NORTH DAKOTA GAME AND FISH DEPARTMENT

Final Report

Evaluating the Distribution of River Otters and Beavers throughout the Missouri and Souris River Drainages in North Dakota

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Submitted by
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Summary

Virtually nothing is known about the status and distribution of river otters (*Lontra canadensis*) or American beavers (*Castor canadensis*) in central and western North Dakota (i.e., the Missouri and Souris River drainages) or human dimensions issues related to their management, This project applied social science survey techniques to determine attitudes of key stakeholders towards otters and beavers throughout the study area. Traditional field surveys (riparian surveys for otter and beaver sign near bridges) to determine if otters occupy drainages in those portions of the state, and how the known population of American beavers were distributed in the region. We also used questionnaire evaluations of conservation professionals in the study area to determine if they had knowledge of the presence of otters. No evidence of river otters was detected during field surveys, nor did emulations of conservation professionals suggest any evidence of an otter population. We also evaluated the efficacy of olfactory lures for attracting river otters in controlled captive settings (i.e., zoos). The purpose of this project was to determine which lures would be most effective for attracting otters to remote camera stations as another way to monitor presence/absence of the species.

Human Dimension Surveys

River otters.—During May-October 2011, interviews of 397 anglers were conducted in North Dakota along the portions of the Red River of the North and Missouri River drainages. Our primary purpose for conducting these surveys was to determine the familiarity and attitudes of anglers towards river otters, and if responses varied by region and demographic covariates. Generally, anglers generally were familiar that river otters are now occurring in eastern North Dakota, and most had favorable attitudes towards the species. Information from food studies conducted on river otters in eastern North Dakota should be distributed to anglers and other outdoor enthusiasts as a means of better informing them about the role of river otters as aquatic predators.

American beavers.—Additionally, From May (2011)-August (2012) beaver surveys (*n=176)* were administered face-to-face to North Dakota anglers at 10 locations along the Missouri and Red Rivers. During July 2012 mail surveys were sent to property owners in North Dakota who had received government assistance for problem beavers (USDA) *(n=309)* and to the Delta Waterfowl group (*n=300*). For analysis, an attitude index was created based on the 15 Likert style attitude questions included in the survey. Logistic regression was used to determine acceptable beaver management techniques for each of the 3 stakeholder groups. Overall, USDA Group participants indicated the most familiarity with beavers and beaver regulations in ND, followed by DW Group participants, and lastly by general Angler Group participants. As expected, participants of the USDA Group demonstrated less favorable opinions and attitudes towards beavers than participants in the other two groups. While DW Group participants were often more positive or less negative than Angler Group participants, this may be somewhat reflective of the former's higher within-group agreement and greater tendency toward neutrality.

Field Surveys

Based on survey results (field and responses of agency officials), there is no evidence to suggest that an established population of river otters exists in western North Dakota. Responses of wildlife professionals working employed by USDA Wildlife Services indicating no established otter populations in central and western North Dakota are particularly compelling given the extensive work they do in association with aquatic systems to control beaver. There is nonetheless the possibly of an undetected otter population in the region, but we believe this is unlikely given the combination of field and social surveys implemented during our study.

The likelihood of rapid recolonization of otters in western and central North Dakota from adjacent states (Montana and South Dakota) and Manitoba are limited based on response of furbearer biologists in these states and province, respectively. Montana has populations of otters in the Yellowstone and Missouri Rivers, which may provide a source on individuals for establishing populations in the Missouri River drainage in North Dakota. However, furbearer biologists in Montana do not consider otters to occupy these drainages in the eastern portion of the state. Similarly, South Dakota does not consider otters to occupy the Missouri River in that state near the border of North Dakota.

Natural recovery of river otter populations in the Missouri and Souris River drainages of North Dakota is limited by the absence of established nearby populations (i.e., the Missouri River) or completely absence of populations (i.e., the Souris River). Otters have the capacity for long-distance dispersal. Hence, there is a realistic possibility that otters from the Yellowstone and Missouri Rivers in eastern and central Montana will contribute to the recovery of otters in the Missouri River drainage in North Dakota. However, the Souris River drainage in North Dakota is more isolated from established otter populations and is less likely to be recolonized in the near future. We regarded the Souris River to provide excellent habitat for river otters. Given the limited likelihood for natural recolonization of the Souris River, this is an area that could be considered for reintroducing otters.

Lures

The efficacy of olfactory lures at attracting river otters has received almost no formal investigation. However, scents may potentially be useful at attracting river otters to field devices, such as scent and track stations, remote cameras, and traps, to obtain data on reestablished and existing wild populations. This study evaluated the efficacy of 6 olfactory lures (diluted Fatty Acid Scent, Synthetic Fermented Egg, skunk essence, beaver castoreum, Alaskan salmon oil, and Cronk's Otter Lure) at attracting captive river otters. To deploy each lure, a 25 x 5-mm plaster disc was soaked in liquid scent for 1 hour and subsequently inserted into a 26-mm long x 70-mm diameter, single-closed-ended PVC pipe with a 32 mm diameter, double-open-ended PVC screw-top. From April – July 2010, 17 adult river otters were observed at 7 captive facilities in Pennsylvania,

West Virginia and New York. Subject animals were observed individually or in pairs in 10-minute video-taped focal sessions for a period of 6 days. Prior to each observation, 1 of the 6 lures and a blank control was situated within a large, naturalistic portion of the otter's enclosure, and then the focal animal(s) were allowed to enter and explore the area. Any time a subject animal moved within 1 meter of the lure or control, an "approach" was recorded. Subsequently, the swiftness, duration, and frequency of approaches were compared between each of the 6 lures and its corresponding control. Results demonstrated that lures outperformed controls among the 4 main parameters assessed; however, these differences were not significant. Cronk's Otter Lure (COL) yielded a stronger response than the other 5 lures for each of the 4 main parameters assessed although none of these differences were significant. Field analyses are needed to determine whether COL or other scents are useful for attracting wild river otters to remote tracking devices.

Acknowledgements

This project was challenged throughout by extreme weather conditions, particularly the extreme flooding that occurred during the first year of the project. We appreciate the guidance and assistance provided by Sandra Johnson, Patrick Isakson, and Steve Dyke of the Conservation Section of the Conservation/Communication Division of North Dakota Game and Fish Department, and for understanding the challenges of conducting riparian surveys during flooding condones. Thanks to Steve Peper and Jesse Voight for diligently conducting surveys and creatively adapting to flooding conditions during the fires year of the project. Information on the human dimension study reported herein is from Vanessa Emerson's thesis. Both Jennifer Bohrman and Zoe Hanley were helpful in collecting a substantial amount of survey data on which that thesis is based. Zoe Hanley also contributed substantially to collection of field data in the Souris River drainage.

Section 1

Assessing attitudes and knowledge towards the river otter and American beaver in North Dakota

Abstract

Historically, river otters were common in North Dakota and occurred in all major rivers of the state; however, their populations declined from the fur trade. Recently river otters have been reported along the Red River in the eastern part of North Dakota. The species' status in the western part of the state along the Missouri River Drainage is currently unknown and the species is in need of conservation in North Dakota; however, there have been few studies conducted about otters in the state. There has not been an assessment of angler demographics in North Dakota nor of their knowledge about river otters. During May-October 2011, interviews of 397 anglers were conducted in North Dakota along the portions of the Red River of the North and Missouri River drainages. Our primary purpose for conducting these surveys was to determine the familiarity and attitudes of anglers towards river otters, and if responses varied by region and demographic covariates. 39% of anglers said that North Dakota had an otter population, 72% of anglers knew that otters ate fish, and 78% correctly identified an otter picture. Additionally, from May (2011)-August (2012) beaver surveys (*n=176)* were administered face-to-face to North Dakota anglers at 10 locations along the Missouri and Red Rivers. During July 2012 mail surveys were sent to property owners in North Dakota who had received government assistance for problem beavers (USDA) *(n=309)* and to the Delta Waterfowl group (*n=300*). For analysis, an attitude index was created based on the 15 Likert style attitude questions included in the survey. Logistic regression was used to determine acceptable beaver management techniques for each of the 3 stakeholder groups. Overall, USDA Group participants indicated the most familiarity with beavers and beaver regulations in ND, followed by DW Group participants, and lastly by general Angler Group participants. As expected, participants of the USDA Group demonstrated less favorable opinions and attitudes towards beavers than participants in the other two groups. While DW Group participants were often more positive or less negative than Angler Group participants, this may be somewhat reflective of the former's higher within-group agreement and greater tendency toward neutrality.

Objectives

1. To determine attitudes and knowledge of fishermen about otters, with the primary intent of using this baseline information to formulate an outreach program about otter conservation.
2. To assess attitudes and knowledge of stakeholders regarding beavers and beaver management techniques

Introduction

1. Attitudes and knowledge towards river otters

Otters historically occurred throughout the United States and Canada, but the population declined substantially from unregulated trapping and disturbances to aquatic habitats (Jenkins 1983, Melquist and Hornocker 1983, Lariviere and Walton 1998, Raesly 2001, Kruuk 2006). During the last 20 years river otter populations have been restored in many areas through natural recolonization and reintroduction projects (Griess 1987, Polechla 1990, Serfass et al. 1993). River otters (*Lontra canadensis*) are a semi-aquatic predator that may sometimes come into conflict with certain human recreational activities due to their diet preferences. A river otter's diet consists primarily of fish and crayfish, but sometimes they consume insects, birds, amphibians, mammals, and freshwater mussels (Greer 1955, Melquist and Hornocker 1983, Serfass et al. 1990, Kruuk 2006, Stearns and Serfass 2011). The high concentration of fish in the diet and ongoing expansion of river otter populations could potentially contribute to increasing conflicts through perceptions that they compete with anglers for game fish (Hamilton 1999, Pollick 2004, Link 2012).

Historically, river otters were common in North Dakota and occurred in all major rivers of the state; however, their populations declined from the fur trade (Adams 1961, Hagen et al. 2006, Wilson 2008). Recently river otters have been reported along the Red River in the eastern part of North Dakota (Hagen et al. 2006, Stearns and Serfass 2011, Triska et al. 2011). The species' status in the western part of the state along the Missouri River Drainage is currently unknown (Wilson 2008). River otters are listed as a species in need of conservation in North Dakota (Hagen et al. 2006); however, there have been few studies conducted about otters in the state (see Stearns and Serfass (2011) and Triska et al. (2011) for recent investigations in the Red River of the North Drainage). There has not been an assessment of angler demographics in North Dakota nor of their knowledge about river otters.

Methods

Between May-October 2011, face-to-face interviews of 397 anglers were conducted in North Dakota along portions of the Red River of the North and Missouri River drainages. Those surveyed were anglers engaged in fishing or participating in other recreational activities near the waterway. The primary purpose for conducting these surveys was to determine the familiarity and attitudes of anglers towards river otters.

The study was conducted at an area of the Red River associated with the city of Grand Forks, and 2 areas of Missouri River associated with the cities Williston and Bismarck. We hypothesized a difference in opinions and attitudes between these three study areas because of different opportunities to be exposed to information about river otters, along with demographic differences among the areas. Grand Forks, for example, was selected as part of the study because river otters have been recently establishing populations in the area, and their occurrence has been publicized by newspapers in the area. In contrast, river otters have occasionally been reported, but are not known to have populations established in the Missouri River drainage.

The survey consisted of both open and closed ended questions grouped in the following themes: 1) demographic (i.e., age, race, gender, education and occupation); 2) knowledge (i.e., dietary habits, picture identification); 3) attitudes about otter re-colonizing portions of the study area

Results

Angler Profile

Of 484 survey participants, 397 (82%) identified themselves as an angler. Among these anglers, 71 (18%) were surveyed in the Grand Forks region, 160 (40%) in the Williston region, and 166 (42%) in the Bismarck region (Table 1). Most anglers in the survey were white (*n* = 365; 92%), male (*n* = 347; 87%), without a 4 year degree (*n* = 298; 75%), and hunted (*n* = 275; 69%); but only 46 (12%) participated in trapping—these demographic patterns were consistent among survey areas (Table 1). Overall, anglers had a mean age of 41 years (SD = 14.9), but those surveyed in the Williston region were on average younger than those in other survey areas (i.e., 35 years [SD = 11.7] versus 40 years [SD = 14.2] and 47 years [SD = 15.5] in Grand Forks and Bismarck, respectively). Sixty-eight percent (*n* = 269) of anglers were residents of North Dakota, and 61% (*n* = 241) were considered "permanent" (i.e., long-term residents of the state [a distinction made to distinguish those who recently moved to the state for employment in the oil industry, which I regarded as a potentially useful variable in explaining variations in attitudes]) (Table 1). A majority of anglers in Williston were classified as temporary or non-residents of North Dakota (*n* = 122; 76%), whereas those from Grand Forks and Bismarck regions were classified more frequently as permanent residents (Table 1).

Angler Knowledge of River Otters

The majority of anglers responded "Yes" to the question "Have you ever heard of a river otter?" (*n* = 348; 88%); this response differed among regions, ranging from 82% in Williston (*n* = 131) to 93% in Grand Forks (*n* = 65) (Table 2). Additionally, the majority of anglers correctly identified the river otter picture (*n* = 308; 78%), with anglers in Grand Forks and Bismarck correctly identifying the image of the river otter more often (*n* = 55; 79% and *n* = 140; 85% respectively) than those in Williston (*n* = 112; 70%) (Table 2). Fewer anglers (*n* = 155; 39%) were aware that North Dakota has an otter population (i.e., responded "Yes" to the question "Does North Dakota have an otter population?"), with anglers from Bismarck and Grand Forks more aware that river otters occurred in North Dakota (*n* = 81*;* 49% and *n* = 32*;* 45%, respectively) than those from Williston (*n* = 42*;* 26%) (Table 2). When anglers indicating they knew an otter population existed in North Dakota were asked "How do you know [North Dakota has an otter population]?" 47% responded with "personal observation" (*n* = 79), a response that was similar among regions (Table 3). The majority of anglers indicated they had seen a river otter (*n* = 273; 69%), a response that was higher in Bismarck (*n* = 131; 79%) than in Williston or Grand Forks (*n* = 100; 63% and *n* = 42; 59%, respectively). When responding to the question "Please indicate what river otters eat" the majority of anglers indicated "fish" (*n* = 284; 72%) (Table 2). Fewer anglers provided "Incorrect" responses

or did not know the answer to this question in Bismarck (*n* = 15; 9%) which differed from those in Grand Forks (*n* = 21; 29.6%) and Williston (*n* = 52; 32.7%) (Table 2).

Anglers' Attitudes toward River Otters

River Otter Presence.—Overall, anglers had favorable opinions about river otters and their presence in North Dakota. The majority of anglers agreed (i.e., selected "Strongly agree" or "Agree") when asked, "I would be happy if otters are near waterways I go fishing at" (*n* = 256; 65%), with anglers in Williston agreeing less often (*n* = 94; 59%) than those in Grand Forks (*n* = 47; 66%) and Bismarck (*n* = 115; 69%) (Table 4). Additionally, the majority of anglers agreed to the following statements: "I like having an otter population in North Dakota," (*n* = 275; 69%); "I hope otter populations continue to expand to other suitable habitat in North Dakota" (*n* = 317; 80%); "It is important that future generations of North Dakota see otters in the wild" (*n* = 360; 91%), "I would be happy if I saw a living otter in the wild during my visit today" (*n* = 363; 92%)—these responses were generally consistent among regions (Table 4). When asked "What is your overall attitude towards the presence of otters in North Dakota?" the majority of anglers responded with "like" (*n* = 274; 69%), an opinion consistent among regions (Table 4).
River Otter Food Habits.—Seventy-two percent of anglers were knowledgeable that a river otter's diet comprises of fish (*n* = 284). Forty percent (*n* = 158) of anglers agreed with the statement, "I believe that otters prefer to eat game fish," which differed by region with fewer anglers in Bismarck agreeing with the statement (*n* = 47; 28%) in comparison to Grand Forks (*n* = 33; 47%) and Williston (*n* = 78; 49%) (Table 5). When read the statement, "Otters are NOT a threat to game fish populations," 24% (*n* = 95) of anglers disagreed (i.e., selected "Strongly disagree" or "Disagree"), which differed among regions with those in Williston disagreeing more often (*n* = 46; 29%) compared to Bismarck and Grand Forks (*n* = 34; 21% and *n* = 15; 21%, respectively) (Table 5).
River Otter Management.— The majority of anglers agreed to the statement "If there is a viable population of otters in North Dakota, I would support having a trapping season of them" (*n* = 278; 70%), with Grand Forks having the lowest agreement (*n* = 41; 58%) compared to Williston and Bismarck (*n* = 115; 72% and *n* = 122; 74%, respectively) (Table 6). Additionally, almost half of anglers surveyed agreed when asked "I would support the restrictions on trapping furbearing animals in North Dakota to protect otters from accidently being caught" (*n* = 173; 44%), with Bismarck having the lowest agreement (*n* = 61; 37%) among the regions (Table 6).

Perceptions of the River Otter.– Anglers' perceptions about river otters generally were favorable. For example, few anglers agreed to the following statements: "I believe otters create problems for people" (*n* = 25; 6%), "A river otters' direct or indirect presence causes me to feel anxiety, stress, or fear" (*n* = 3; 1%), and few said "yes" to the question, "Do you consider the otter to be a public safety concern?" (*n* = 6; 2%); these responses were consistent among regions (Table 7). Most anglers responded with like (i.e., selected "Strongly like" or "Like") to the statement, "Please indicate your overall attitude towards river otters" (*n* = 247; 62%), with a few anglers in Williston responding with dislike (i.e., selected "Strongly dislike" or "Dislike") (*n* = 8; 5%), which was not seen in other regions (Table 7).

Discussion and Management Implications

To address the small portion of anglers, despite their location in the state, who were less familiar with the species, a suggestion for the distribution of river otter educational materials could be by North Dakota Game and Fish (NDGF) when anglers renew their angling licenses. When anglers renew their angling license they could be presented with a small card about some wildlife they may encounter while fishing in North Dakota, including the river otter. On the card could be a picture of the animal and a few simple facts about the animal, which could include their distribution in the state, defining physical attributes, diet preference, and what to do if an individual were to encounter the animal in the wild. In addition, the card could have the contact information for NDGF so anglers could potentially assist wildlife management officials by reporting sightings of animals of unknown status in the state. This wildlife card would be small enough to be kept with the angler's angling license for quick and easy reference and would serve as additional educational material made available to the public by NDGF.

If education of anglers about river otters were to be done by region, it is recommended that the region of Williston be the priority. Future assessments should also address whether or not knowledge of and attitudes towards river otters has changed in the state. Additionally, it is recommended that another assessment be done of angler attitudes if and when a river otter population is confirmed in North Dakota along the Missouri River Drainage, either through natural recolonization or a reintroduction project. Another assessment of angler attitudes in North Dakota is also recommended due to flooding in the state, which occurred prior to and during the study months, resulting in people evacuating from the state and some boating dock locations condemned or made inaccessible to the public.

II. Attitudes towards beavers and beaver management techniques in North Dakota

Overall, USDA Group participants indicated the most familiarity with beavers and beaver regulations in ND, followed by DW Group participants, and lastly by general Angler Group participants. As expected, participants of the USDA Group demonstrated less favorable opinions and attitudes towards beavers than participants in the other two groups. While DW Group participants were often more positive or less negative than Angler Group participants, this may be somewhat reflective of the former's higher within-group agreement and greater tendency toward neutrality. Our comparisons suggest that familiarity with beavers can either enhance or degrade attitudes towards a species, likely dependent on the nature of an individual's experience. Moreover, they suggest that personal conflict with beavers (i.e., property damage) is more likely to increase negative opinions and attitudes towards beavers than being affiliated with DW is likely to increase positive opinions and attitudes.

Table 1. Demographics of the anglers interviewed in North Dakota. Surveys were conducted between May-October 2011.

	Grand Forks		Williston		Bismarck		Total (No.)	%
Characteristic	No.	%	No.	%	No.	%		
Race								
White	67	94.4	142	88.8	156	94.0	365	91.9
Not white	4	5.6	18	11.3	10	6.0	32	8.1
Gender								
M	54	76.1	143	89.4	150	90.4	347	87.4
F	17	23.9	17	10.6	16	9.6	50	12.6
Education[a]								
4 yr degree	24	33.8	27	16.9	47	28.5	98	24.7
No 4 yr degree	47	66.2	133	83.1	118	71.5	298	75.3
Hunter								
Yes	44	62.0	117	73.1	114	68.7	275	69.3
No	27	38.0	43	26.9	52	31.3	122	30.7
Trapper								
Yes	8	11.3	18	11.3	20	12.0	46	11.6
No	63	88.7	142	88.8	146	88.0	351	88.4
Age[b]								
<30	24	34.3	63	39.6	22	13.3	109	27.6
30-49	25	35.7	79	49.7	64	38.6	168	42.5
50+	21	30.0	17	10.7	80	48.2	118	29.9
Residence								
North Dakota	55	77.5	58	36.3	156	94.0	269	67.8
Not North Dakota	16	22.5	102	63.8	10	6.0	128	32.2
Residence status based on occupation								
Permanent	52	75.4	38	23.8	151	91.5	241	61.2
Temporary/ Non-resident	17	24.6	122	76.3	14	8.5	153	38.8

[a]One response not given in Bismarck.
[b]One response not given in Grand Forks and Williston.
[c]"Permanent" includes any job that is not affiliated with the oil field and those who stated North Dakota as their residence and are unemployed, students, or retired. "Temporary" includes those who work in the oil field and those who stated their residence outside of North Dakota and are unemployed, students, or retired. One person was not asked their occupation (Grand Forks and Bismarck) and another declined to give their occupation (Grand Forks).

Table 2. Angler knowledge of river otters in North Dakota. Interview surveys were conducted between May-October 2011.

Knowledge

Question	Grand Forks No.	Grand Forks %	Williston No.	Williston %	Bismarck No.	Bismarck %	Total	%
"Have you ever heard of a river otter?"[a]								
Yes	65	92.9	131	81.9	152	92.1	348	88.1
No	5	7.1	29	18.1	12	7.3	46	11.6
Not sure	0	0.0	0	0.0	1	0.6	1	0.3
"River otter picture identification"[c]								
Correct	55	78.6	112	70.0	140	85.4	308	78.2
Misidentified	2	2.9	5	3.1	11	6.7	18	4.6
Did not know	8	11.4	14	8.8	1	0.6	23	5.8
Shown	5	7.1	29	18.1	12	7.3	45	11.4
"Does North Dakota have an otter population?"								
Yes	32	45.1	42	26.3	81	48.8	155	39.0
No	3	4.2	11	6.9	13	7.8	27	6.8
Not sure	36	50.7	107	66.9	72	43.4	215	54.2
"Have you seen a river otter?"								
Yes	42	59.2	100	62.5	131	78.9	273	68.8
No	22	31.0	51	31.9	32	19.3	105	26.4
Not sure	7	9.9	9	5.6	3	1.8	19	4.8
"Please indicate what river otters eat."[b]								
"Fish"	46	64.8	97	61.0	141	84.9	284	71.7
Other diet items besides "fish"	4	5.6	10	6.3	10	6.0	24	6.1
Incorrect	2	2.8	5	3.1	7	4.2	14	3.5
Did not know	19	26.8	47	29.6	8	4.8	74	18.7

[a]One angler in Grand Forks and another in Bismarck had a discrepancy on their survey. Response was recorded as "yes" to question and was marked that the angler was shown the river otter picture (an action that protocol dictated only when the response was "no").

[b]One angler was not read the question in Williston.

[c]A total of three anglers did not respond to the pictures of the animals. In Grand Forks, one angler reported he had to leave. In Bismarck, two anglers were not shown the animal pictures because it was too dark or the pictures were unavailable.

