive alien species at zoos.

Method 1 vs Method 2	n	Mean Comparison (± SD)	z	p
Seeing IAS on exhibit vs Reading signs about IAS	73	3.21 ± 1.09 *vs.* 3.29 ± 0.95	0.170	0.865
Seeing IAS on exhibit vs Speaking with educators about IAS	44	3.43 ± 1.00 *vs.* 3.93 ± 0.79	-2.44	0.014
Seeing IAS on exhibit vs Watching shows/presentations about IAS	21	3.67 ± 1.02 *vs.* 3.76 ± 1.09	-0.267	0.790
Reading signs about IAS vs Speaking with educators about IAS	41	3.56 ± 0.98 *vs.* 4.05 ± 0.74	-2.32	0.020

Reading signs about IAS vs Watching shows/presentations about IAS	24	3.79 ± 0.88 *vs.* 3.96 ± 0.91	-0.92	0.356
Speaking with educators about IAS vs Watching shows/presentations about IAS	22	4.00 ± 0.87 *vs.* 3.95 ± 0.84F5	0.20	0.842

Table A16. Mann-Whitney tests comparing educator and visitor perceptions of the effectiveness of different invasive alien species educational methods.

Question	Group	No.	Mean (±SD)	z	p
[Is] seeing species invasive to Florida on exhibit [an effective way to learn] about invasive species?					
	Visitors	123	3.01 ± 1.09	0.937	0.349
	Educators	38	3.21 ± 0.84		
[Are] signs and interactive displays about species invasive to Florida [an] effective way [to learn] about invasive species?					
	Visitors	102	3.33 ± 0.97	0.182	0.855
	Educators	38	3.32 ± 0.90		

'[Is] speaking with an employee or volunteer about species invasive to Florida [an effective way to learn] about invasive species?					
	Visitors	63	3.89 ± 0.88	-0.437	0.686
	Educators	38	3.82 ± 0.83		
'[Is] attending a show or presentation with information about species invasive to Florida [an effective way to learn] about invasive species?					
	Visitors	31	3.90 ± 0.94	-1.103	0.286
	Educators	37	3.70 ± 0.85		

Table A17. Kruskal-Wallis comparison test ($\chi^2(1)= 12.00$; p=0.007) with Dunn's post-hoc analysis test assessing educators' perceptions of the effectiveness of different educational methods for presenting information about invasive alien species at zoos (n=37).

Educational Method	Seeing IAS on exhibit	Reading signs about IAS	Speaking with educators about IAS
Reading signs about IAS	$\chi^2(1) = -0.74$ p= 0.229	-	-
Speaking with educators about IAS	$\chi^2(1) = -2.99$ p= 0.001	$\chi^2(1) = -2.24$ p= 0.013	-
Watching shows/presentations about IAS	$\chi^2(1) = -2.49$ p= 0.006	$\chi^2(1) = -1.75$ p= 0.040	$\chi^2(1) = 0.50$ p= 0.310

Table A18. Kruskal-Wallis comparison test assessing educators' perceptions of how much information about introduction pathways for invasive alien species (IAS) was presented based on what different educational methods the educator stated were used to communicate IAS information ($\chi 2(1)=11.71$; $p=0.069$).

Educational Method(s)	n	Mean	SD	Rank sum
Only conversations with visitors about IAS	9	1.22	± 1.20	128.5
Conversations with visitors about IAS and exhibits featuring IAS	8	1.38	± 1.60	122.0
Conversations with visitors about IAS and shows/presentations with information about IAS	4	1.50	± 1.29	67.0
Conversations with visitors about IAS, exhibits featuring IAS, and signs with information about IAS	3	1.00	± 1.00	38.5
Conversations with visitors about IAS, exhibits featuring IAS, signs with information about IAS, and shows/presentations with information about IAS	5	3.00	± 1.41	134.0
Conversations with visitors about IAS, signs with information about IAS, and shows/presentations with information about IAS	3	4.33	± 2.08	93.5
Conversations with visitors about IAS, exhibits featuring IAS, and shows/presentations with information about IAS	5	2.40	± 0.89	119.5