Table 3. Angler attitudes towards river otters in North Dakota. Interview surveys were conducted between May-October 2011.

RIVER OTTER PRESENCE: LIKERT STATEMENT	Grand Forks		Williston		Bismarck		Total	%
	No.	%	No.	%	No.	%		
"I would be happy if otters are near waterways I go fishing at."								
Strongly agree	11	15.5	15	9.4	25	15.1	51	12.8
Agree	36	50.7	79	49.4	90	54.2	205	51.6
Neutral	19	26.8	26	16.3	25	15.1	70	17.6
Disagree	2	2.8	26	16.3	17	10.2	45	11.3
Strongly disagree	0	0.0	4	2.5	1	0.6	5	1.3
No opinion	3	4.2	10	6.3	8	4.8	21	5.3
"I like having an otter population in North Dakota."								
Strongly agree	14	19.7	20	12.5	30	18.1	64	16.1
Agree	34	47.9	83	51.9	94	56.6	211	53.1
Neutral	17	23.9	36	22.5	28	16.9	81	20.4
Disagree	0	0.0	6	3.8	2	1.2	8	2.0
Strongly disagree	0	0.0	0	0.0	0	0.0	0	0.0
No opinion	6	8.5	15	9.4	12	7.2	33	8.3
"I hope otter populations continue to expand to other suitable habitat in North Dakota."								
Strongly agree	10	14.1	18	11.3	18	10.8	46	11.6
Agree	46	64.8	104	65.0	121	72.9	271	68.3
Neutral	13	18.3	18	11.3	19	11.4	50	12.6
Disagree	0	0.0	11	6.9	3	1.8	14	3.5
Strongly disagree	0	0.0	2	1.3	0	0.0	2	0.5
No opinion	2	2.8	7	4.4	5	3.0	14	3.5
"It is important that future generations of North Dakota see otters in the wild."								
Strongly agree	18	25.4	33	20.6	26	15.7	77	19.4
Agree	50	70.4	109	68.1	124	74.7	283	71.3
Neutral	2	2.8	12	7.5	11	6.6	25	6.3
Disagree	0	0.0	3	1.9	3	1.8	6	1.5
Strongly disagree	0	0.0	0	0.0	0	0.0	0	0.0
No opinion	1	1.4	3	1.9	2	1.2	6	1.5

"I would be happy if I saw a living otter in the wild during my visit today."								
Strongly agree	18	25.4	39	24.4	37	22.3	94	23.7
Agree	48	67.6	102	63.8	119	71.7	269	67.8
Neutral	3	4.2	11	6.9	8	4.8	22	5.5
Disagree	1	1.4	6	3.8	0	0.0	7	1.8
Strongly disagree	1	1.4	0	0.0	0	0.0	1	0.3
No opinion	0	0.0	2	1.3	2	1.2	4	1.0
"What is your overall attitude towards the presence of otters in North Dakota?"								
Strongly like	15	21.1	24	15.0	33	19.9	72	18.1
Like	38	53.5	73	45.6	91	54.8	202	50.9
Neutral	10	14.1	45	28.1	34	20.5	89	22.4
Dislike	0	0.0	2	1.3	1	0.6	3	0.8
Strongly dislike	0	0.0	0	0.0	0	0.0	0	0.0
No opinion	8	11.3	16	10.0	7	4.2	31	7.8

Table 4. Interview responses to Likert statements pertaining to river otter food habits from 397 anglers in North Dakota about river otters were analyzed using Chi-square ($P<0.05$), May-October, 2011.

RIVER OTTER FOOD HABITS: LIKERT STATEMENT	Grand Forks		Williston		Bismarck		Total	%
	No.	%	No.	%	No.	%		
"I believe that otters prefer to eat game fish."								
Strongly agree	1	1.4	9	5.6	6	3.6	16	4.0
Agree	32	45.1	69	43.1	41	24.7	142	35.8
Neutral	17	23.9	25	15.6	36	21.7	78	19.6
Disagree	10	14.1	26	16.3	56	33.7	92	23.2
Strongly disagree	0	0.0	2	1.3	5	3.0	7	1.8
No opinion	11	15.5	29	18.1	22	13.3	62	15.6
"Otters are NOT a threat to game fish populations."[a]								
Strongly agree	3	4.2	7	4.4	8	4.8	18	4.6
Agree	23	32.4	56	35.4	84	50.6	163	41.3
Neutral	8	11.3	30	19.0	24	14.5	62	15.7
Disagree	13	18.3	39	24.7	33	19.9	85	21.5
Strongly disagree	2	2.8	7	4.4	1	0.6	10	2.5
No opinion	22	31.0	19	12.0	16	9.6	57	14.4

[a]Two responses not given in Williston.

Table 5. Interview responses to Likert statements pertaining to river otter management from 397 anglers in North Dakota about river otters were analyzed using Chi-square ($P<0.05$), May-October, 2011.

RIVER OTTER MANAGEMENT: LIKERT STATEMENT	Grand Forks		Williston		Bismarck		Total	%
	No.	%	No.	%	No.	%		
"If there is a viable population of otters in North Dakota, I would support having a trapping season of them."								
Strongly agree	5	7.0	14	8.8	7	4.2	26	6.5
Agree	36	50.7	101	63.1	115	69.3	252	63.5
Neutral	11	15.5	12	7.5	18	10.8	41	10.3
Disagree	15	21.1	25	15.6	19	11.4	59	14.9
Strongly disagree	2	2.8	5	3.1	2	1.2	9	2.3
No opinion	2	2.8	3	1.9	5	3.0	10	2.5
"I would support the restrictions on trapping furbearing animals in North Dakota to protect otters from accidently being caught."								
Strongly agree	6	8.5	9	5.6	10	6.0	25	6.3
Agree	32	45.1	65	40.6	51	30.7	148	37.3
Neutral	10	14.1	15	9.4	27	16.3	52	13.1
Disagree	14	19.7	55	34.4	63	38.0	132	33.2
Strongly disagree	5	7.0	6	3.8	3	1.8	14	3.5
No opinion	4	5.6	10	6.3	12	7.2	26	6.5

Table 6. Interview responses to Likert statements pertaining to river otter perception from 397 anglers in North Dakota about river otters were analyzed using Chi-square ($P<0.05$), May-October, 2011.

RIVER OTTER PERCEPTION: LIKERT STATEMENT/ QUESTION	Grand Forks		Williston		Bismarck		Total	%
	No.	%	No.	%	No.	%		
"I believe otters create problems for people."[a]								
Strongly agree	0	0.0	2	1.3	0	0.0	2	0.5
Agree	2	2.8	12	7.5	9	5.4	23	5.8
Neutral	13	18.3	24	15.1	23	13.9	60	15.2
Disagree	51	71.8	91	57.2	107	64.5	249	62.9
Strongly disagree	4	5.6	15	9.4	10	6.0	29	7.3
No opinion	1	1.4	15	9.4	17	10.2	33	8.3
"A river otters' direct or indirect presence causes me to feel anxiety, stress, or fear."[b]								
Strongly agree	0	0.0	0	0.0	0	0.0	0	0.0
Agree	1	1.4	1	0.6	1	0.6	3	0.8
Neutral	4	5.6	6	3.8	10	6.0	20	5.1
Disagree	46	64.8	101	63.9	107	64.5	254	64.3
Strongly disagree	19	26.8	46	29.1	42	25.3	107	27.1
No opinion	1	1.4	4	2.5	6	3.6	11	2.8
"Do you consider the otter to be a public safety concern?"								
Yes	0	0.0	4	2.5	2	1.2	6	1.5
No	65	91.5	141	88.1	159	95.8	365	91.9
Unsure	4	5.6	10	6.3	3	1.8	17	4.3
No opinion	2	2.8	5	3.1	2	1.2	9	2.3
"Please indicate your overall attitude towards river otters."								
Strongly like	12	16.9	21	13.1	22	13.3	55	13.9
Like	33	46.5	73	45.6	86	51.8	192	48.4
Neutral	26	36.6	58	36.3	58	34.9	142	35.8
Dislike	0	0.0	5	3.1	0	0.0	5	1.3
Strongly dislike	0	0.0	3	1.9	0	0.0	3	0.8

[a]One response not given in Williston.
[b]Two responses not given in Williston.

Introduction

II. Attitudes towards beavers and beaver management techniques in North Dakota

The Delta Waterfowl Foundation

The Delta Waterfowl Foundation of North America (DW) is a nonprofit organization operating in 41 U.S. states and seven provinces with an approximated 46,000 members. Following the notable decline of waterfowl in North America during the 1930s, Minneapolis entrepreneur and sportsman James Ford Bell advocated waterfowl conservation and sustained hunting opportunities through a science-based understanding of waterfowl behavior. After consulting with scientists and Aldo Leopold, Bell established a graduate research program at Delta Marsh in Manitoba, and recruited Hans Albert Hochbaum, a favorite student of Leopold's, to launch the DW research program in 1938. The DW Research Station, now led by Dr. Miles Pirnie Dr. Frank Rohwer of Louisiana State University, has produced more than 350 alumni in its mission to conserving waterfowl and preserve North America's waterfowl hunting culture through scientific research. In addition to serving the original mission of advancing scientific understanding, DW has placed more recent emphasis on developing practical applications for managing waterfowl, including predator control and the provision of nesting structures for breeding birds. Additionally, DW now partners with several Canadian farm groups and Alternative Land Use Services (ALUS), a habitat conservation program for prairie Canada (Delta Waterfowl Foundation 2013).

Effects of Beavers on Waterfowl Hunting and Fishing

Among the scientific community, it is generally acknowledged that ponds created by active beaver dams provide important breeding and brood-rearing habitats for waterfowl (Beard, 1953; Rosell et al., 2005; McKinstry et al., 2007), particularly in barren regions (Nummi, 1991). Several studies have demonstrated a link between beaver activity and waterfowl production (Beard, 1953; Nummi, 1991; Ringleman & Longcore, 1982; Ringleman, 1991; Rupp, 1995; Kemp et al., 2012). For instance, a study in New Brunswick of 15 active and 26 inactive beaver ponds found that active ponds supported 6.8% more duck broods per acre than inactive ponds (Renouf, 1972). A survey of 70 wetlands in New York found that those occupied by beaver contained greater waterfowl species richness and abundance compared to inactive ponds of comparable size (Grover & Baldassarre, 1995). Similarly, McKinstry et al. (2001) counted 7.5 ducks/km of stream in Wyoming areas with beaver ponds as opposed to 0.1 ducks/km of stream in similar areas unoccupied by beavers.

Structural changes to habitats created by beavers are often attractive to waterfowl; for instance, flooded forests create shallow-water foraging areas with canopy cover and underlying shrub cover, offering protection from predators and isolation from other breeding pairs. Moreover, emergent vegetation, dams and lodges provide loafing areas and island nesting sites for migrating and breeding ducks and geese (Arner & Hepp, 1989; Dieter & McCabe, 1989; Rosell et al., 2005). The presence of beavers not only increases the amount of wetland area available to waterfowl, but also enhances wetland fertility. Beaver dams retain sediment and organic matter that is normally carried downstream, and beavers introduce additional plant and fecal material, increasing the

nutrient base for aquatic plants and invertebrates (Ringleman, 1991). Invertebrate biomass and density is generally two to five times greater in beaver ponds than in streams (McCall et al., 1996), and pond biota are more easily exploited by waterfowl than stream taxa (Ringleman, 1991).

The impact of beaver habitat modification on sport fishes is subject to greater debate (Kemp et al., 2012). Despite extensive research, biologists have reached no definite conclusion on whether the influence of beavers on the qualitative and quantitative composition of ichthyofauna is positive or negative (Domagala et al., 2013). On one hand, beaver dams can present barriers to fish movements, impeding migrating species from reaching important foraging or spawning grounds. Moreover, altered currents and water temperature, excess siltation and low oxygen levels associated with beaver ponds may produce suboptimal spawning habitat for certain fishes, such as salmonids. On the other hand, beaver ponds have been shown to increase available food for many sports fishes and reduce predation by offering abundant aquatic cover (Kemp et al., 2012; Domagala et al., 2013).

In a systematic review of the impacts of beaver dams on fishes and fish habitat based on a meta-analysis of the literature and expert opinion in Europe and North America, benefits were cited more frequently than costs. Moreover, the majority of 49 North American and European experts considered beaver habitat modification to have an overall positive impact on fish populations by increasing abundance and productivity. However, measurable impacts were spatially and temporally variable and differed among species (Kemp et al., 2012). Thus, depending on regional geographic context (Collin & Gibson, 2000; Schlosser & Kallemeyn, 2000) and ichthyofauna of interest, the presence of beaver ponds may enhance angling opportunities (Collin & Gibson, 2000). For instance, in cool waterways with strong currents, beaver ponds are likely more beneficial for salmonids as they should remain adequately cold (Collin & Gibson, 2001; Domagala et al., 2013), slow down currents that may be overly strong for young fishes (Domagala et al., 2013), and offer increased forage and refugia compared with streams (Collin & Gibson, 2000; Domagala et al., 2013). However, in larger streams where water temperatures exceed optimal range for salmonids, other fishes, such as cyprinids, catostomids, percids, or centrarchids may become dominant (Collin & Gibson, 2000).

Among surveyed hunters in Arkansas, duck hunting and angling opportunities were among the most frequently cited benefit of beavers (Wigley and Garner, 1987). As beaver dams can provide important forage or habitat for various sports fish, anglers may derive recreational benefit from the presence of appropriately managed beaver populations. Anglers who are also members of Delta Waterfowl may profit additionally from the benefits that beaver dams create for waterfowl. However, anglers who have suffered property damage from beavers are likely to regard the species as a nuisance or threat, thereby negatively influencing existing attitudes or opinions. It was thus expected that participants from the DW Group would be most favorable towards beavers and their presence in North Dakota and that participants of the USDA Group would be least favorable.

Methods

Two similar versions of a questionnaire were developed to gain insight on participant knowledge, familiarity, attitudes, and opinions towards beavers in North

Dakota. The version was administered in the form of face-to-face interviews to anglers at popular ND fishing sites, as well as to members of the Delta Waterfowl Foundation (DW Group) and property owners having contacted government authorities to remove nuisance animals (USDA Group) via mail-in surveys (Appendix IV). The second version (Appendix V) was administered in the form of face-to-face interviews to additional anglers at popular ND fishing sites. Both versions of the survey were approved by the Institutional Review Board (IRB) for sociological research.

The initial portions of both questionnaires were designed to develop a character profile of the participants based on demography, residence, occupation, education, involvement in consumptive wildlife recreation (hunting, trapping, and fishing), and attitudes toward hunting and trapping. Subsequent sections of the questionnaires focused on evaluating participants' knowledge about aspects of beavers and beaver management in North Dakota.

Assessment of attitudes was based primarily on participants' responses to a set of 15 statements using a 6-point Likert-style response format. This format requires an affirmative ("Strongly Agree" or "Agree," Likert score = 1 or 2, respectively), opposing ("Disagree" or "Strongly Disagree," Likert score = 4 or 5, respectively), Neutral (Likert score = 3), or "No Opinion" (Likert score = 6) response to a particular statement. The final section of the questionnaires aimed to reveal additional opinions about beavers, including participants' views of acceptable control methods.

Participant Categories

Participants were selected from and compared among three categories of ND anglers: general anglers (Angler Group), anglers affiliated with the Delta Waterfowl Foundation (DW Group), and anglers who had experienced personal property damage by beavers and had contacted USDA Wildlife Services to remove nuisance animals (USDA Group).

The proportion of participants in the Angler and DW Groups having experienced personal conflict with beavers can be assumed to be minor. Although most anglers and DW members were not explicitly asked about experience with nuisance beavers, a subsample of 36 anglers were asked whether they had suffered personal property damage by beavers. Five of the 36 subsampled anglers indicated that they had experienced personal property damage, and were omitted from Angler Group. Additionally, eight of the remaining 124 anglers as well as eight of the remaining 95 DW members indicated that they had experienced personal conflict with beavers when asked, "If beavers are viewed as pests, how have beavers been a pest to you?" These 16 participants were omitted from their respective groups before analysis.

Similarly, the proportion of participants in the Angler and USDA Groups affiliated with Delta Waterfowl can assumed to have been low. Although participants were not explicitly asked about membership in conservation organizations, affiliation with Delta Waterfowl is low among the general ND population (need to obtain statistics for here).

Angler Interviews

From 6/5/11 to 7/17/11, 85 beaver surveys were administered to North Dakota anglers at 10 locations along the Missouri and Red Rivers. An additional 36 beaver

surveys were administered from 9/18/11 – 10/22/11 at nine locations along the Missouri River (Appendix V). From 7/7/12 and 8/02/1212, a final set of 65 interviews were conducted between at five locations along the Missouri River (Appendix IV).

Prior to being interviewed, anglers were provided with a brief overview of the interview process, informed that the surveys had been approved by the IRB, and assured that their responses would remain anonymous (names of participants were not taken). Interviewers emphasized that there were no correct or incorrect responses to the survey questions, nor any risk or benefit associated with participating. No additional information about ND wildlife was provided until completion of the interview. All interviews followed the same protocol. Participants were asked to respond to a set of questions or statements read to them from a questionnaire. Most questions and statements were presented in a closed format.

DW and USDA Group Mail-in Surveys

Members of DW and property owners who had received government assistance for problem beavers were each contacted by mail and asked to participate in the survey by self-administering the questionnaire (Appendix IV) and mailing back their responses. Phil Mastrangelo of USDA Wildlife Services provided a list of 309 property owners who had contacted Wildlife Services to have nuisance beavers removed from their properties. On 7/9/12, a cover letter (Appendix VI) and survey were mailed to the address of each of the 309 names on the list. A complete list of Delta Waterfowl members was obtained from ___contact name?____ of Delta Waterfowl, and on 7/19/12, a cover letter (Appendix IV) and survey were sent to 300 randomly selected ND residents on the list. For analysis, an attitude index was created based on the 15 Likert style attitude questions included in the survey. Logistic regression was used to determine acceptable beaver management techniques for each of the 3 stakeholder groups.

Results

Participant Demographics

A total of 176 anglers agreed to participate in the survey. From these, 116 participants were male ND residents who had not indicated personal conflict or property damage by beavers, and were thus included in analysis. The mean age of these 116 participants was 41.89 years (SD = 13.30), and most individuals identified themselves as white (96.55%, n = 112). In addition, three participants (2.59%) identified themselves as Native American and one (0.86%) as more than one race. The highest level of formal education achieved by the greatest number of respondents was a high school diploma (33.62%, n = 39), followed by a two-year or Associate's degree (25.86%, n = 30), a four-year or Bachelor's degree (17.24%, n = 20), and some college (13.79%, n = 16). Four participants (3.45%) were educated beyond a four-year or Bachelor's degree; four (3.45%) attended high school but did not graduate, and two (1.72%) attended vocational school after high school. The most frequently listed occupations among participants were oil field worker (9.73%, n = 11), farmer (6.19%, n = 7), construction worker (4.42%, n = 5), maintenance worker (5.31%, n = 6), retired (4.42%, n = 5), and self-employed (4.42%, n = 5).

A total of 104 DW members agreed to participate in the survey. Of these, 87 selected participants were male anglers and ND residents who had not indicated personal conflict or property damage by beavers and were thus included in analysis. The mean age of these 87 participants was 51.52 years (SD = 15.42), and most individuals identified themselves as white (96.55%, n = 84). In addition, two participants (2.30%) identified themselves as black, and one (1.15%) as more than one race. The highest level of formal education achieved by the greatest number of respondents was beyond a four-year or Bachelor's degree (29.07%, n = 25), followed by a four-year or Bachelor's degree (25.58%, n = 22), and some college (16.28%, n = 14). Nine participants (10.47%) had a high school diploma; eight (9.30%) attended vocational school after high school; seven (8.14%) had earned a two-year or Associate's degree, and one (1.16%) had attended but not graduated high school. The most frequently listed occupations among participants were construction worker (6.45%, n = 4) and farmer (4.84%, n = 3).

A total of 136 property owners who had received assistance from the state government to control problem beavers (USDA group) agreed to participate in the survey. Of these, 92 selected participants were male anglers and ND residents, and thus included in analysis. The mean age of these 92 participants was 60.81 years (SD = 11.42), and most individuals identified themselves as white (95.65%, n = 88). In addition, four participants (4.35%) identified themselves as black. The highest level of formal education achieved by the greatest number of respondents was a high school diploma (23.91%, n = 22), followed by a four-year or Bachelor's degree (19.56%, n = 18), and some college (16.30%, n = 15). Thirteen participants (13.13%) had attended vocational school in addition to high school, 11 (11.96%) were educated beyond a four-year or Bachelor's degree, 11 (11.96%) had earned a two-year or Associate's degree, and two (2.17%) had never attended high school. The most frequently listed occupation among participants was farmer/rancher (46.74%, n = 43) (Table 1).

Participation in Consumptive Wildlife Recreation

Most Angler Group participants (81.03%, n = 94) considered themselves to be hunters, but only 14.65% (n = 17) considered themselves to be trappers. Similarly, most DW Group participants considered themselves to be hunters (97.70%, n = 85), but only 35.63% (n = 31) considered themselves to be trappers. A majority of USDA Group participants also considered themselves to be hunters (81.03%, n = 94), whereas a minority (45.65%, n = 42) considered themselves to be trappers (Table 1).

Knowledge of and Familiarity with Beavers

All USDA participants (100.00%, n = 92), a majority of DW Group participants (91.95%, n = 80), and a slightly lesser majority of Angler Group participants (87.93%, n = 102) were aware that ND has a beaver population (Figure 1). Likewise, all USDA Group participants (100.00%, n = 92) and large proportions of DW Group participants (94.25%, n = 82) and Angler Group participants (89.66%, n = 104) had seen a wild beaver in ND (Figure 4). USDA Group participants reported that they came into beavers more frequently than participants of the other two groups (Figure 5), and a majority of USDA Group participants (71.69%, n = 70) reported that they had a beaver population near their residence. In contrast, most Angler Group participants (74.56%, n = 85) and DW Group participants (67.82%, n = 59) reported that they did not live near a known

beaver population (Figure 6). When asked whether they were familiar with the ND laws pertaining to beaver regulation, only a minority of participants from each group indicated yes. The USDA Group comprised the largest proportion of participants who claimed to be knowledgeable of beaver regulation laws (43.68%, n = 38), followed by the DW Group (26.44%, n = 23), and the Angler Group (20.87%, n = 24) (Figure 7).

Opinions of Beavers

Most Angler Group participants (79.31%, n = 92) and DW Group participants (80.77%, n = 84) believed that beavers create habitat for other wildlife. Only 9.48% (n = 11) of Angler Group participants and 2.30% (n = 2) of DW Group participants did not believe beavers create wildlife habitat. In contrast, fewer USDA Group participants (56.52%, n = 52) believed that beavers create habitat, and 19.57% (n = 18) believed they do not (Figure 8). Participants who believed beavers create habitat for other wildlife were asked to name wildlife that benefits from beaver habitat modification. Of Angler Group responses, 61.64% (n = 45) explicitly included fish; 43.84% (n = 32) explicitly included waterfowl; and 50.68% (n = 37) listed other flora or fauna. Of DW Group responses, 38.89% (n = 21) explicitly included fish; 64.81% (n = 35) explicitly included waterfowl; and 66.67% (n = 36) listed other flora or fauna. Finally, of USDA Group responses, 15.38% (n = 21) explicitly included fish; 84.62% (n = 33) explicitly included waterfowl; and 48.72% (n = 19) listed other flora or fauna (Figure 9).

A majority of Angler Group participants (60.87%, n = 70) and DW Group participants (66.67%, n = 58) did not consider beavers to be a pest species; however, a high proportion of USDA Group participants (76.07%, n = 70) did consider beavers to be pests (Figure 8). A large majority (89.13%, n = 81) of USDA Group participants and lesser majorities of Angler Group participants (71.68%, n = 81) and DW Group participants (61.63%, n = 53) felt that the size of the beaver population in ND should be controlled (Figure 11). When asked whether certain proposed methods for controlling nuisance beavers were acceptable or not, a majority of participants in all three groups considered the following control methods acceptable: culling by property owners (A: 64.15%, n = 68; DW: 61.18%, n = 52; USDA: 73.33%, n = 66; Figure 10), culling by recreational trappers (A: 81.13%, n = 86; DW: 77.65%, n = 66; USDA: 83.33%, n = 75; Figure 11), and general, overall population reduction by recreational trapping (A: 85.71%, n = 42; DW: 74.12%, n = 63; USDA: 67.78%, n = 61; Figure 14). Additionally, a high proportion of USDA participants (92.22%, n = 83) and slight majority of Angler Group participants (57.14%, n = 60) considered culling by government officials to be acceptable. In contrast, a small majority of DW Group participants (55.29%, n = 47) considered it unacceptable (Figure 15).

Most Angler Group participants (63.27%, n = 31) and DW Group participants (55.29%, n = 47) considered live trapping and relocating to be an acceptable control method, whereas 57.78% (n = 52) of USDA Group participants considered it unacceptable (Figure 16). A slight majority of Angler Group participants (55.10%, n = 27) felt that nonlethal deterrents, such as fencing trees, was acceptable beaver control; however, most DW Group participants (58.82%, n = 50) and USDA Group participants (80.00%, n = 72) considered it unacceptable (Figure 17). All Angler Group participants (100.00%, n = 53), nearly all DW Group participants (98.82%, n = 84), and most USDA Group participants (87.78%, n = 79) considered total eradication of beavers unacceptable

(Figure 16). Finally, no Angler Group participants (0.00%, n = 0) and very few DW participants (1.18%, n = 1) and USDA participants (2.22%, n = 2) felt that killing or removing beavers was not an option (Figure 19).

When prompted for their overall view of beavers, only 15.38% (n = 14) of USDA Group participants indicated that they strongly liked or liked beavers, whereas 42.86% (n = 39) indicated that they disliked or strongly disliked beavers. By contrast, 47.41% (n = 55) of Angler Group participants and 33.72% (n = 29) of DW Group participants responded favorably to the statement, with 21.55% (n = 25) of Angler Group participants and 10.47% (n = 9) of DW Group participants indicating that they disliked or strongly disliked beavers (Figure 20).

Attitudes Towards Beavers

USDA Group participants demonstrated less positive attitudes towards beavers than DW and Angler Group participants for all Likert-scale responses (Figures 21 – 35). For example, 29.67% (n = 32) of USDA Group participants strongly agreed or agreed with the statement, "I like having a beaver population in North Dakota," as opposed to 26.37% (n = 24) who disagreed or strongly disagreed. By contrast, 71.55% (n = 83) of Angler Group participants and 76.74% (n = 66) of DW Group participants responded favorably to the statement, and only 4.65% (n = 4) of DW Group participants and 11.21% (n = 13) of Angler Group participants disagreed or strongly disagreed (Figure 21). In response to the statement "I support efforts to decrease the beaver population in North Dakota," 61.96% (n = 57) of USDA participants agreed or strongly agreed, versus only 8.70% (n = 8) who disagreed or strongly disagreed. In contrast, 48.24% (n = 41) of Angler Group participants and 17.24% (n = 15) of DW Group participants were in agreement, with 11.76% (n = 10) of Angler Group participants and 27.59% (n = 24) of DW Group participants in disagreement (Figure 25).

Overall, DW Group participant responses were slightly more positive or less negative toward beavers than Angler Group respondents and demonstrated greater within-group agreement. Angler Group participants were more divided between positive and negative responses, whereas DW Group participants tended to show more neutrality. For example, in response to the statement, "I like/want beaver dams on my property, 41.38% (n = 48) of Angler Group participants and 17.24% (n = 15) of DW Group participants agreed or strongly agreed, 8.62% (n = 10) of Angler Group participants and 29.89% (n = 26) of DW Group participants were neutral, and 42.24% (n = 49) of Angler Group participants and 34.48% (n = 30) of DW Group participants disagreed or strongly disagreed with the statement (Figure 27).

Discussion and Management Implications

II. Attitudes towards beavers and beaver management techniques in North Dakota

Overall, USDA Group participants indicated the most familiarity with beavers and beaver regulations in ND, followed by DW Group participants, and lastly by general Angler Group participants. As expected, participants of the USDA Group demonstrated less favorable opinions and attitudes towards beavers than participants in the other two

groups. While DW Group participants were often more positive or less negative than Angler Group participants, this may be somewhat reflective of the former's higher within-group agreement and greater tendency toward neutrality.

Our comparisons suggest that familiarity with beavers can either enhance or degrade attitudes towards a species, likely dependent on the nature of an individual's experience. Moreover, they suggest that personal conflict with beavers (i.e., property damage) is more likely to increase negative opinions and attitudes towards beavers than being affiliated with DW is likely to increase positive opinions and attitudes. It is important to note, however, that surveyed anglers were interviewed in person by one of five graduate student surveyors (females of age 23 – 25), whereas DW and USDA participants responded to questionnaires via mail-in surveys. For this reason, it is presumable that surveyor administrators and the interview process influenced Angler Group participants' responses to a greater extent than those of the USDA or DW Groups. Several studies suggest that the presence of an interviewer may bias survey participants to provide responses likely to be endorsed by the interviewer or avoid responses that may put them at odds with the expected beliefs of the interviewer (Sudman, 1983; Tourangeau et al., 1997, Bowling, 1999; Bowling, 2001; Bowling, 2005). Face-to-face interviews have been shown to elicit more positive and socially desirable responses among participants than self-administered (e.g., postal) surveys (Tourangeau and Smith, 1996; Presser and Stinson, 1998). Thus, Angler Group participants may have responded more positively to questions than those of the DW and USDA Groups simply because of the social context of survey administration. If such is the case, there may have been greater disparity between Angler Group and DW Group participant responses than evident from our analysis.

Among respondents who believed beavers create habitat for other wildlife, a majority of Angler Group participants explicitly mentioned fish, and a majority of DW Group participants explicitly mentioned waterfowl, suggesting that those groups' more positive opinions and attitudes towards beavers was influenced by the perception that the presence of beavers may enhance angling or waterfowl hunting opportunities. Although a lesser proportion of USDA Group participants felt that beavers create habitat for other wildlife compared with Angler Group and DW Group participants, among USDA Group respondents who did believe beavers create habitat, a higher percentage explicitly included waterfowl in their responses than DW Group participants. Thus, it may be inaccurate to assume that DW Group participants possessed a greater awareness of the benefits that beavers create for waterfowl simply because of a personal interest in waterfowl. Even if personal interest in fish or waterfowl does contribute to positive opinions and attitudes towards beavers, it would appear that negative personal experience with beavers outweighs perceived benefits of their presence.

When making management decisions about game species, wildlife professionals should be aware of the multitude of factors that may influence public attitudes, opinions, and behaviors towards species (Endter-Wada et al., 1998; Bruskotter et al., 2010). Sociological methodologies can reveal sources of variation among individual perspectives and elucidate broad cultural, political, and economic factors influencing support for a species or conservation technique. Just as personal conflict with beavers can heighten negative attitudes and increase support for population control, affiliation with hunting groups or conservation organizations can positively influence attitudes towards

species. Sociological investigations such as this one are invaluable for improving our understanding of the complex framework upon which the success of wildlife conservation efforts is based.

Tables and Figures

Table 1. Demographics of three participant categories (Angler Group, DW Group, and USDA Group) compared by their knowledge, familiarity, and attitudes towards beavers in North Dakota during 2011 – 2012.

Participant Category	Anglers	DW	USDA
Mean Age (SD)	41.89 yrs (13.30)	51.52 yrs (15.42)	60.81 yrs (11.42)
Percentage White (%)	96.55%	96.55%	95.65%
Predominant Education (%)	High school (33.62%)	Beyond bachelor's (29.07%)	High school (23.91%)
Predominant Occupation (%)	Oil field worker (9.73%)	Construction worker (6.45%)	Farmer/rancher (46.74%)
Percentage Hunter	81.03%	97.70%	91.30%
Percentage Trapper	14.65%	35.63%	45.65%

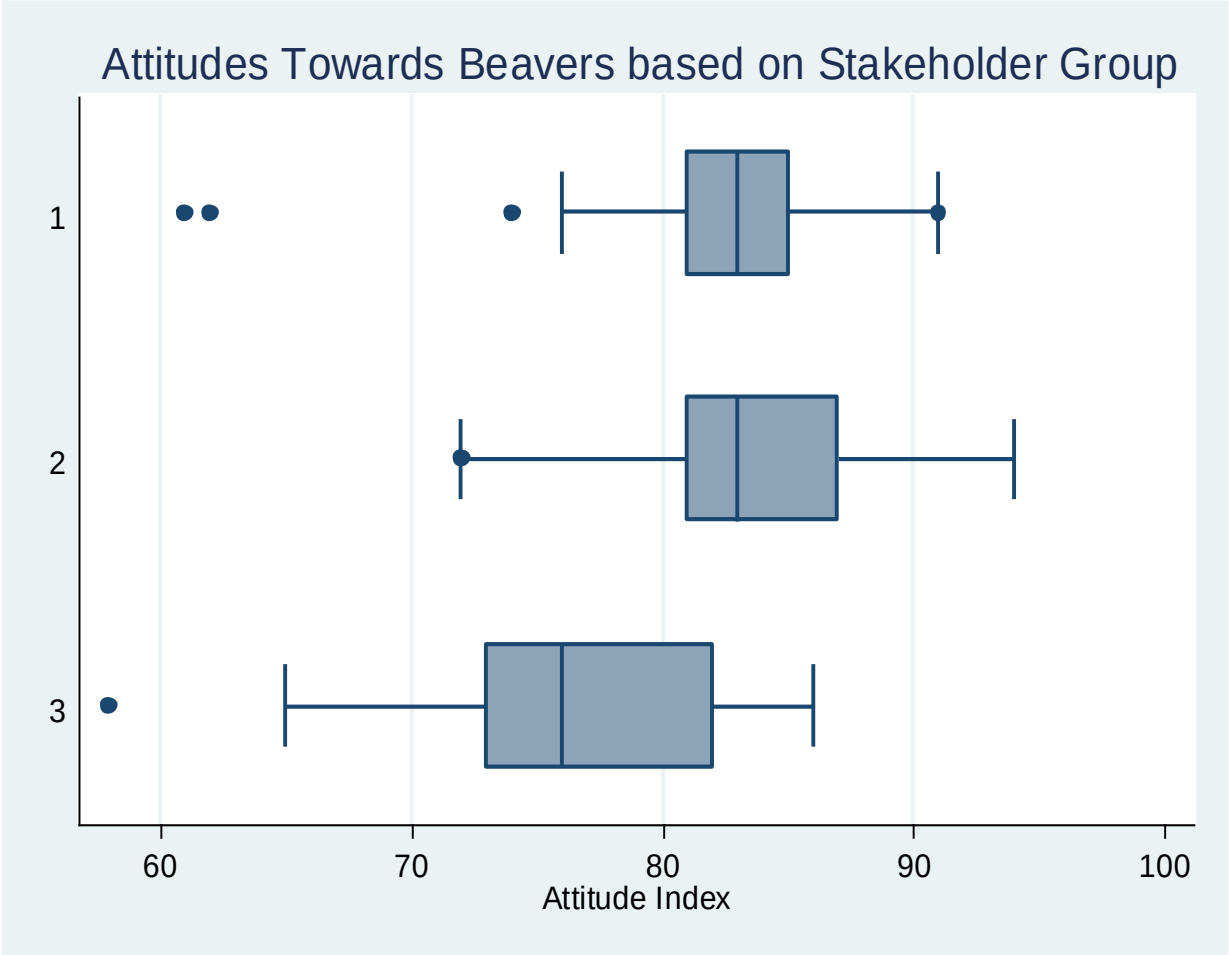
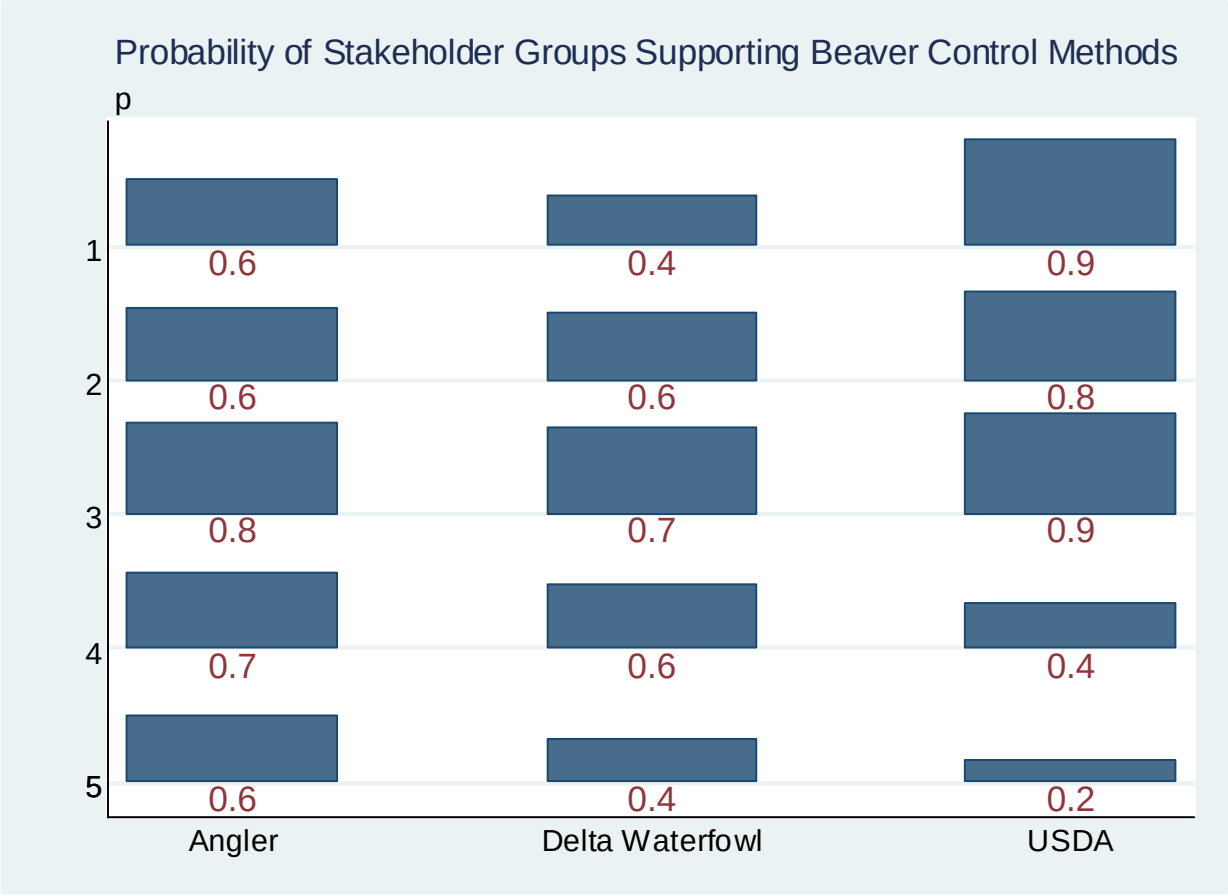


Figure 1. Boxplot of attitude index for each stakeholder group. There was a significant difference for the mean attitude index between Angler (*x=82.08)* and USDA (*x*=76.73) (*t-value*=6.4 *p*<0.0001) and between Delta Waterfowl (*x*=83.127) and USDA (*t-value*= 6.9 *p*<0.0001)

Figure 2. Probabilities of stakeholder groups supporting various control methods for nuisance beaver(s) 1) Killing (e.g., trapping, shooting) by government officials 2) Killing (e.g., trapping shooting) by self 3) Trapping by recreational trappers 4) Trap and relocation 5) Non-lethal control methods (e.g., fencing around tree)



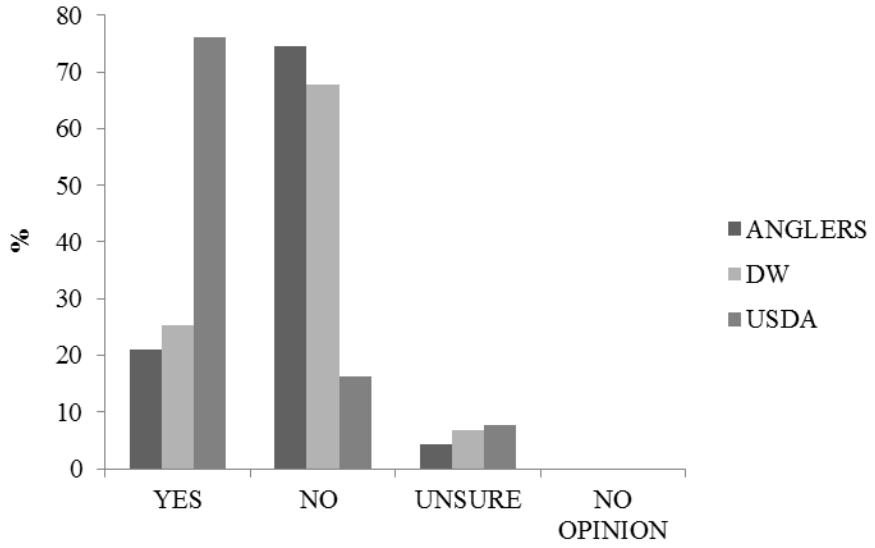


Figure 3. Responses to the question, "Does ND have a beaver population?" among Angler Group (n = 116), DW Group (n = 87), and USDA Group (n = 92) participants (2011 – 2012).

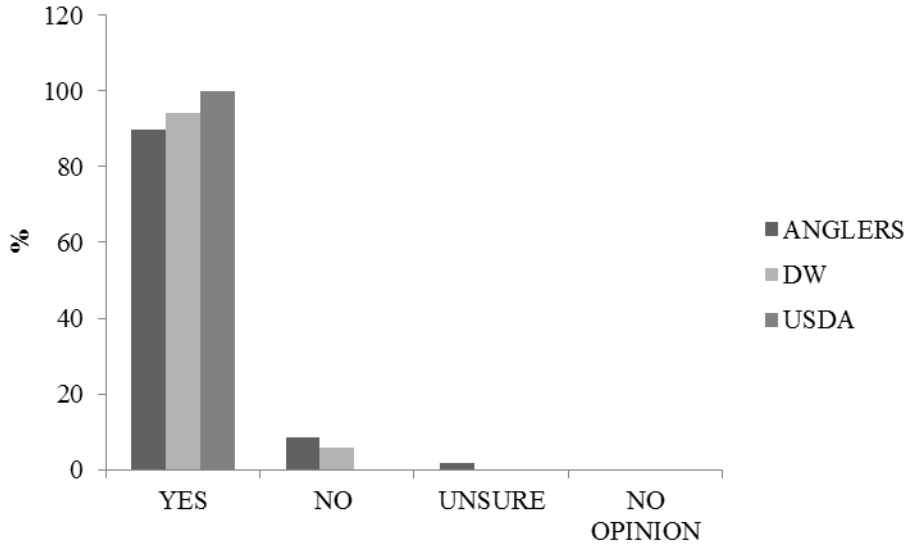


Figure 4. Responses to the question, "Have you seen a beaver in ND?" among Angler Group (n = 116), DW Group (n = 87), and USDA Group (n = 92) participants (2011 – 2012).

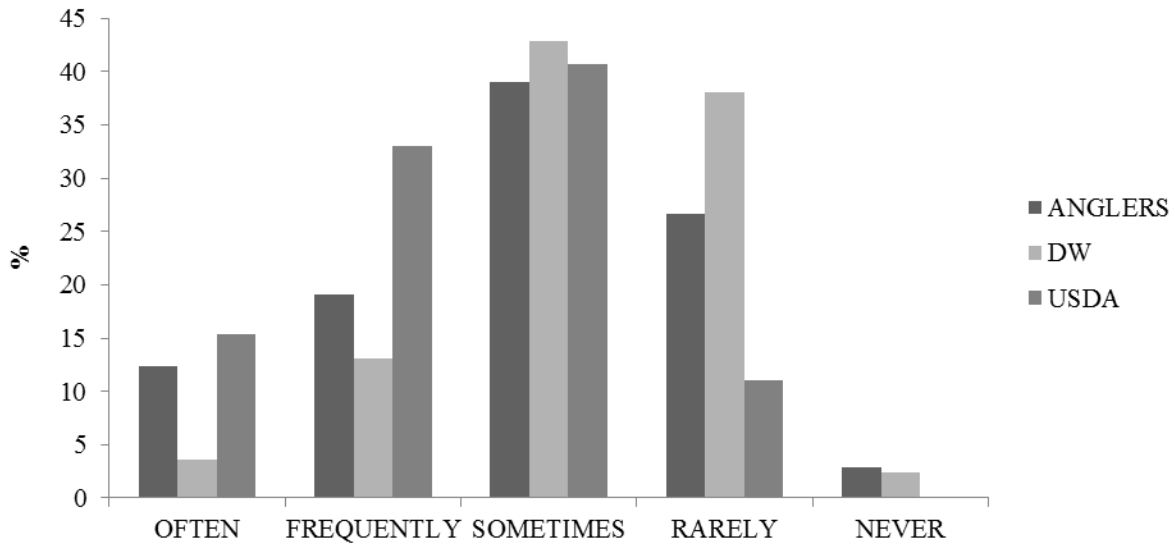


Figure 5. Responses to the question, "How often do you come in contact with beavers?" among Angler Group (n = 105), DW Group (n = 84), and USDA Group (n = 91) participants (2011 – 2012).

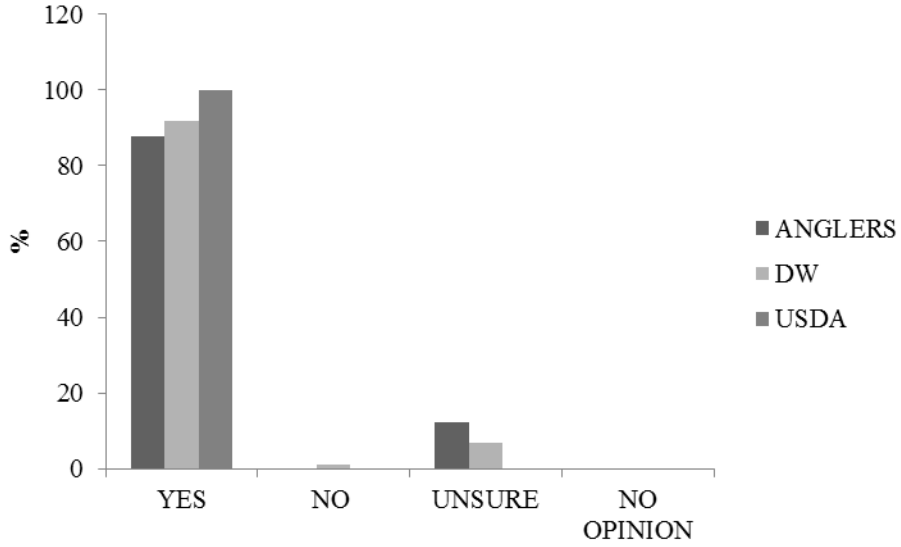


Figure 6. Responses to the question, "Do you have a beaver population near your residence?" among Angler Group (n = 114), DW Group (n = 87), and USDA Group (n = 92) participants (2011 – 2012).

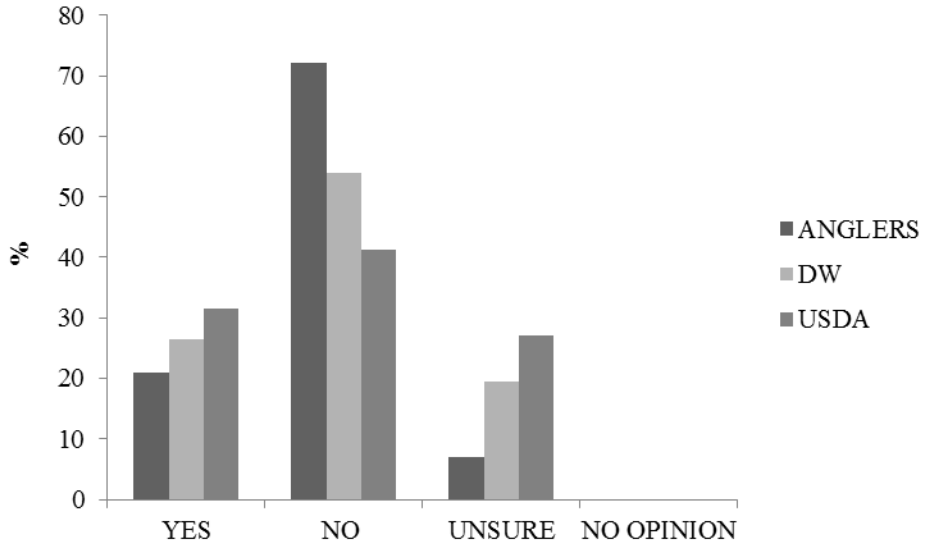


Figure 7. Responses to the question, "Are you familiar with the ND laws pertaining to beaver regulation?" among Angler Group (n = 115), DW Group (n = 87), and USDA Group (n = 92) participants (2011 – 2012).

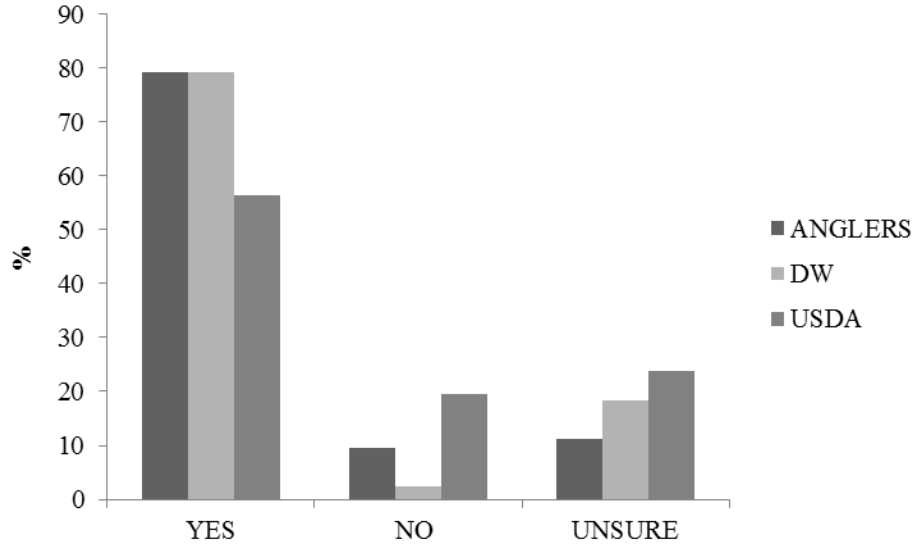


Figure 8. Responses to the question, "Do beavers create habitat for other wildlife?" among Angler Group (n = 116), DW Group (n = 87), and USDA Group (n = 92) participants (2011 – 2012).

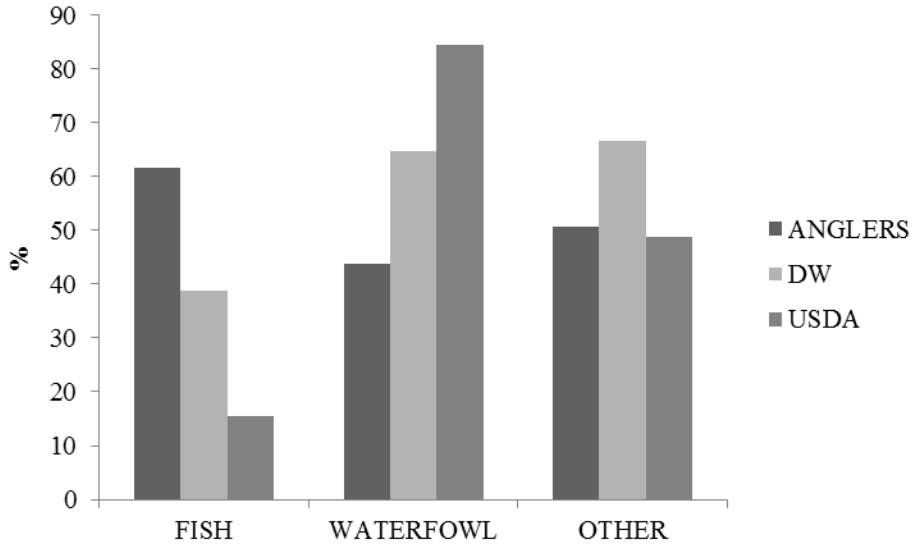


Figure 9. Responses to the question, "For what wildlife do beaver dams create habitat?" among Angler Group (n = 73), DW Group (n = 54), and USDA Group (n = 39) participants who indicated that beavers create habitat for other wildlife (see Figure 6) (2011 – 2012).

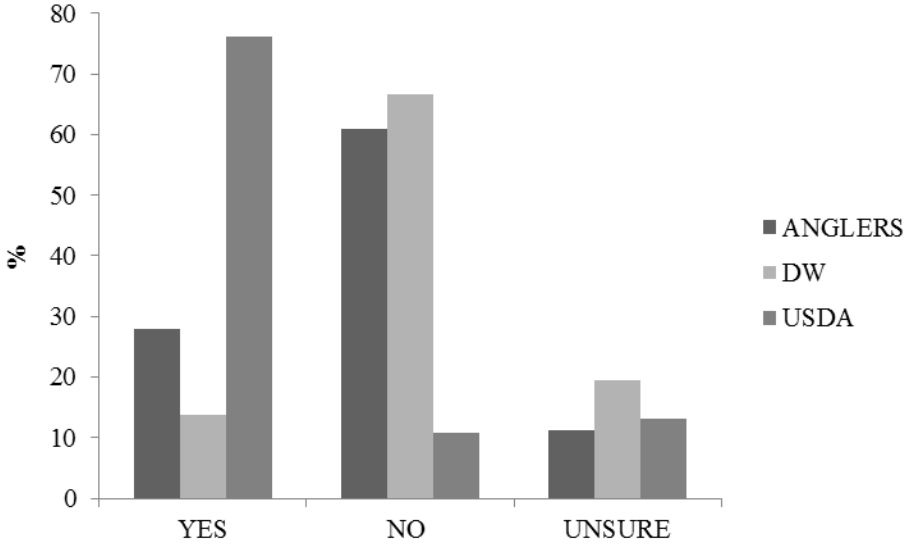


Figure 10. Responses to the question, "Do you consider beavers to be a pest species?" among Angler Group (n = 115), DW Group (n = 87), and USDA Group (n = 92) participants (2011 – 2012).

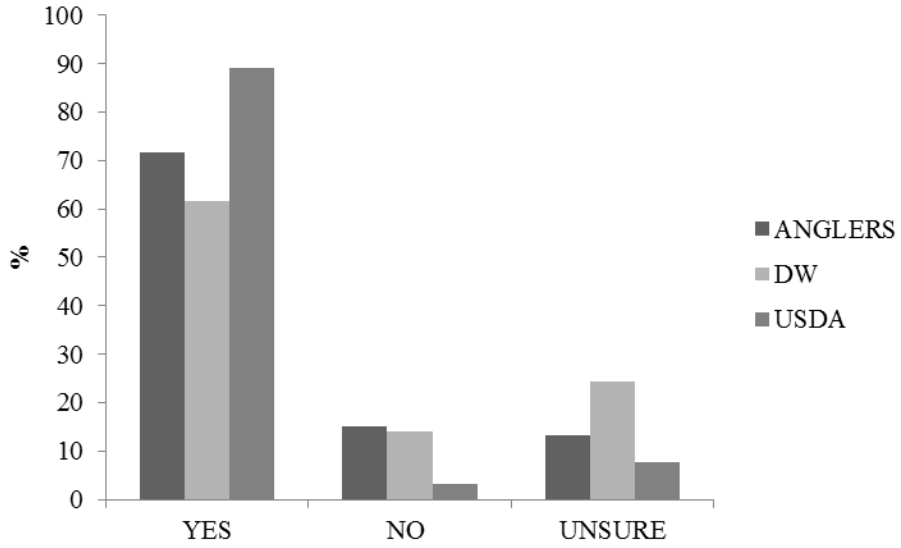


Figure 11. Responses to the question, "Do you think the size of the beaver population needs to be controlled in ND?" among Angler Group (n = 113), DW Group (n = 86), and USDA Group (n = 92) participants (2011 – 2012).

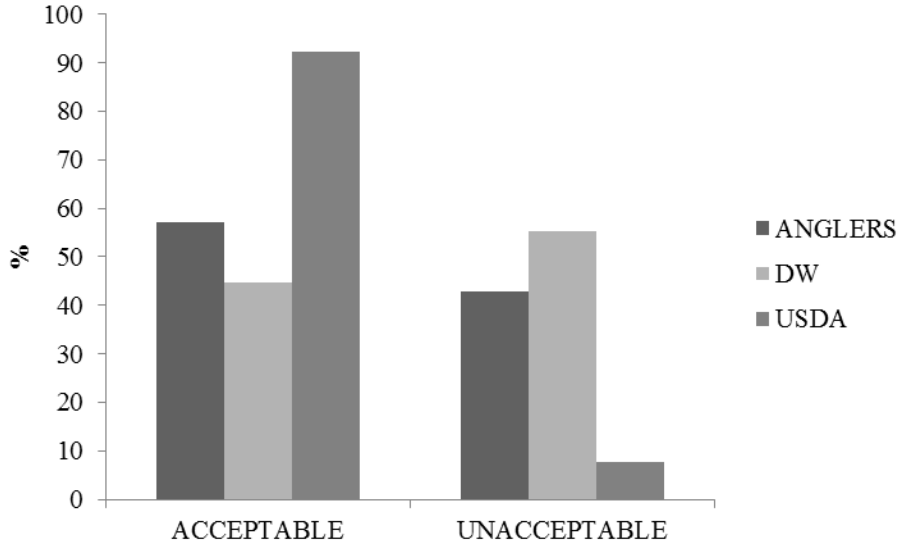


Figure 12. Responses to the beaver control option of "killing nuisance beavers (e.g., traps, shooting, etc.) by government officials" among Angler Group (n = 105), DW Group (n = 85), and USDA Group (n = 90) participants (2011 – 2012).

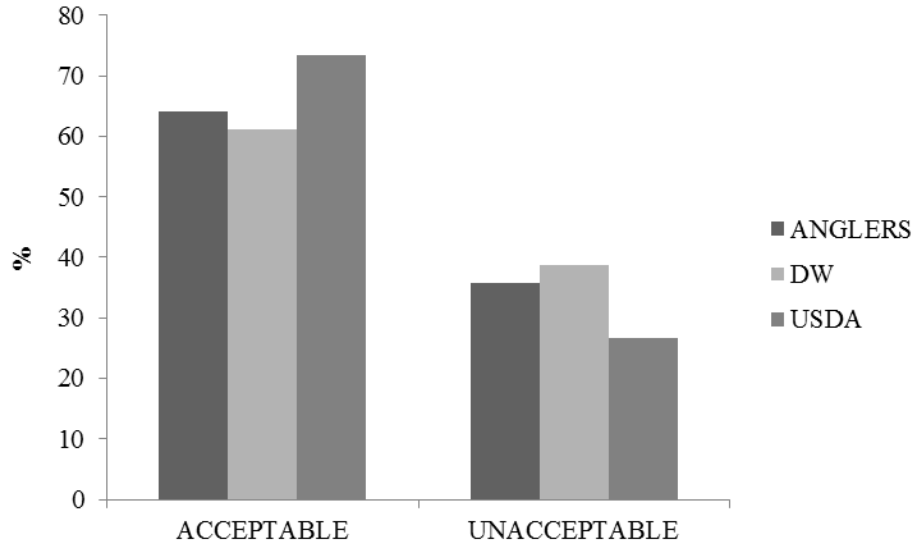


Figure 13. Responses to the beaver control option of "killing nuisance beavers (e.g., traps, shooting, etc.) by property owners" among Angler Group (n = 106), DW Group (n = 85), and USDA Group (n = 90) participants (2011 – 2012).

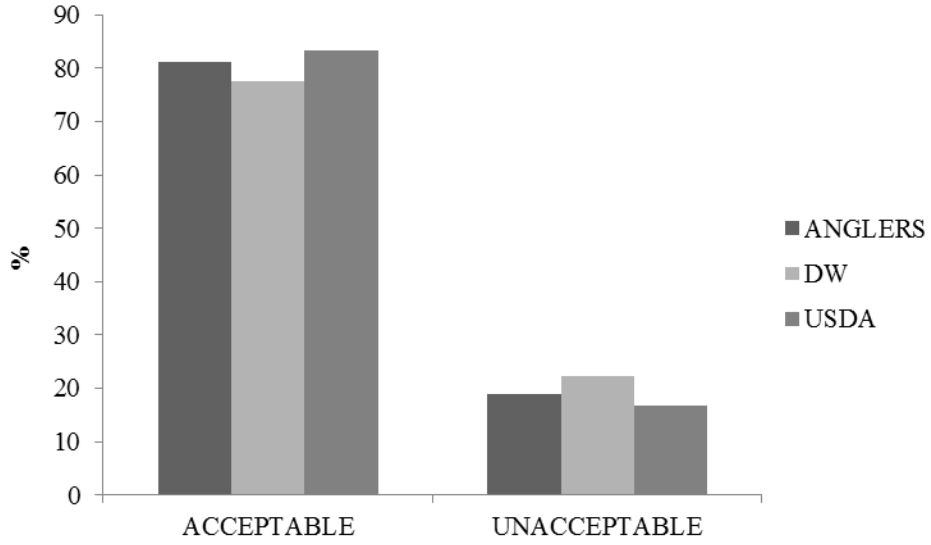


Figure 14. Responses to the beaver control option of "killing nuisance beavers by recreational trappers" among Angler Group (n = 106), DW Group (n = 85), and USDA Group (n = 90) participants (2011 – 2012).

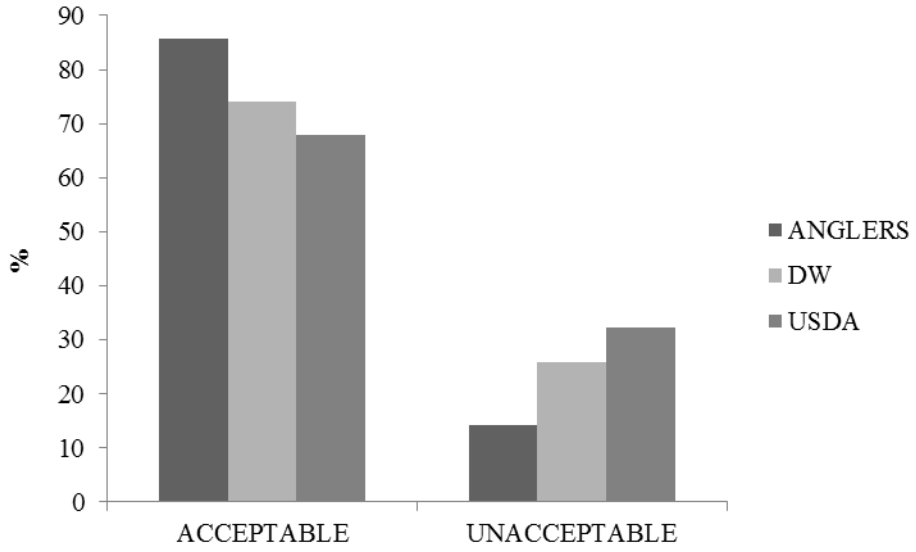


Figure 15. Responses to the beaver control option of "general, overall population reduction" among Angler Group (n = 49), DW Group (n = 85), and USDA Group (n = 90) participants (2011 – 2012).

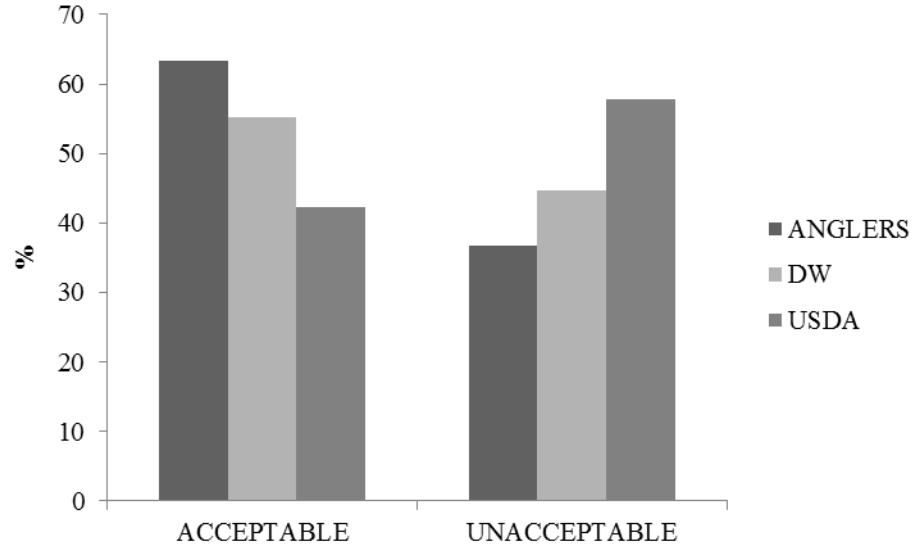


Figure 16. Responses to the beaver control option of "live trapping and relocating nuisance beavers" among Angler Group (n = 49), DW Group (n = 85), and USDA Group (n = 90) participants (2011 – 2012).

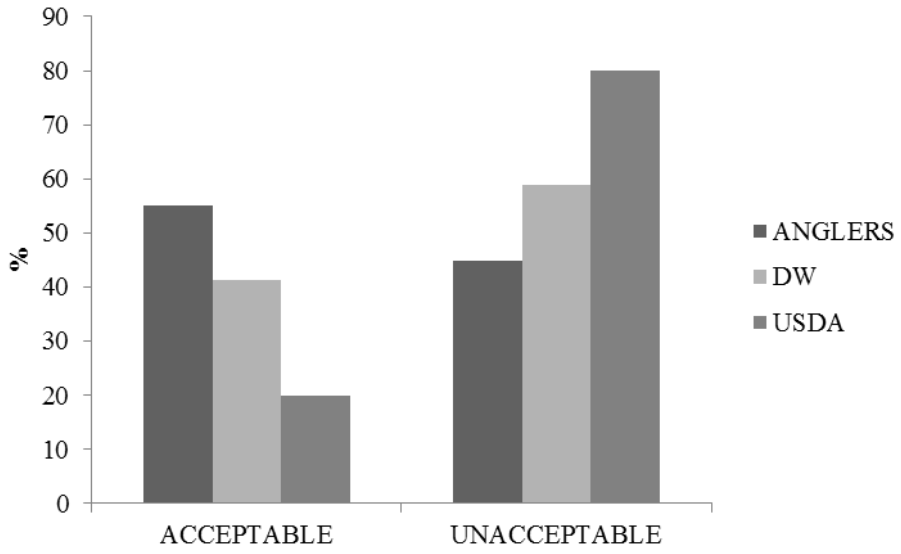


Figure 17. Responses to the beaver control option of "nonlethal deterrents (i.e., fencing trees)" among Angler Group (n = 49), DW Group (n = 85), and USDA Group (n = 90) participants (2011 – 2012).

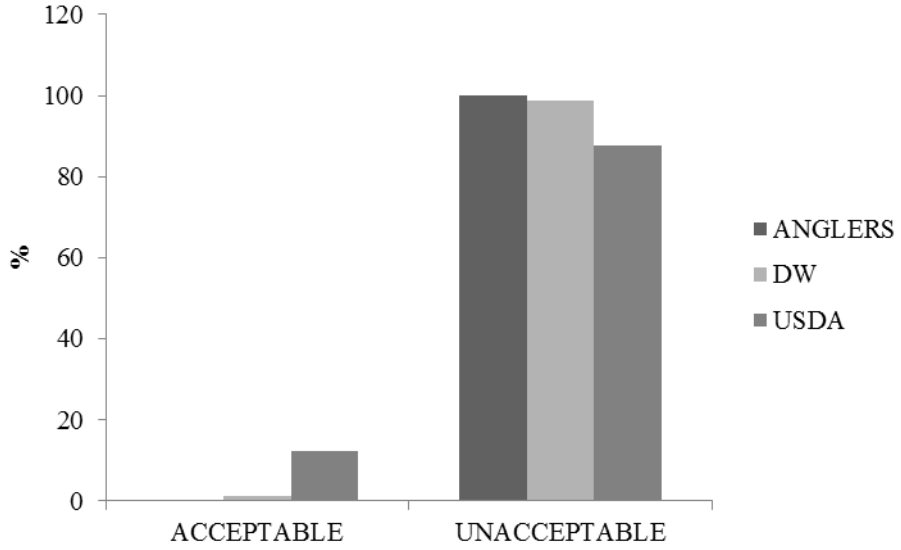


Figure 18. Responses to the beaver control option of "total eradication of beavers in ND" among Angler Group (n = 49), DW Group (n = 85), and USDA Group (n = 90) participants (2011 – 2012).

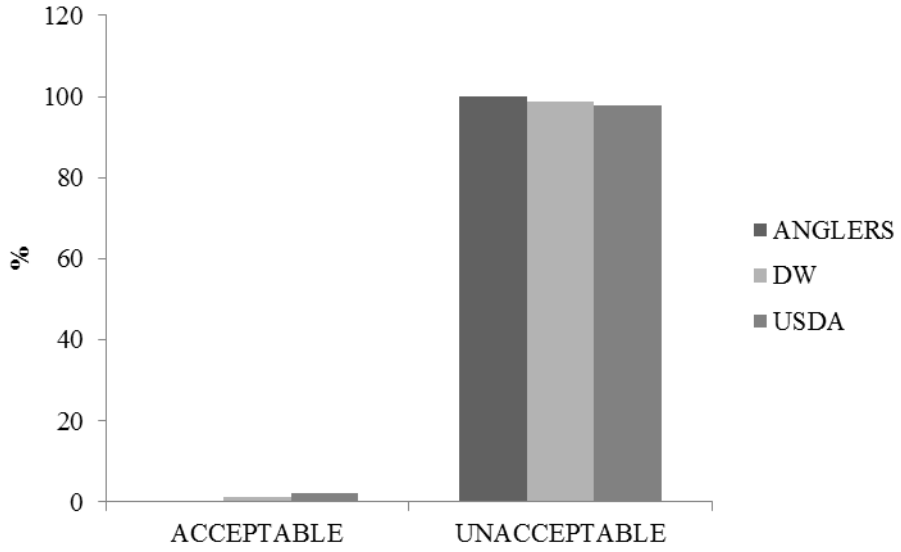


Figure 19. Responses to the beaver control option of "killing or removing the beaver is not an option" among Angler Group (n = 49), DW Group (n = 85), and USDA Group (n = 90) participants (2011 – 2012).

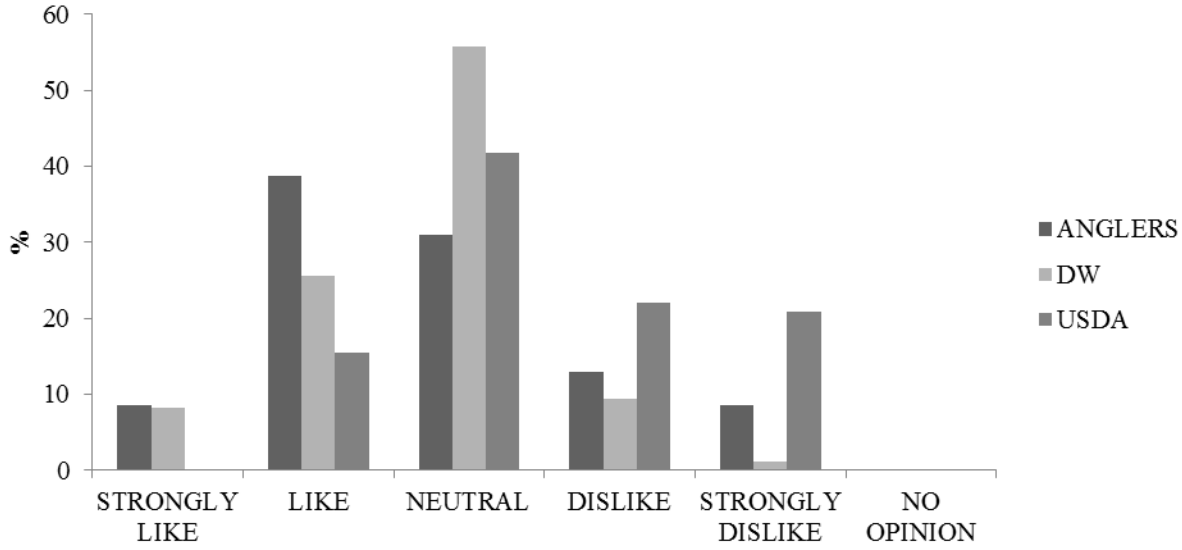


Figure 20. Responses to question, "What is your overall view of beavers in ND?" among Angler Group (n = 116), DW Group (n = 86), and USDA Group (n = 91) participants (2011 – 2012).

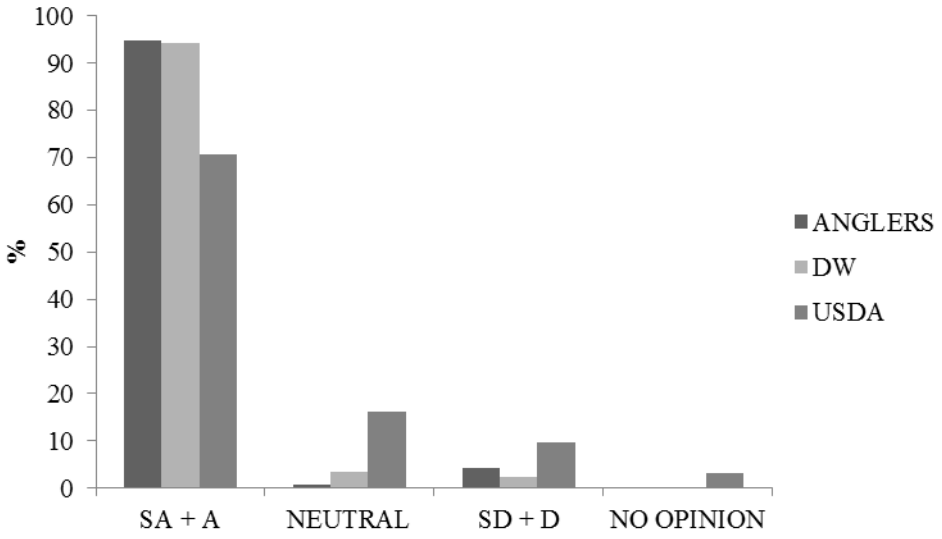


Figure 21. Responses to Likert-style statement, "Beavers have the right to exist" among Angler Group (n = 116), DW Group (n = 87), and USDA Group (n = 92) participants (2011 – 2012).

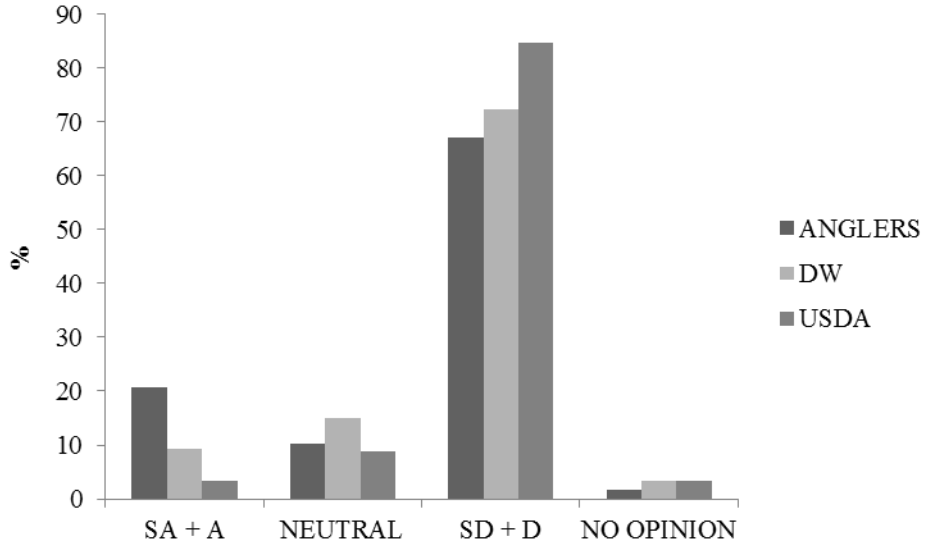


Figure 22. Responses to Likert-style statement, "No beaver should be destroyed" among Angler Group (n = 116), DW Group (n = 87), and USDA Group (n = 92) participants (2011 – 2012).

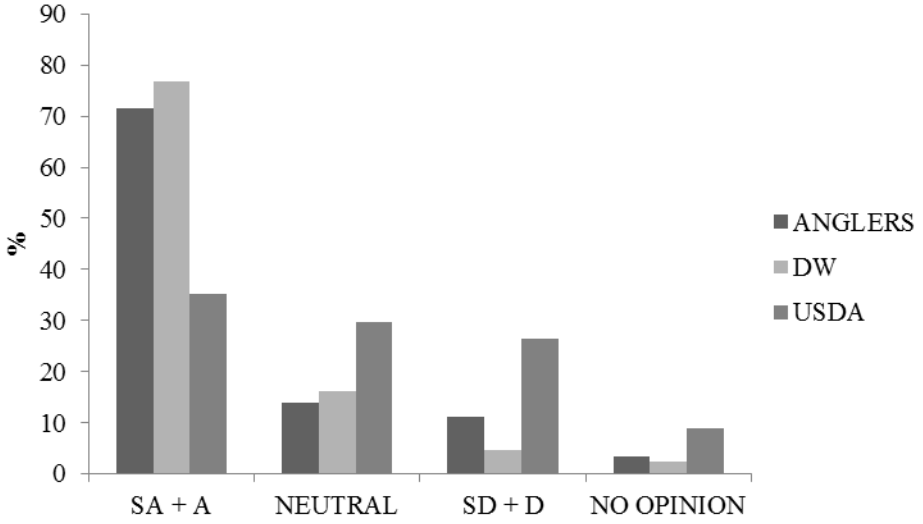


Figure 23. Responses to Likert-style statement, "I like having a beaver population in ND" among Angler Group (n = 116), DW Group (n = 86), and USDA Group (n = 91) participants (2011 – 2012).

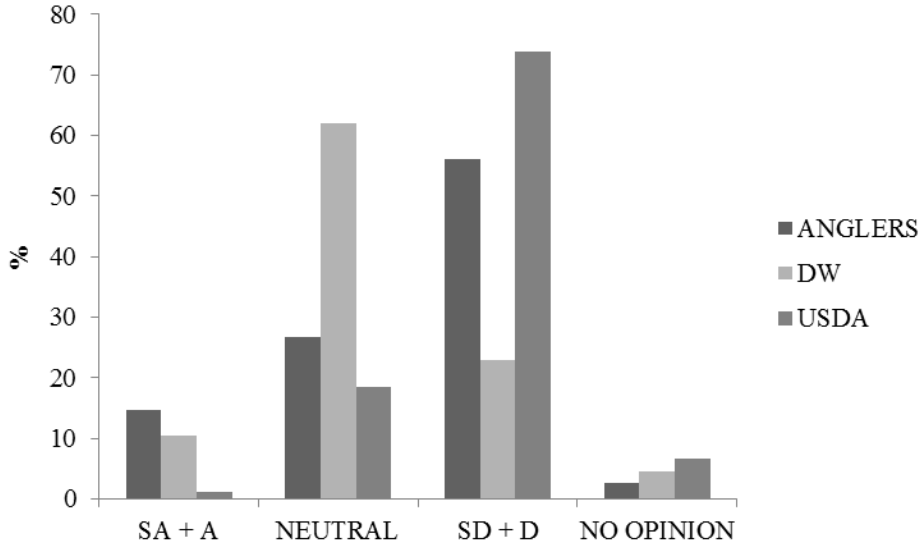


Figure 24. Responses to Likert-style statement, "I would like a larger beaver population in ND" among Angler Group (n = 116), DW Group (n = 87), and USDA Group (n = 92) participants (2011 – 2012).

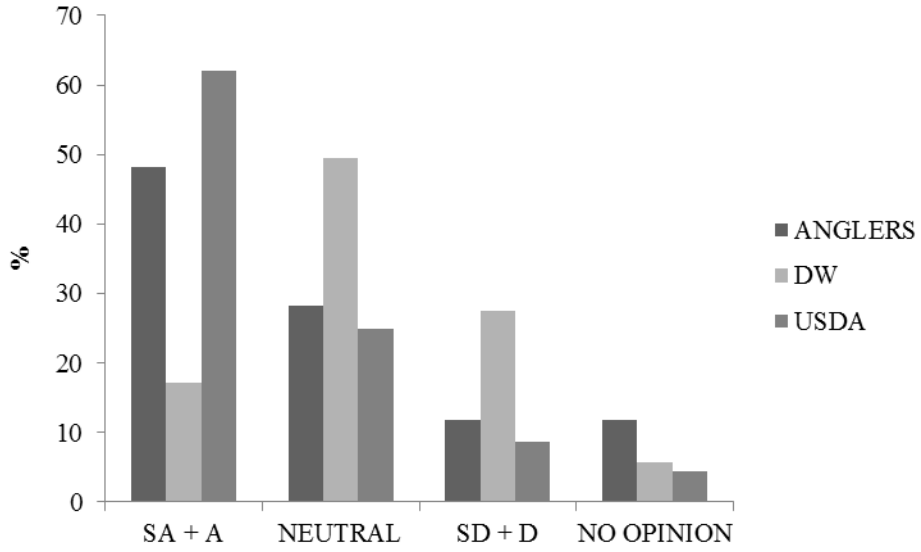


Figure 25. Responses to Likert-style statement, "I support efforts to decrease the beaver population in ND" among Angler Group (n = 85), DW Group (n = 87), and USDA Group (n = 92) participants (2011 – 2012).

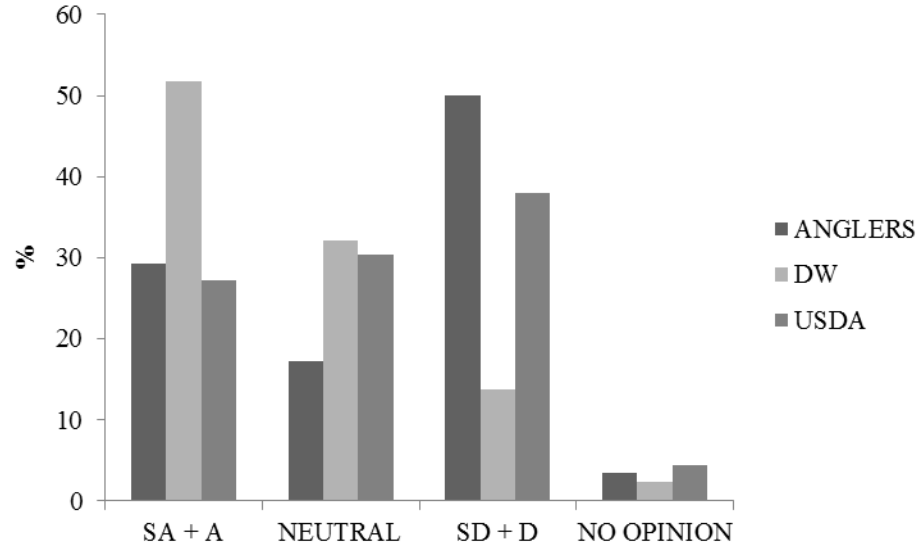


Figure 26. Responses to Likert-style statement, "I think beaver dams are attractive" among Angler Group (n = 85), DW Group (n = 87), and USDA Group (n = 92) participants (2011 – 2012).

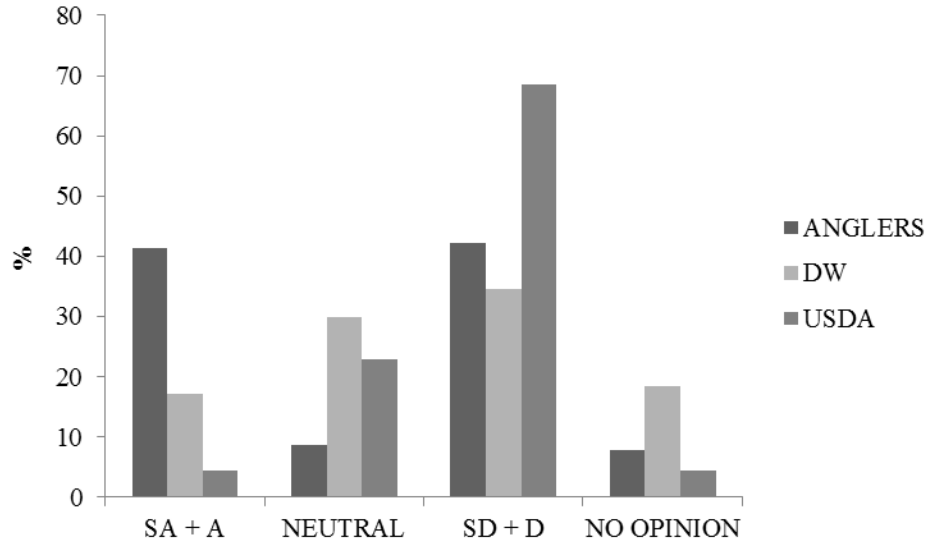


Figure 27. Responses to Likert-style statement, "I like/want beaver dams on my property" among Angler Group (n = 116), DW Group (n = 87), and USDA Group (n = 92) participants (2011 – 2012).

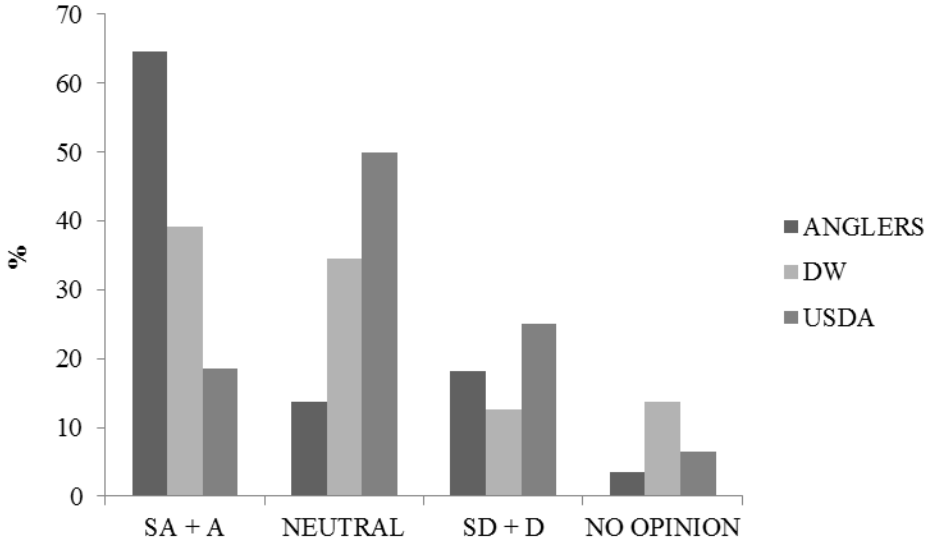


Figure 28. Responses to Likert-style statement, "I like/want beaver dams on public property" among Angler Group (n = 116), DW Group (n = 87), and USDA Group (n = 92) participants (2011 – 2012).

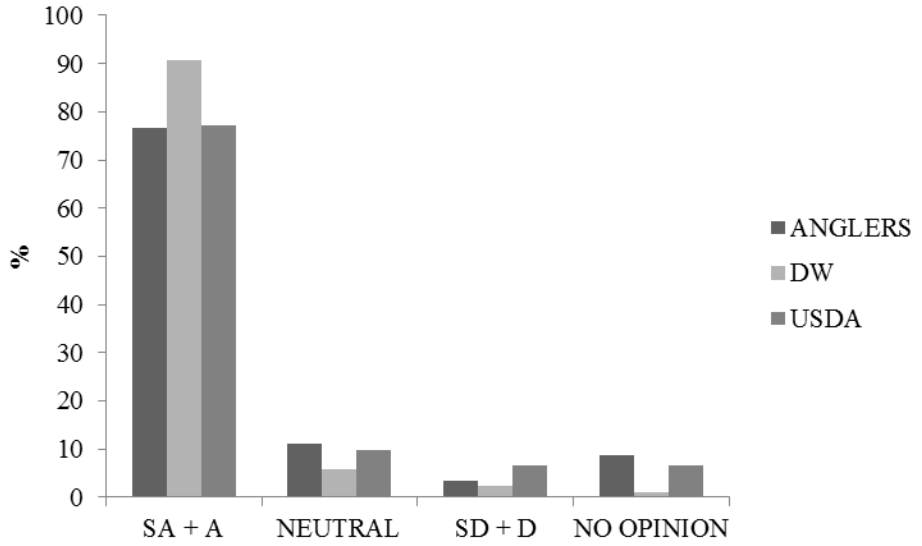


Figure 29. Responses to Likert-style statement, "I support regulated beaver trapping in ND" among Angler Group (n = 116), DW Group (n = 87), and USDA Group (n = 92) participants (2011 – 2012).

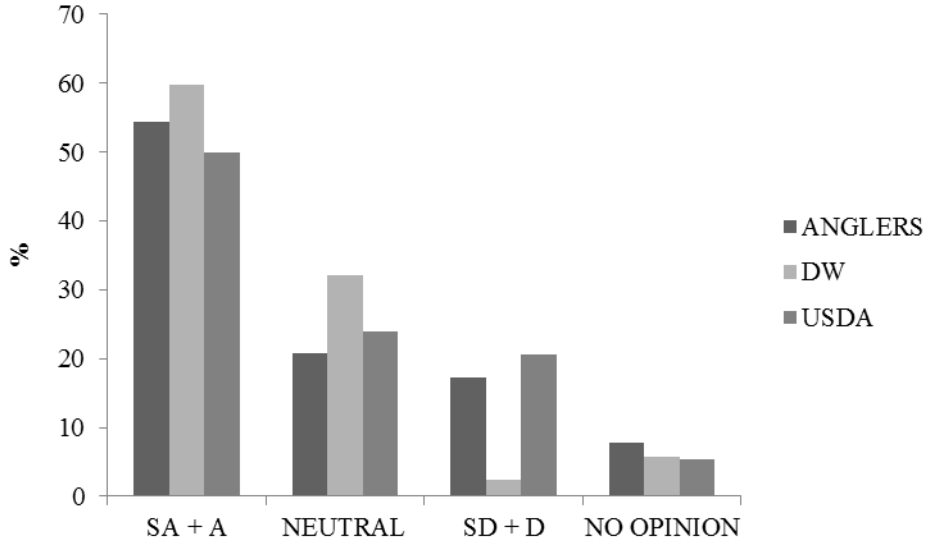


Figure 30. Responses to Likert-style statement, "I am satisfied with the North Dakota Department of Game and Fish's management of beavers in ND" among Angler Group (n = 116), DW Group (n = 87), and USDA Group (n = 92) participants (2011 – 2012).

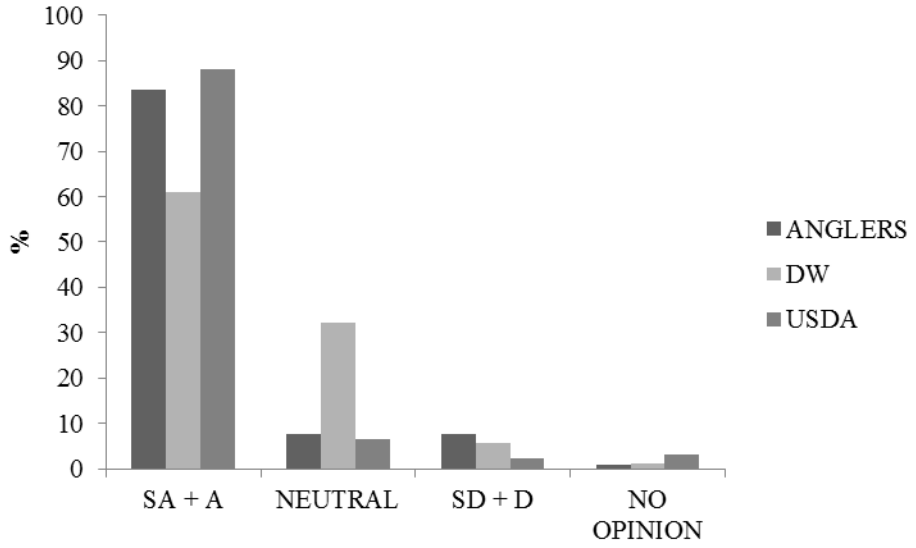


Figure 31. Responses to Likert-style statement, "Beavers are damaging to property" among Angler Group (n = 116), DW Group (n = 87), and USDA Group (n = 92) participants (2011 – 2012).

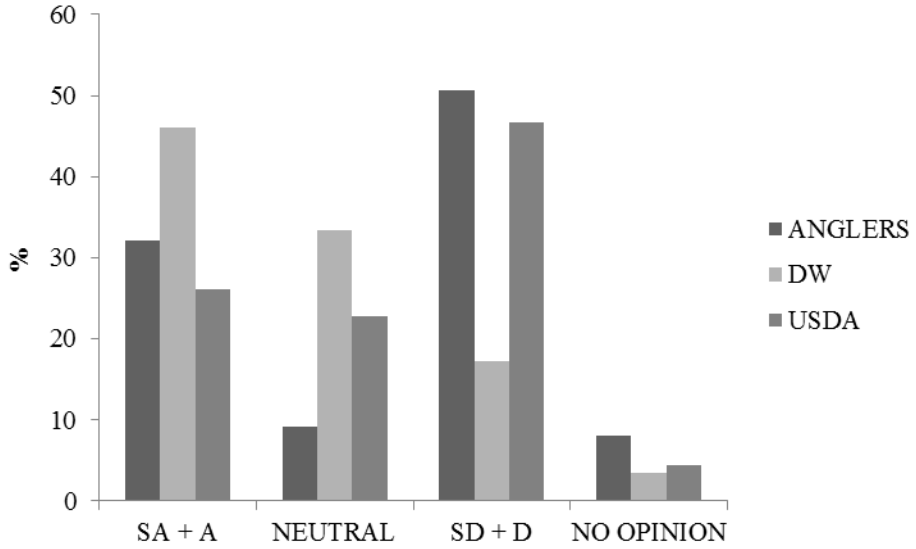


Figure 32. Responses to Likert-style statement, "Residents living near beavers should learn to live with some beaver-related conflicts" among Angler Group (n = 87), DW Group (n = 87), and USDA Group (n = 92) participants (2011 – 2012).

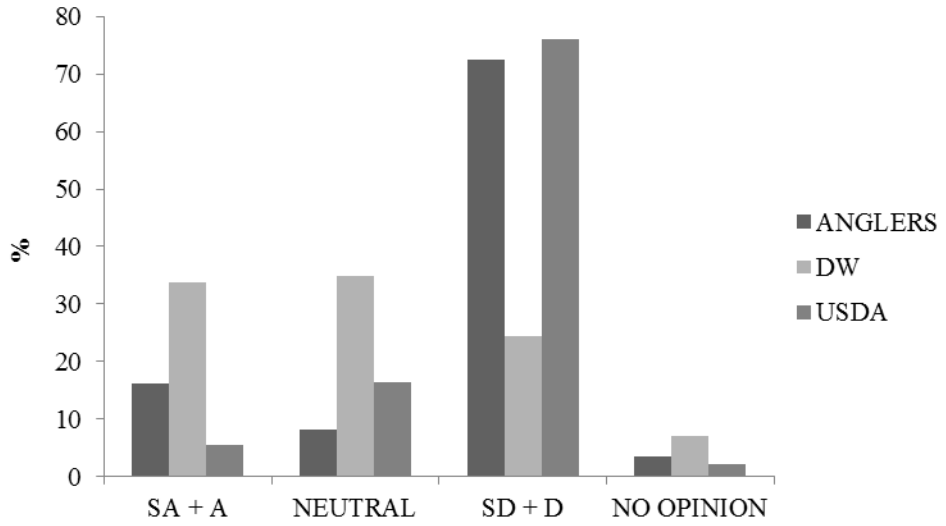


Figure 33. Responses to Likert-style statement, "I like/would like having a beaver population near my residence" among Angler Group (n = 87), DW Group (n = 86), and USDA Group (n = 92) participants (2011 – 2012).

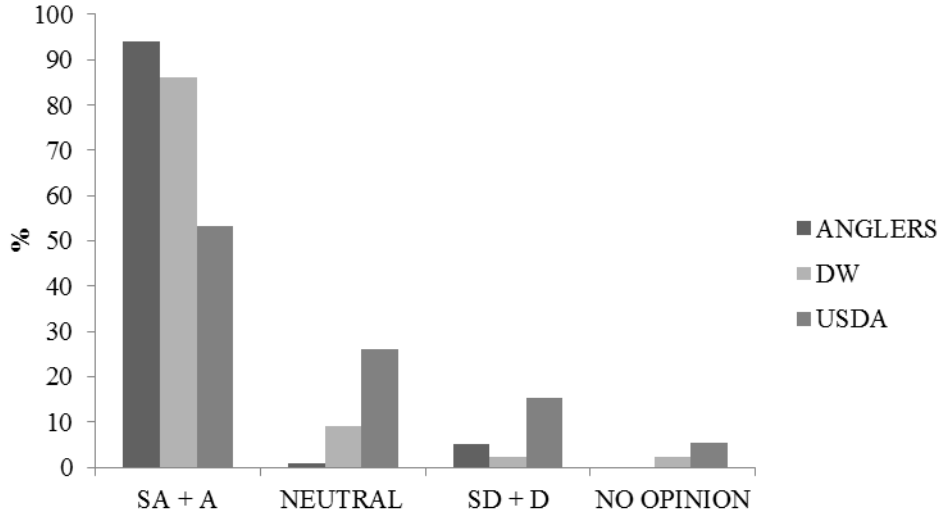


Figure 34. Responses to Likert-style statement, "It is important that beavers persist in ND for future generations" among Angler Group (n = 116), DW Group (n = 87), and USDA Group (n = 92) participants (2011 – 2012).

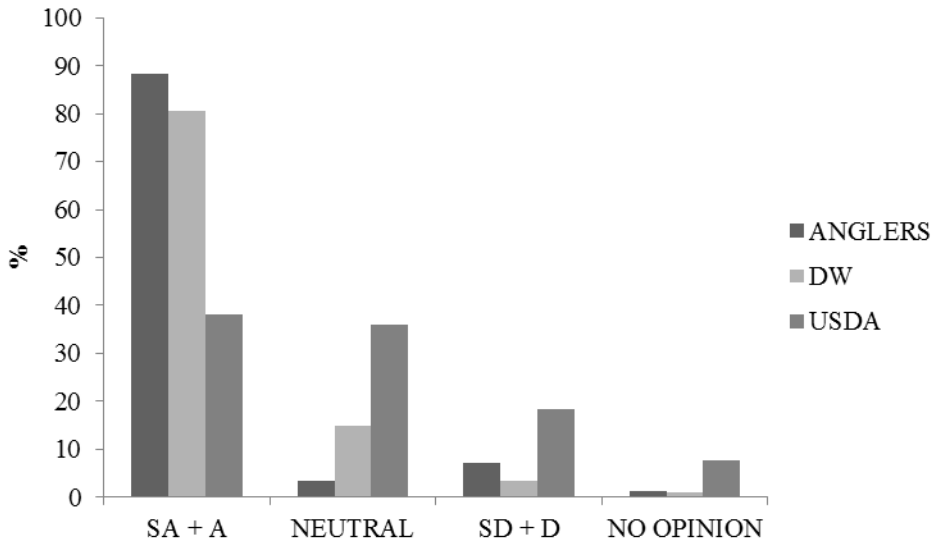


Figure 35. Responses to Likert-style statement, "I would be happy if I saw a living beaver in the wild today" among Angler Group (n = 85), DW Group (n = 87), and USDA Group (n = 92) participants (2011 – 2012).

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Section 2

Evaluating the Distribution of River Otters and Beavers throughout the Missouri and Souris River Drainages in North Dakota

Abstract: Virtually nothing is known about the status and distribution of river otters (*Lontra canadensis*) in central and western North Dakota (i.e., the Missouri and Souris River drainages). This project applied traditional field surveys (riparian surveys for otter and beaver sign near bridges) to determine if otters occupy drainages in those portions of the state, and how the known population of American beavers (*Castor canadensis*) were distributed in the region. We also used questionnaire evaluations of conservation

professionals in the study area to determine if they had knowledge of the presence of otters. No evidence of river otters was detected during field surveys, nor did evaluations of conservation professionals suggest any evidence of an otter population. Beavers were widely distributed in the study area.

Introduction

River otters **-** Through the mid-1800's river otters occupied all major waterways in North America except in the Arctic of northern Canada and desert regions of the southwestern United States (Melquist et al. 2003). However, during the late-1800s and early 1900s otter populations suffered substantial declines throughout much of their historic range, especially in the central United States (Melquist et al. 2003). Recent, high-profile reintroduction programs, improved water quality, and more conservative harvest regulations have enabled otters to repopulate portions of their historic range in many areas of North America—especially the central United States (Serfass et al. 1998, Melquist et al. 2003). By the mid-1990s North Dakota was among the few states considered to not be supporting a viable population of otters (Melquist et al. 2003).

In North Dakota otters were associated with larger aquatic systems and considered relatively common in those habitats into the 1890s. By the 1920s otters were reported to still occupy portions of most major waterways and some of the major lakes, but had become rare by the 1960s (Bailey 1926, Adams 1961). Since 1964, and particularly in recent years, reports of otters gradually have been increasing in the state—mostly along the Red River of the North and its tributaries (Hagen et al. 2005). A recent study by Frostburg State University in cooperation with the North Dakota Game and Fish Department (NDGF) has demonstrated that apparently viable otter populations do occupy portions of the Red River of the North drainage, especially in northeastern North Dakota (Stearns 2008). Although there have been some reports of otters occupying drainages in the central and western North Dakota, particularly portions of the Missouri River drainage (Hagen et al. 2005), no formal, systematic efforts have been conducted to document the status of otters in these regions of the state. Otters are among North Dakota's 100 species of conservation priority and are listed as a moderate level (Level II) of conservation concern (Dyke et al. 2004, Hagen et al. 2005). Establishing the status, distribution, and habitat associations of a species is fundamental for developing and implementing appropriate conservation strategies. Also, virtually nothing is known about otters in arid landscapes, conditions which are predominate throughout western North Dakota. The World Conservation Union/Species Survival Commission Otter Specialist Group (IUCN/SSC OSG) has identified the development and implementation of systematic, standardized monitoring protocols as a high priority for all of the world's species of otters. IUCN/SSC OSG's position is based on the almost complete absence of standardized approaches for monitoring otter populations outside of Europe. The intent of this investigation will be to gather baseline data on the distribution of otters throughout the Missouri River (central and western North Dakota) and Souris River (north central North Dakota) drainages with the intent of determining if river otters occupy the region and for developing a standardized approach for application in monitoring long-term trends in the population. This project will be designed with the intent of providing

important baseline information from which informed decision-making can be applied to the development of comprehensive, long-term conservation planning appropriate for otters in the aforementioned regions of North Dakota.

Beavers – Beavers are important economically as a furbearer and also for the ecological services they provide (Wright et al. 2002, Cunningham et al. 2007, Chandler et al. 2009). In many aquatic systems otters benefit from habitat modifications associated with beaver activities. For example, in smaller riverine systems beaver dams may substantially increase the volume of water in an area and thereby increase the diversity and abundance of prey for otters. In almost all aquatic systems otters will use beaver dens (traditional lodges and bank dens) for resting, shelter, and rearing young (Swimley et. al. 1999, Melquist et. al. 2003). Therefore, otters benefit directly from habitats created by beavers and their distribution appears to be influenced by the occurrence of beaver-created structures (i.e, dens, lodges, and dams; Swimley et al. 1998, Swimley et. al. 1999). Relatively little is known about the habitat use of beavers in arid landscapes, or how their occurrence in these areas may relate to the presence of otters. In addition to otters, habitat alterations by beaver benefit a variety of species, including many species of fish, amphibians, and water-associated birds (Wright et al. 2002, Cunningham et al. 2007, Chandler et al. 2009). Beaver dams in smaller drainages may be particularly important to species dependent on aquatic ecosystems. Consequently, knowing the current distribution of beavers has implication not only for their conservation, but also the conservation of species that benefit from landscape-altering activities associated with active beaver colonies. An important aspect of this project will be to delineate the distribution of beavers throughout western and central North Dakota and develop models for predicting preferred habitats and the types of habitat modifications they perform in various aquatic conditions (e.g., stream conditions where they are more likely to create dams). Finally, conserving beavers is dependent on human tolerance for various behavioral aspects of the species. In addition to creating habitat important for other species, the landscape modifying activities of beavers sometimes creates conflicts with humans. For example, beaver dams may flood roads and fields, and beavers may remove ornamental, shade, or otherwise desirable trees from yards. Consequently, this project also will assess opinions and attitudes of various stakeholders (e.g., including natural resource managers, trappers, and landowners adjacent to aquatic systems) about beavers and beaver conservation. Understanding these factors will be critical in the management of not only beavers, but also other species like otters that are dependent on habitats modified by beavers.

OBJECTIVES

River otters:

1. To evaluate location of prospective source populations of otters in Montana, South Dakota, and Manitoba.
2. To conduct surveys associated with permanent bodies of water (stratified to include upper, middle, and lower portions of all riparian systems). The survey

approach was originally intended to focus on stream-reaches, but changed to focus on sections of riparian habitat associated with bridges. Also, seasonal assessments indicated in the original proposal were modified to reflect areas where we received anecdotal reports (e.g., reports from anglers) of the possible occurrence of otters. These modifications were made to adjust for extreme flooding in 2011 that compromised both sociological and field-aspects of the project (i.e., there were fewer anglers along rivers and certain sections of aquatic habitats were unsuitable for riparian surveys [i.e., flooded]) during large portions of the sampling seasons. These conditions caused more extensive travel during the first year of the project, limited data collection, and created a deficit that persisted throughout the project. Nonetheless, revised protocols were conducted in accordance with accepted and typical sampling protocols for river otters in the United States and elsewhere for other species.

3. The above field conditions and associated challenges to surveys likewise compromised meaningful use of remote cameras. The objective to conduct captive trials to assess the efficacy of various commercial lures in attracting rivers was accomplished with the goal of providing ongoing field application and evaluation in North Dakota and elsewhere (Section 3 of this report).

Beavers:

1. To determine the distribution of beavers based on riparian surveys conducted near bridges.
2. To collect habitat covariates during surveys (e.g., stream order, tree cover, anthropogenic disturbance, and region) among bridges included in surveys to develop future predictive models for use in enhancing survey techniques for beavers.

Methods

Field Surveys

Field surveys for river otters and beavers were conducted during the summer 2011, spring, summer, and fall 2012, and spring 2013. Surveys included 115 sites (102 bridges and 13 "other" sites). Other sites included bases of large dams (areas where river otters will leave the water to cross the dam, and usually establish well-used trails when present), and entire lengths of low, earthen impoundments at waterfowl management areas (also areas where otters use established trails when crossing impoundments). We also surveyed about 20 km of the eastern shore of the Missouri River, centered by the mouth of apple Creek (i.e., about 10 km north and south of the mouth of Apple Creek). Also, segments of Apple Creek comprising approximately 50 km the Creek were surveyed on both sides, beginning at the impoundment at Rice Lake Wildlife Management Area (i.e., the headwaters of Apple Creek).

Latrine and other sign surveys generally are considered reliable for detecting the presence of river otters (Shackelford and Whitaker 1997, Swimley et al. 1998, Melquist et al. 2003, Gallant 2008), but less useful for assessing changes in population density (Roberts et al. 2008). Similarly, Kruuk and Conroy (1987) considered scat surveys as unreliable for assessing population trends in Eurasian otters. Also, failure to detect latrines (or other sign) cannot be used as an absolute inference that an area is not occupied by river otters, as the occurrence of latrines can vary seasonally (Carpenter 2001, Serfass et al. 2003, Mills 2004) and by habitat conditions (Newman and Griffin 1994, Dubuc et al. 1990, Swimley et al. 1998).

Surveys to detect latrines (or other sign) for river otters are time consuming and costly because of logistics associated with accessing riparian areas—particularly in remote areas. To minimize logistical constraints associated with accessing survey sites many states, including California, Georgia, Indiana, Kansas, Nebraska, New York, and Oklahoma, have conducted sign surveys in riverine systems at bridge-crossings (Clark et al. 1987, Shackleford and Whitaker 1997, Berkley and Johnson 2000, Johnson 2001, Ostroff 2001, Bischof 2002, Breux et al. 2002, Ermer 2003) as a primary method of evaluating river otter populations. The length of shoreline surveyed at bridges typically varies from 100 - 200 m (Clark et al. 1987, Shackleford and Whitaker 1997, Ermer 2003) to 600 m (Ostroff 2001), sometimes including one or both shorelines at a survey location.

To enhance probability of detection, our survey typically consisted of 500m of shoreline on both shoreline and both sides of bridges (i.e., 2 km of shoreline per bridge). Overall, about 230 km of shoreline were surveyed throughout the study area.

Written surveys (otter presence)

We conducted written surveys of representatives from each of the 9 regions of USDA Wildlife services, the 8 regions of North Dakota Fish and Game, and 3 large state parks and 7 national wildlife refuges in western North Dakota (Table 1). The field representative for each of USDA Wildlife Services' region are particularly well informed about the presence of otters given their frequent work to trap nuisance beavers (throughout the United States river otters are associated with habitats occupied by beavers) and their general familiarity with trappers. Correspondents for North Dakota Game and Fish were regional supervisors, and information from state parks and wildlife refuges were provided by the respective superintendents.

Surveys of furbearer biologists in Montana, South Dakota, Manitoba

Interview surveys were conducted with furbearer biologists in Manitoba, South Dakota and Montana to determine river otter presence in the respective state.

Results

River otter surveys

Field surveys.—No evidence of river otters were detected during surveys at any sample locations in the study region (Fig. 1).

Agency surveys.—The regional supervisor for the North Dakota Department of Game and Fish reported anecdotal evidence of river otter(s) occurring in the southwest region (Region 5) and indicated that if river otters occurred there numbers were low (1 to 5 individuals). Representatives from other agencies surveyed indicated that river otters were not occurring in their jurisdictions (Table 1).

Surveys of furbearer biologists in adjacent states.—Montana, South Dakota, and Manitoba each share drainages with our study area in western North Dakota—the Missouri River for Montana and South Dakota and Souris River for Manitoba. Furbearer biologists in Montana do not consider river otters to be present in the eastern part of the state (Fig. 1). Likewise, the furbearer biologist in South Dakota reported not having an otter population on the Missouri River near North Dakota and furbearer biologist in Manitoba considers river otters not to be present in the Souris River drainage.

Beaver surveys

Beavers were detected widely at bridges throughout both the Missouri River and Souris River study areas (Figure 2). Overall, beavers were detected at 55 of 80 bridges (63%) in the Missouri River drainage and 17 of 35 bridges in the Souris River drainage. Not only were beavers widely distributed with the study area, they likewise occurred in lower order streams (Fig. 2) and higher order streams, as well as areas with limited or virtually no tree cover. Overall, beavers appear to be thriving throughout the Missouri and Souris River drainages.

Surveys of furbearer biologists in Montana, South Dakota, Manitoba

In Montana, Brian Giddings, furbearer biologist, indicated no harvest records or incidental trappings of the river otter in the western portions state, including the Missouri and Yellowstone rivers or their confluence. He indicated that the river otter population diminishes upstream of Mile City on the Yellowstone River. There are river otter trapping records in the south central portion, where the Big Horn River intersects the Yellowstone River. The furbearer biologists in South Dakota and Manitoba indicated no evidence of river otters, respective in the Missouri River in South Dakota or the Souris River drainage in Manitoba.

Discussion and Management Implications

Based on survey results (field and responses of agency officials), there is no evidence to suggest that an established population of river otters exists in western North Dakota.

Responses of wildlife professionals working employed by USDA Wildlife Services indicating no established otter populations in central and western North Dakota are particularly compelling given the extensive work they do in association with aquatic systems to control beaver. There is nonetheless the possibly of an undetected otter population in the region, but we believe this is unlikely given the combination of field and social surveys implemented during our study.

The likelihood of rapid recolonization of otters in western and central North Dakota from adjacent states (Montana and South Dakota) and Manitoba are limited based on response of furbearer biologists in these states and province, respectively. Montana has populations of otters in the Yellowstone and Missouri Rivers, which may provide a source on individuals for establishing populations in the Missouri River drainage in North Dakota. However, furbearer biologists in Montana do not consider otters to occupy these drainages in the eastern portion of the state. Similarly, South Dakota does not consider otters to occupy the Missouri River in that state near the border of North Dakota.

Natural recovery of river otter populations in the Missouri and Souris River drainages of North Dakota is limited by the absence of established nearby populations (i.e., the Missouri River) or completely absence of populations (i.e., the Souris River). Otters have the capacity for long-distance dispersal. Hence, there is a realistic possibility that otters from the Yellowstone and Missouri Rivers in eastern and central Montana will contribute to the recovery of otters in the Missouri River drainage in North Dakota. However, the Souris River drainage in North Dakota is more isolated from established otter populations and is less likely to be recolonized in the near future. We regarded the Souris River to provide excellent habitat for river otters. Given the limited likelihood for natural recolonization of the Souris River, this is an area that could be considered for reintroducing otters.

Also, landscape altering activities by beavers (e.g., construction of dams and lodges) create important habitat for otters and, therefore, understanding the distribution of beavers has potential future management implications for otters in the future. Age and attitudes of key stakeholders will be evaluated to determine their knowledge, opinions, and tolerance of both otters and beavers.

Tables and Figures

Table 1. Results of survey with North Dakota State Parks, USFWS Wildlife refuges located in North Dakota, North Dakota Game and Fish and Wildlife Services on the presence of river otters along with other carnivore species. Surveys were conducted between 2011-2012.

Carnivore Survey		Otter	Wolf	Mt. Lion	Swift Fox	B-f ferre	Sp Skunk	Am Marten	Mink	Fisher	B. Bear	Am Beaver	Moose	Bobcat	Coyote
ND State Parks															
	Lake Sakakawea	No	No	No	No	No	No	No	No	No	No	No	No	No	No
	Lake Metigoshe	No	Yes	Yes	No	No	No	No	No	No	Yes	No	No	No	No
	Fort Ransom	No	No	No	No	No	No	No	No	Yes	No	No	No	No	No
USFWS Wildlife Refuges															
	Sullys Hill/Lake Alice/Kelly Sloug	Yes	No	No	No	No	No	No	Yes	Yes	No	No	No	No	No
	Arrowwood	No	No	Yes	No	No	No	No	Yes	No	No	No	No	No	No
	Lostwood	No	No	No	No	No	No	No	No	No	No	No	No	No	No
	Long Lake	No	No	Yes	No	No	No	No	Yes	No	No	No	No	No	No
	Des Lacs	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No
	Audubon	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No
	Chase Lake	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No
	J. Clark Salyer	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No
ND Game and Fish*															
	Northeast [1] - Kurt Aufforth	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No	No	No
	Northeast [2] - Gary Rankin	Yes	No	No	No	No	No	No	No	Yes	No	No	No	No	No
	Northcentral [3] - Jonathan Toftel	No	Yes	Yes	No	No	No	Yes	No	No	No	No	No	Yes	No
	Northwest [4] - Ken Skuza	No	No	No	No	No	No	No	No	No	No	No	No	No	No
	Northwest [5] - Jim Burud	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No	No	No
	Southwest [6] - Dan Hoenke	Yes[9]	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Southeast [7] -Mark Pollert	No	No	No	No	No	No	No	No	Yes	No	No	No	No	No
	Southeast [8] - Tim Phalen	No	No	No	No	No	No	No	No	Yes	No	No	No	No	No
Wildlife Services															
	District 1 (NW)	No	No	Yes	No	No	No	No	No	No	No	Yes	No	No	No
	District 2 (NWC)	No	Yes	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No
	District 3 (NE)	Yes	NC	No	No	No	No	No	No	Yes	No	Yes	No	Yes	Yes
	District 4 (W)	No	No	Yes	No	No	No	No	No	No	No	Yes	No	No	No
	District 5 (EC)	No	No	Yes	No	No	Yes	No	No	Yes	No	Yes	No	No	No
	District 6 (SW)	No	No	Yes	Yes	No	No	No	No	No	No	Yes	No	Yes	No
	District 7 (SCW)	No	No	Yes	No	No	Yes	No	No	No	No	Yes	No	No	No
	District 8 (SC)	Yes	No	Ys	No	No	No	No	No	No	No	Yes	Yes	No	No
	District 9 (SE)	Yes	No	No	No	No	Yes	No	No	No	No	Yes	No	No	No
	**Regional supervisors*														
	[1] Towner, Rolette, Ramsey, Cavalier, Benson, Pierce														
	[2] Grand Forks, Walsh, Traill, Steele, Griggs, Nelson														
	[3] Bottineau, Rolette														
	[4] McLean, Ward, Mountrail														
	[5] Renville, Burke, Ward, Divide														
	[6] Bowman, Slope, Golden Valley, Billings, Stark, Hettinger, Adams, Morton, Dunn, Sioux, Oliver, Mercer														
	[7] Stutsman, Barnes														
	[8] Sargent, Ransom, Richland														
	[9] Data is not supported by Wildlife Services														

Otter detections in the Missouri and Souris River drainages

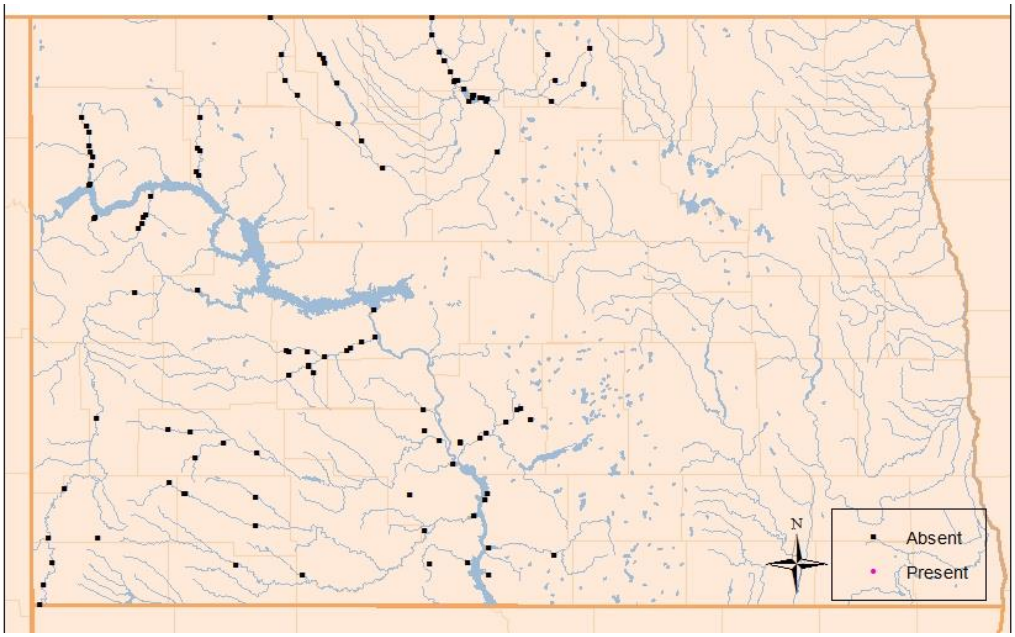

Figure 1. Otter detections in the Missouri and Souris River drainages based on bridge and other surveys completed 2011-2013. Otters were not detected in either river drainage.

American Beaver detections in the Missouri and Souris River drainages

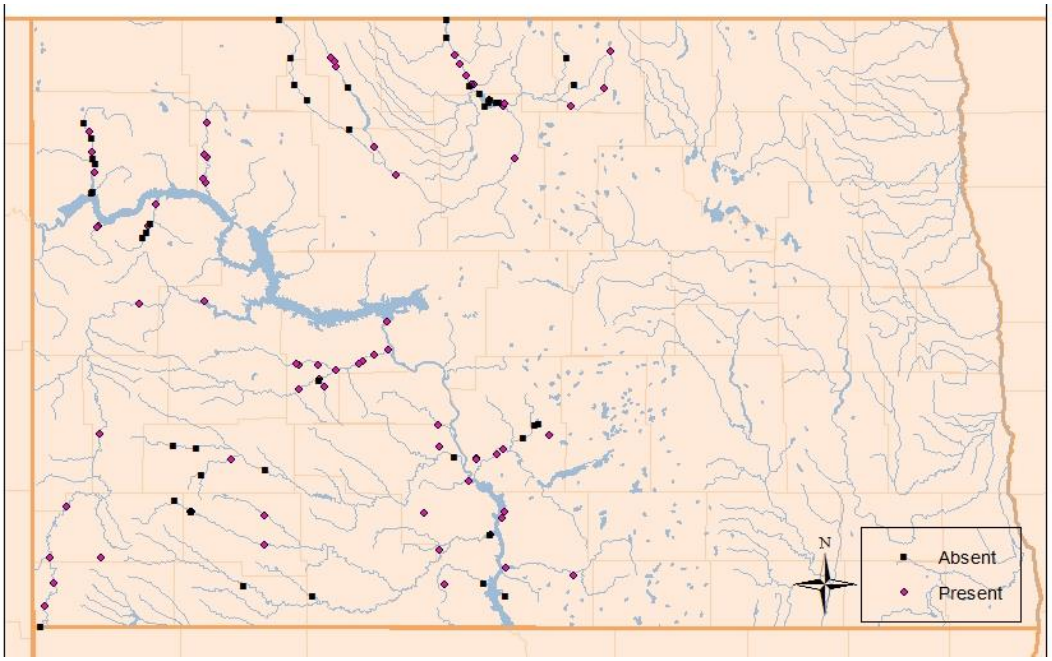

Figure 2. American beaver detections in the Missouri and Souris River drainages based on bridge and other surveys completed 2011-2013. Beavers were detected in 72 out of 115 sites (63%).

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Section 3

*Efficacy of Olfactory Lures at Attracting Captive River Otters (*Lontra canadensis*)*

ABSTRACT

The efficacy of olfactory lures at attracting river otters has received almost no formal investigation. However, scents may potentially be useful at attracting river otters to field devices, such as scent and track stations, remote cameras, and traps, to obtain data

on reestablished and existing wild populations. This study evaluated the efficacy of 6 olfactory lures (diluted Fatty Acid Scent, Synthetic Fermented Egg, skunk essence, beaver castoreum, Alaskan salmon oil, and Cronk's Otter Lure) at attracting captive river otters. To deploy each lure, a 25 x 5-mm plaster disc was soaked in liquid scent for 1 hour and subsequently inserted into a 26-mm long x 70-mm diameter, single-closed-ended PVC pipe with a 32 mm diameter, double-open-ended PVC screw-top. From April – July 2010, 17 adult river otters were observed at 7 captive facilities in Pennsylvania, West Virginia and New York. Subject animals were observed individually or in pairs in 10-minute video-taped focal sessions for a period of 6 days. Prior to each observation, 1 of the 6 lures and a blank control was situated within a large, naturalistic portion of the otter's enclosure, and then the focal animal(s) were allowed to enter and explore the area. Any time a subject animal moved within 1 meter of the lure or control, an "approach" was recorded. Subsequently, the swiftness, duration, and frequency of approaches were compared between each of the 6 lures and its corresponding control. Results demonstrated that lures outperformed controls among the 4 main parameters assessed; however, these differences were not significant. Cronk's Otter Lure (COL) yielded a stronger response than the other 5 lures for each of the 4 main parameters assessed although none of these differences were significant. Field analyses are needed to determine whether COL or other scents are useful for attracting wild river otters to remote tracking devices.

INTRODUCTION

Following release, monitoring translocated animals is necessary to evaluate their ability to reestablish healthy populations (Hein 1997, Miller et al. 1998, Semlitsch 2002). Due to their elusive nature, obtaining demographic information on wild river otters (*Lontra canadensis*) is challenging (Robson and Humphrey 1985). In light of costs and the potentially harmful effects of stress, less invasive tracking methods, such as scent and track stations and remote cameras are often preferable. Baits, including whole fish (Melquist and Dronkert 1987) are occasionally used to attract otters to field devices, although the efficacy of baits has not been systematically assessed (Schlexer 2008). Olfactory lures may serve better as long-distance attractants than baits, as certain pungent scents should be detectable at greater distances than bait odors, and are not subject to being consumed by non-target animals.

Many carnivores rely heavily on olfactory signals for hunting and communication, as scents often are more easily and extensively transmissible and longer lasting than visual and auditory cues (Gorman and Trowbridge 1989). The primary form of social communication for the North American river otter (*Lontra canadensis*) is scent-marking. River otters deposit scent from glands located under the feet as well as in the form of urine and spraints (Kruuk 2006). Like many carnivores, otters have a superior sense of smell. Captive European otters (*Lutra lutra*) have demonstrated the ability to distinguish among the spraints of individuals (Gorman and Trowbridge 1989), and research suggests that male river otters can identify the social status of other males based on their scent-markings (Rostain et al. 2004).

The efficacy of olfactory attractants for river otters has received almost no research attention. Robson and Humphrey (1985) tested the efficacy of scents on captive and wild otters and detected no significant differences between 2 types of lures and a

blank control on the behavioral responses of captive and wild otters. However, the researchers tested the lures on only 3 captive individuals, and admitted that repeatedly introducing scents to the same 3 animals probably introduced a conditioning bias. Furthermore, in their field study, Robson and Humphrey (1985) did not compare visitation rates to lure-baited scent-stations with blank controls. Therefore, the use of scents as long-distance attractants for river otters has yet to be thoroughly assessed both in captivity and the wild.

A wide variety of chemical attractants have been used in carnivore surveys, including surveys for various mustelid species. However, the efficacy of such lures has only been thoroughly, systematically assessed in canids. Among coyotes (*Canis latrans*), 2 of the most proven lures in pen and field tests are synthetic Fatty Acid Scent (FAS) (Roughton and Sweeny 1982, Phillips et al. 1990, Kimball et al. 2000), and Synthetic Fermented Egg (SFE) (Roughton 1982, Turkowski et al. 1983). FAS has been established as the standard lure for coyote surveys in the United States (Roughton 1982) and has been used effectively in a variety of other carnivore surveys (Schlexer 2008). Whereas FAS can only be purchased at a relatively high price from the USDS Pocatello Supply Company (Schlexer 2008), SFE is less expensive and commercially sold. Skunk essence is another inexpensive, commercially available lure that is commonly used to attract mustelids, including wolverines (*Gulo gulo*), American badgers (*Taxidea taxus*), American martens (*Martes americana*) (Schlexer 2008), and fishers (*Martes pennanti*) (Fuller et al. 2001, Weir 2003). Beaver castoreum [exudate from the castor sacs, or preputial scent glands, of the American beaver (*Castor canadensis*)] has proven effective at attracting wild lynx (*Lynx lynx*) (McDaniel et al. 2000) and has been used in a variety of other carnivore surveys (Mowat et al. 2001, Harrison 2006, Schlexer 2008). Fish oils and extracts, including salmon oil, have also been used extensively in mustelid surveys (Schlexer 2008), and these prey odors may elicit a predatory response in otters. Finally, a number of brand-name commercially manufactured synthetic lures are commonly used by trappers to attract predators. Cronk's Otter Lure is one of the most successfully sold commercial otter lures available.

Roughton and Sweeny (1982) evaluated 7 methods of deploying liquid scent (FAS) and determined that the most effective technique consisted of a 25 x 5 mm plaster disc immersed for 1 hour in FAS. This method produced the highest volitalization rate in laboratory tests and received the greatest number of visits by wild coyotes during field tests. Because the technique is both inexpensive and convenient, Roughton and Sweeny recommended it as the standard U.S. Fish and Wildlife Service (USFWS) procedure for liquid lure-based scent-stations.

The objectives of this study were to:

1. Quantify captive river otters' behavioral responses to 6 common olfactory lures and unscented control devices;
2. Compare otters' responses to lures and unscented control devices;
3. Compare otters' responses among the 6 different lures.

It was hypothesized that lures would perform better than controls at attracting captive river otters, based on behavioral data. Additionally, FAS was hypothesized to elicit a stronger response from otters than the other 5 scents.

METHODS

From April – July, 2010, the efficacy of 6 attractants, diluted FAS, SFE, skunk essence (SKE), beaver castoreum (BVC), Alaskan salmon oil (SAO), and Cronk's Otter Lure (COL), were evaluated on captive river otters. To deploy each lure, a 25 x 5 mm plaster disc was soaked in enough liquid scent to cover each surface in a sealed glass jar for 1 hour. Subsequently, the disc was inserted into a 26 mm long x 70 mm diameter, single-closed-ended PVC pipe, fitted with a 32 mm diameter, double-open-ended PVC screw-top to fasten the device (See Figure 1). When sealed and upright, each device stood 70-mm tall. This design prevented subjects from chewing through the device or removing the plaster disc from inside, while allowing the odor to volatilize through the 26-mm diameter opening at the top. Each scent was presented independently along with a blank control (a PVC device containing a plaster disc soaked in water).

The staff at 1 facility requested that a larger PVC device be used for testing their otters, as there was concern that otters might attempt to swallow the smaller devices. Therefore, a 6-cm long x 8-cm diameter, single-closed-ended PVC pipe, fitted with a 4-cm diameter, double-open-ended PVC screw-top was used to test 4 of the 17 subjects. The same size plaster disc (25 x 5 mm) was inserted in these devices, and the opening at the top, through which the scent was able to volatilize, was consistent with that of the smaller devices (26 mm diameter).

Study Sites

Data were collected from 7 different captive facilities: T&D's Cats of the World (Penns Creek, PA), Claws 'N' Paws Wild Animal Park (Hamlin, PA), ZooAmerica (Hershey, PA), The Lehigh Zoo (Schnecksville, PA), The Oglebay Good Children's Zoo (Wheeling, WV), The Ross Park Zoo (Binghamton, NY), and The Wild Center (Tupper Lake, NY).

Subjects

A total of 17 adult otters (8 males, 9 females) served as subjects. Otters were housed in pairs at each of the 7 facilities. The Oglebay Good Children's Zoo housed 2 pairs of otters (a pair of males and a pair of females), and 2 facilities (The Ross Park Zoo and The Wild Center) housed 3 otters each. At The Wild Center, 1 of these individuals was alternatingly paired with each of the other 2 otters. At The Ross Park Zoo, a male and female that were normally housed together were separated temporarily because the female had recently given birth.

At most of the facilities, separating social pairs to observe subjects individually was logistically challenging; moreover, many otters demonstrated strong pair bonds, causing them to become stressed when isolated. Consequently, 15 of the 17 subjects were observed in pairs. All but 2 social pairings observed were opposite-sex pairs. The social rank (dominant or subordinate) of each subject was recorded after this information was obtained from a staff member at each facility. Social rank was found to be independent of sex. Of the 17 subjects, 8 were indicated to be the dominant individual of their social pairing, and 9 were classified as subordinates.

Paired subjects did not appear to influence each other's behavior noticeably, with individuals typically moving about enclosures and responding to lures and controls independently; however, this potentially confounding factor could not be controlled for in most cases. In addition to the 17 subjects, data were collected for the 2-month-old male offspring of an adult female at The Ross Park Zoo; however, these data were omitted

from analysis because the juvenile's behavior and response to lures and controls were noticeably influenced by his mother.

Procedure

Subjects or pairs of subjects were observed in 10-minute-long video-taped focal sessions. Prior to each observation, 1 of the 6 attractants and a blank control was situated within the largest, most naturalistic portion of the otters' enclosure. After the lure and control were positioned at equal distances from the subjects' point of entry as well as equal distances apart, the focal animal(s) was allowed to enter and explore the area for 10 minutes.

Each subject or pair was observed for a total of 6 days, 1 day for each of the 6 lures. Lures were introduced to subjects according to a rotating timetable, with each individual or pair following a different lure schedule to ensure that each attractant was presented an equal number of times on each day of the 6-day period in an attempt to control for a potential habituation bias. Lures and controls were placed in alternating positions in each enclosure across the 6-day period.

Following focal sessions, videotaped observations were reviewed and behaviors were recorded as follows. Each time a subject animal moved within 1 meter of a lure or control, an "approach" was indicated, and the start and end times recorded. Additionally, the following response behaviors were noted upon occurrence:

1. **Lure-Seeking Behavior (LSB):** inhale deeply or rapidly while moving toward the lure;
2. **Control-Seeking Behavior (CSB):** inhale deeply or rapidly while moving toward the control;
3. **Rub (RUB):** move back and forth or side to side with a large portion of the body in direct contact with the ground, an object, or some other surface;
4. **Scent-mark (SMK):** urinate, defecate, or rake the ground with claws;
5. **Mouth (MTH):** bite, lick, or otherwise contact the lure/control device with mouth;
6. **Move (MOV):** physically move the lure/control by pushing, pulling, or knocking it over;
7. **Carry (CAR):** physically move the lure/control while holding it in the jaws;
8. **Swim with Lure (SWL):** push or carry a lure device through the water while swimming;
9. **Swim with Control (SWC):** push or carry a control device through the water while swimming.

Analysis

To compare lures and controls and lure types, 4 main parameters were assessed. These included the percentage of total trials for each type of lure during which the lure or control device was approached, the mean swiftness of initial approaches of lures and controls, the mean frequency of approaches, and the duration of approaches. Both "mean duration" (i.e. an average of approaches during a single trial) and total duration (cumulative duration of approaches during a single trial) were averaged across subjects.

Data were analyzed using Stata® statistical software (StataCorp, College Station, Texas 77845). Repeated measures analysis of variance (ANOVA) was used to compare continuous variables (i.e., mean swiftness of initial approach, total duration of approaches, and mean duration of approaches) among lure types. The covariates sex, social rank, and facility size were nested within the model. Tukey HSD pairwise comparison was used to identify relationships among variables where significant effects were observed. Prior to analysis, data corresponding to the variable "mean swiftness of initial approach" were log10 transformed. However, these data did not completely

adhere to the expectations of a repeated measures ANOVA even after the transformation. Therefore, non-parametric tests (Friedman's test and Pearson X^2) were run as univariate categorical assessments; however, as they did not yield differences in significance from ANOVA results, they are not reported. Prior to analysis, frequency data were categorized into 4 groups: 0 approaches, 1 approach, 2 approaches, or 3 or more approaches. Additional Pearson X^2 tests were performed to compare lure type and other covariates (sex, social rank, facility size) for categorical variables (i.e., percentage of trials with at least one approach and frequency of approaches). Finally, 2-sample or paired *t*-tests were used to compare each of the 6 lures with its corresponding control. All statistical analyses were considered significant at an alpha level of 0.05.

RESULTS

Overall, otters demonstrated a stronger response to lures than controls for each of the 4 main parameters assessed. Lures were approached during a greater percentage of trials than controls (Fig. 2) and yielded a higher mean swiftness of initial approach, a higher frequency, and longer total and mean durations of approaches (Fig. 3 – 6). The only lure that differed significantly from its corresponding control for mean swiftness of initial approach was COL ($t = 2.94$, 32 df, $P = 0.003$). Comparisons among lure types revealed that COL performed better than the other 5 attractants among the 4 main parameters assessed. COL and SKE were both approached during the greatest percentage of trials (88.83%; Fig. 7). Moreover, COL demonstrated the fastest mean swiftness of initial approach (Fig. 8), and was approached most frequently (Fig. 9) and longer total and mean durations (Fig. 10 and 11, respectively) than the other 5 lures. A significant effect of lure type was observed for both total and mean duration of approaches ($F = 6.01$, 5 df, $P < 0.000$ and $F = 3.03$, 5 df, $P = 0.022$, respectively). Tukey HSD pairwise comparisons demonstrated that total and mean durations were significantly higher for COL than for FAS, BVC and SAO.

Further analyses revealed significant effects of sex on total and mean duration of approaches ($F = 6.57$, 1 df, $P = 0.025$ and $F = 6.21$, 1 df, $P = 0.028$, respectively; Fig. 12 and 13), with males ($n = 9$) spending longer durations within 1 m of lures than females ($n = 8$). There were no significant differences between males and females for percentage of trials with at least 1 approach (Fig. 14), mean swiftness of initial approach (Fig. 15), or frequency of approaches (Fig. 16). A significant effect of social rank was observed for total duration of approaches ($F = 4.78$, 1 df, $P = 0.049$; Fig. 17), with dominant individuals spending more time within 1 m of lures than subordinates; however, there was no effect of rank for mean duration of approaches (Fig. 18). Dominant and subordinate animals did not differ significantly for percentage of trials with at least 1 approach (Fig. 19), mean swiftness of initial approach (Fig. 20), or frequency of approaches (Fig. 21).

Overall, approaches of lures were preceded by a longer duration of "seeking behavior" than controls (Fig. 22), although this difference was not significant. Among the 6 lures, COL elicited the longest duration of seeking behavior, followed by SFE and SKE. FAS, BVC, and SAO demonstrated relatively short durations of seeking behavior. Only the controls for BVC and SAO were each sought for a longer mean duration than the respective lures themselves (Fig. 23).

Scent-marking only occurred within an "approach distance" (1 m) of a lure or control device a total of 17 times: twice within 1 m of a control, and 15 times within 1 m of a lure. The mean frequency of scent-marking was higher for lures than controls, although the difference was not significant (Fig. 24). Among the different lure types, scent-marking occurred most frequently within 1 m of SKE (Fig. 25). When total occurrences of scent-marking (regardless of distance from lure and control devices) were compared across trials, SKE trials were shown to have the highest frequency (Fig. 26). Moreover, there was a significant effect of sex ($X^2 = 5.82$, 1 df, $P = 0.016$), with males scent-marking significantly more frequently than females across trials (Fig. 27).

Rubbing occurred even less frequently than scent-marking during trials. Nine total instances of rubbing were recorded: 3 within 1 m of a control, and 6 within 1 m of a lure. The mean frequency of rubbing was slightly higher for controls than lures (Fig. 28). Among the different lure types, rubbing occurred most frequently within 1 m of the FAS control. Two instances of rubbing were recorded within 1 m each of SKE, SFE, and SAO (Fig. 29). When total occurrences of rubbing (regardless of distance from lure and control devices) were compared across trials, SFE, SKE, and COL trials shared the highest frequency at 4 times (Fig. 30).

Instances of moving, mouthing, carrying, and swimming with the lure or control devices were combined into "playing" for analysis. Most often, instances of playing began with moving or mouthing the lure or control device, proceeded to carrying it, and ended with swimming with the device. Playing occurred 10 times with control devices and 6 times with lures. The mean frequency of playing was higher for controls than lures, although this difference was not significant (Fig. 31). Among the 6 lures, the mean frequency of playing was highest for COL, and among the controls, it was highest for SAO (Fig. 32). COL and SAO were the only 2 lures with which the subjects played during trials (COL = 5 times, SAO = 1 time). Otters played with the controls of each lure except SKE and COL.

DISCUSSION

Results demonstrated that lures, when combined, outperformed controls for each of the 4 main parameters assessed, as was hypothesized. Lures were approached during a greater percentage of trials than controls and were approached, on average, more swiftly, more frequently, and for longer mean and total duration than controls. Moreover, lures elicited a longer mean duration of seeking behavior than controls, suggesting that approaches of lures were more often deliberate, preceded by remote detection of the odor and directed movements toward it, rather than haphazardly encountered. Nevertheless, none of the overall differences between lures and controls were significant, suggesting that the scents evaluated in this study were not sufficiently more attractive to captive river otters than unscented control devices.

According to the 4 main parameters assessed, otters demonstrated a stronger response to COL than the other 5 lures, negating the hypothesis that FAS would elicit the strongest response. COL tied with SKE for the greatest number of trials with at least 1 approach and was approached, on average, more swiftly, more frequently, and for longer durations than the other lures. Furthermore, COL was approached significantly more swiftly than its corresponding control. For 2 variables (total and mean duration of approaches), COL yielded significantly longer response times than 3 of the other lure

types (FAS, BVC, and SAO). Finally, COL elicited the longest mean duration of seeking behavior, suggesting that remote detection of that scent often motivated subjects to actively search for the lure device.

Only the controls for BVC and SAO were sought for longer mean durations than the respective lures themselves. Interestingly, these 2 lures showed, overall, the weakest response according to the 4 main parameters assessed. This suggests that during trials with preferred scents (i.e., COL, SFE, and SKE), subjects devoted more attention to the lure devices, whereas during trials with less favorable scents (i.e., FAS, SAO, and BVC), otters were more occupied with the control devices.

Scent-marking and rubbing were more likely to occur within 1 m of lures than controls. Although these differences were not significant and total numbers of occurrences were low, this suggests that lure odors prompted otters to deposit their own scent nearby, either in the form of urine, spraints, or use of pedal scent glands. There were no significant differences in scent-marking or rubbing across lure types, either within 1 m of lure and control devices or when all instances of these behaviors were counted during each trial.

Otters demonstrated a higher proportion of play behavior towards controls than lure devices. Play behavior is commonly observed in captive otters (Mattive 2010, T&D's Cats of the World, personal communication; Rosevear 2010, The Lehigh Zoo, personal communication) and has been documented in wild otters (Stevens and Serfass 2005) and may explain why responses to controls were higher for relatively unattractive scents, such as SAO and BVC. The fact that otters seemed to perceive control devices to be more favorable "toys" than lure devices may have confounded the dataset for controls and might partially account for the fact that lures and controls did not differ significantly across the 4 main parameters assessed. Play behavior was only directed at 2 of the 6 lures: SAO and COL. Five out of 6 total occurrences of playing with lures involved COL, revealing that COL not only received more attention from subjects, but was also played with more commonly than any other lure. In addition to attracting more attention than the other lures or controls, COL did not deter otters from playing with the PVC device.

Male and female otters did not respond differently to lures or controls according to any of the 4 main parameters assessed except duration (mean and total duration), with males spending significantly longer periods of time within 1 m of lures than females. The sexes also differed in the frequency of scent-marking across trials, with males marking significantly more often than females. As this analysis incorporated all instances of scent-marking, regardless of distance from lure devices, the nature of this behavior seems to be independent of the presence of odors. Dominant and subordinate animals differed in their response behavior toward lures only for total duration of approaches, with dominant animals spending significantly longer periods of time within 1 m of lures than subordinates.

Further analysis of captive otters could evaluate additional scents, especially other lures specially formulated and manufactured to attract wild otters, such as Caven's Otter Lure. SAO was the only "food odor" assessed in this study, but this scent was relatively weak and may not have been a preferred food odor for otters. Therefore, several other types of fish oils, shellfish oils, and extracts, particularly more pungent scents, might elicit a stronger response in captive otters. It may also be worthwhile to evaluate otters'

responses to the scents of conspecifics by presenting them with urine and/or spraint odors of familiar and unfamiliar individuals.

Field analyses of the scent(s) that elicited the best response among captive otters (such as COL) would ascertain whether olfactory lures constitute a useful method of attracting wild otters to remote tracking devices. If odors increase the efficacy of remote cameras, track plates, and traps, use of such lures could enhance researchers' ability to monitor wild otters, thus allowing biologists and wildlife management officials to gain more accurate data about existing and reestablished otter populations and gauge the success of otter translocations.

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FIGURES

Figure 1. Example of lure deployment device introduced to 7 otter enclosures to assess the responses of 17 otters to 6 different scents from April – July 2010.

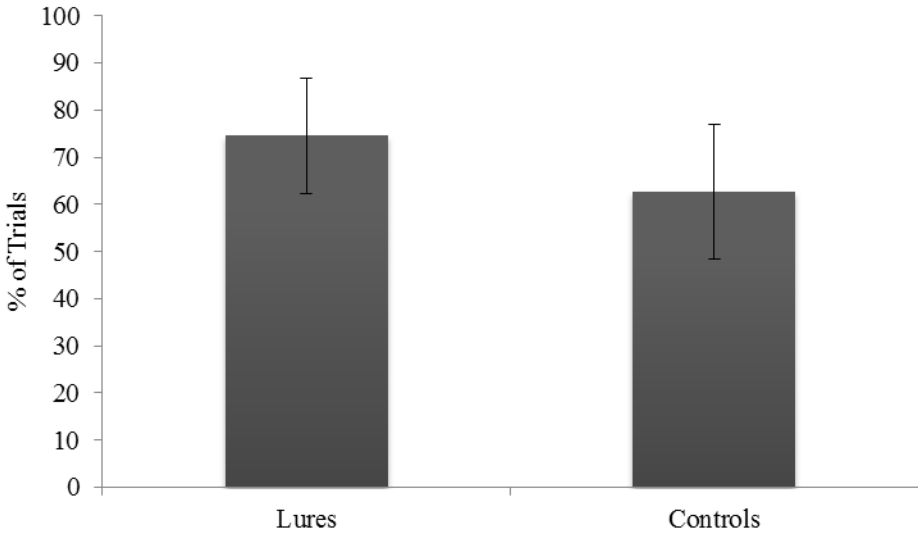

Figure 2. Mean percentage of trials with approach(es) for lures and controls among 17 otters observed at 7 captive facilities from April – July 2010.

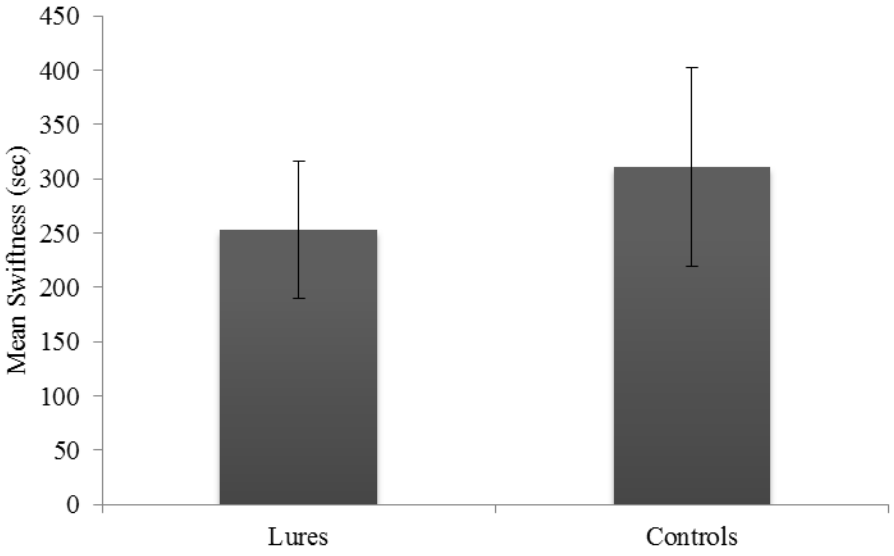

Figure 3. Mean swiftness of initial approach for lures and controls among 17 otters observed at 7 captive facilities from April – July 2010.

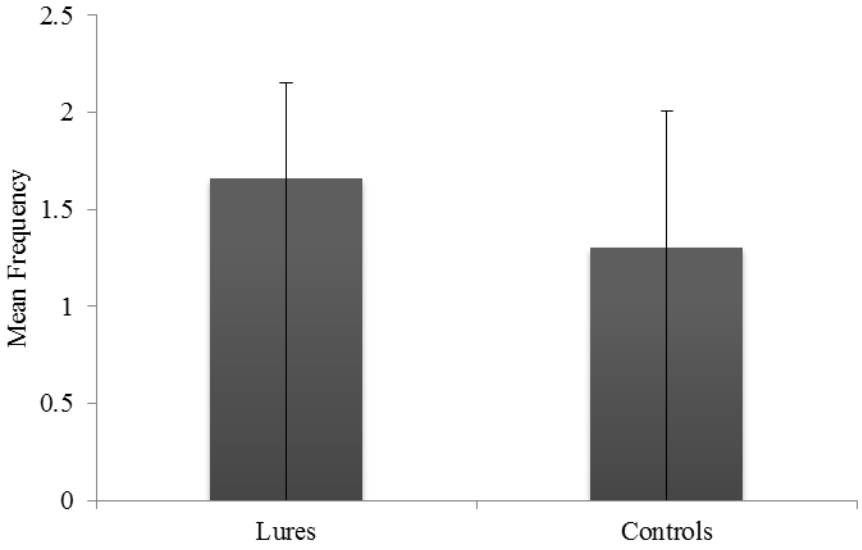

Figure 4. Mean frequency of approaches for lures and controls among 17 otters observed at 7 captive facilities from April – July 2010.

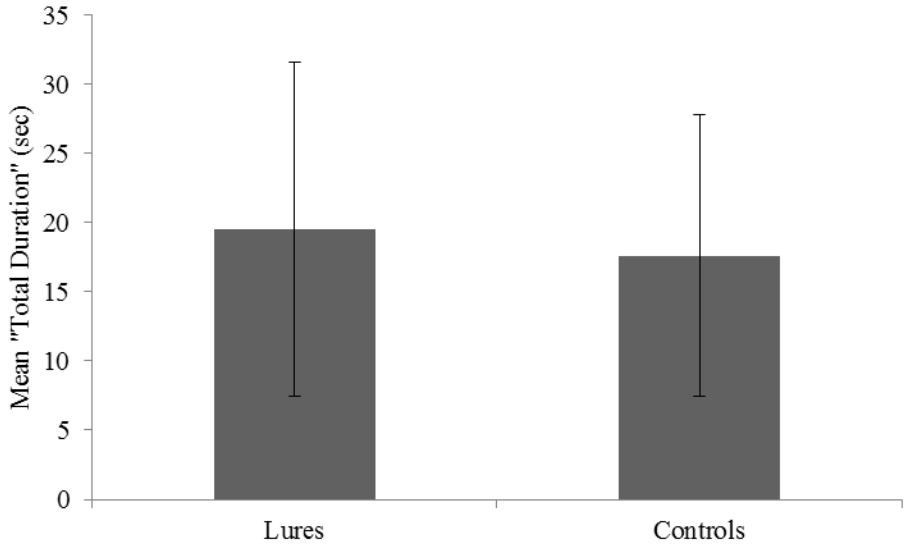

Figure 5. Mean "total duration" of approaches for lures and controls among 17 otters observed at 7 captive facilities from April – July 2010.

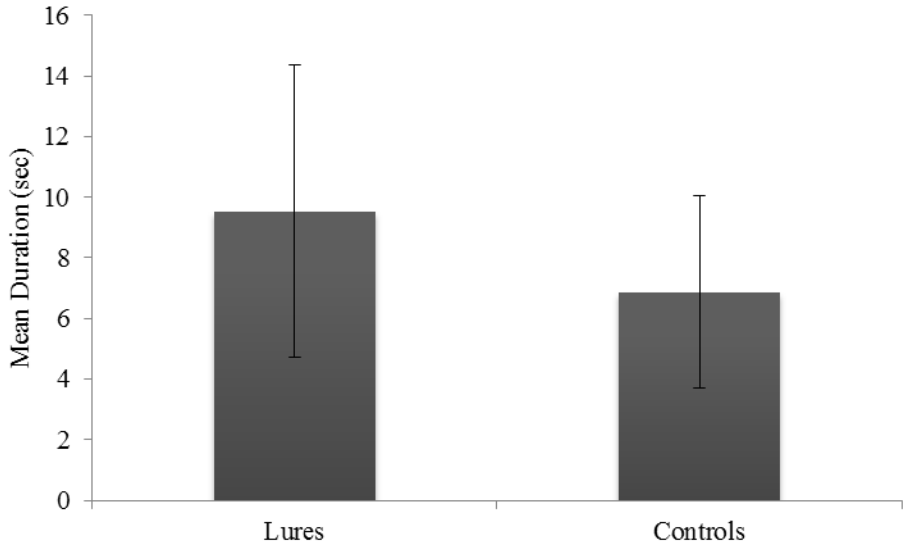

Figure 6. Mean duration of approaches for lures and controls among 17 otters observed at 7 captive facilities from April – July 2010.

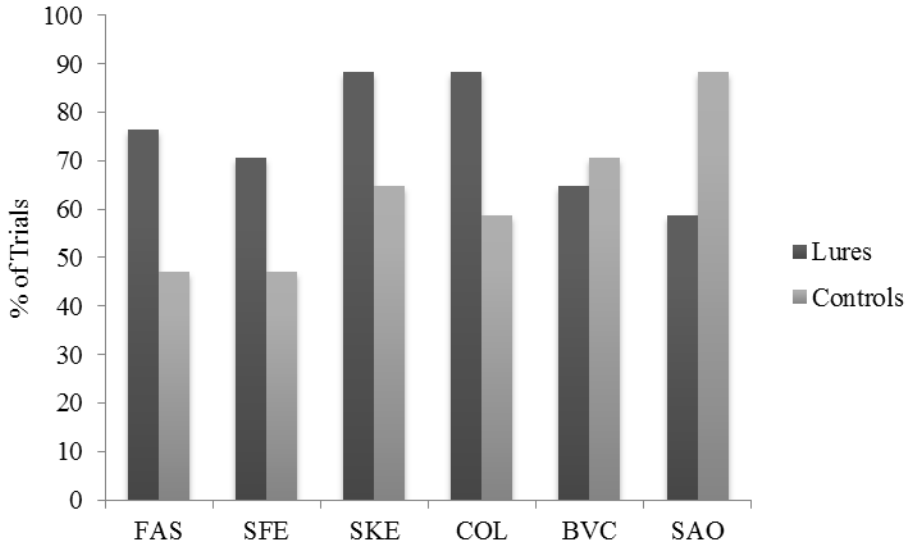

Figure 7. Percentage of trials with approach(es) among lures and controls among 17 otters observed at 7 captive facilities from April – July 2010.

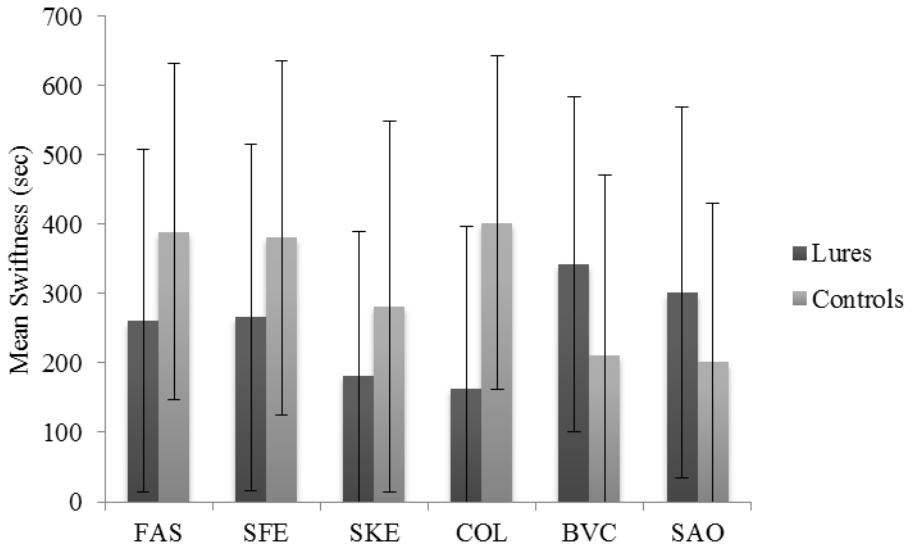

Figure 8. Mean swiftness of initial approach among lures and controls among 17 otters observed at 7 captive facilities from April – July 2010. Statistical significance detected between COL and its corresponding control (t = 2.94, 32 df, P = 0.003).

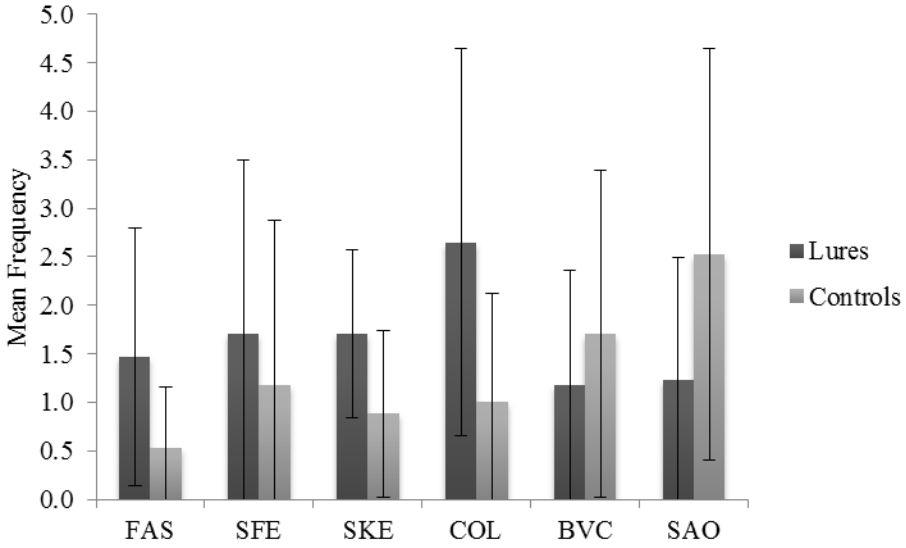

Figure 9. Mean frequency of approaches among lures and controls among 17 otters observed at 7 captive facilities from April – July 2010.

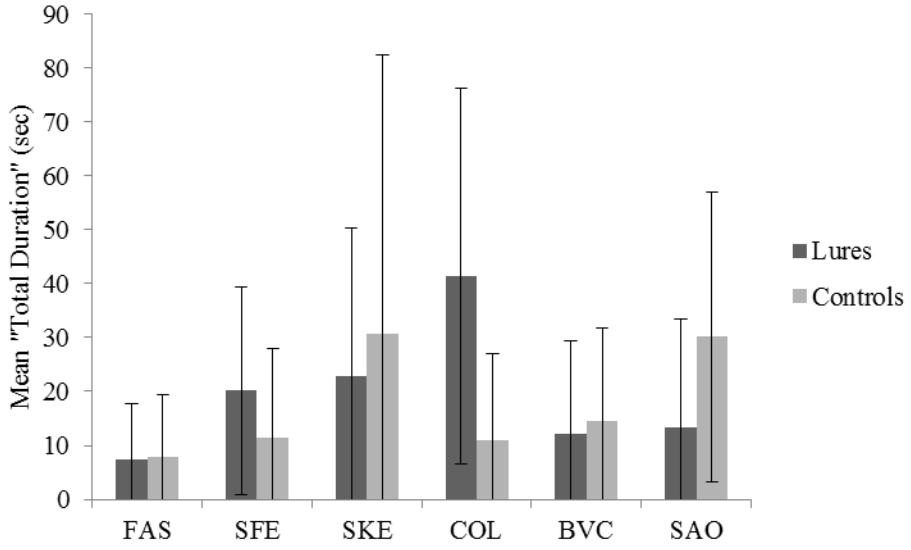

Figure 10. Mean "total duration" of approaches among lures and controls among 17 otters observed at 7 captive facilities from April – July 2010. Statistical significance detected ($F = 6.01$, 5 df, $P < 0.001$).

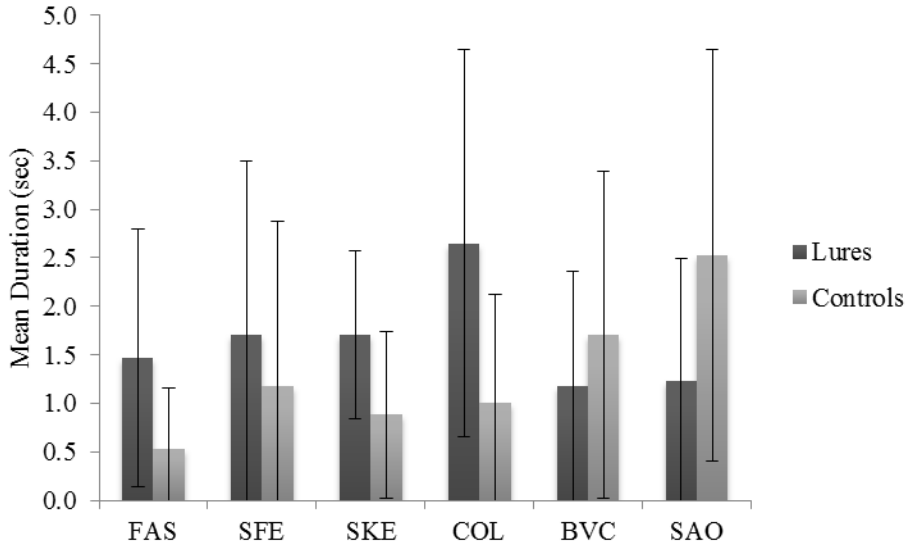

Figure 11.Mean duration of approaches among lures and controls among 17 otters observed at 7 captive facilities from April – July 2010. Statistical significance detected (F = 3.03, 5 df, P = 0.022).

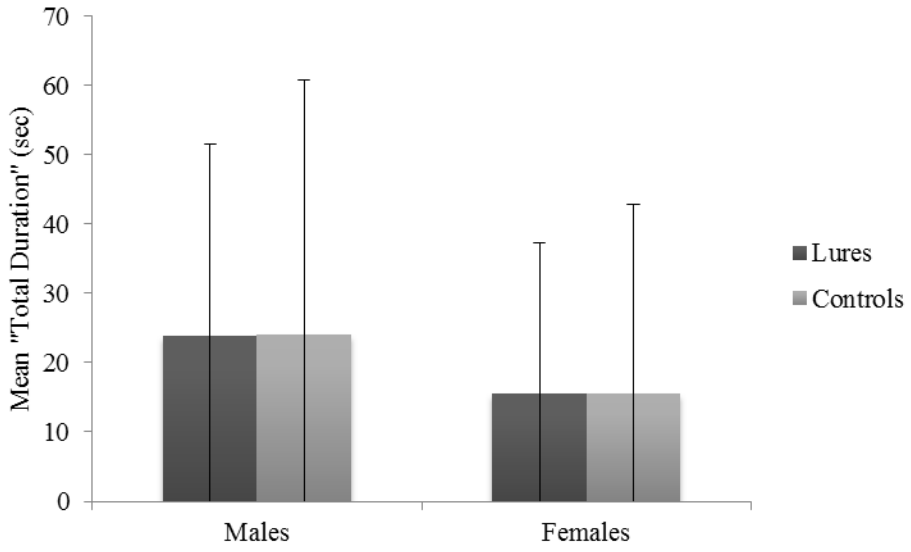

Figure 12. Mean "total duration" of approach(es) by sex for lures and controls among 17 otters observed at 7 captive facilities from April – July 2010. Statistical significance detected at α = .05 (*F* = 6.57, 1 df, *P* = 0.025).

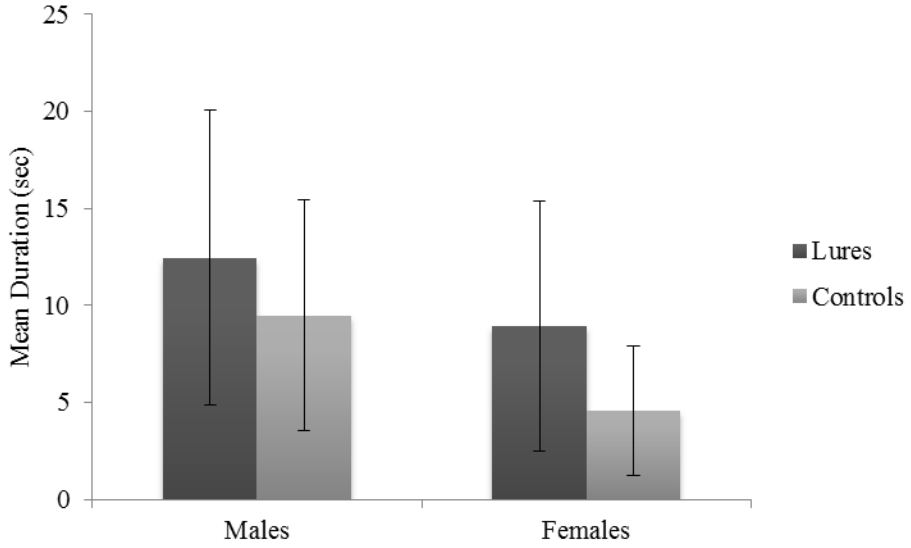

Figure 13. Mean duration of approach(es) by sex for lures and controls among 17 otters observed at 7 captive facilities from April – July 2010. Statistical significance detected at α = .05 (*F* = 6.21, 1 df, *P* = 0.028).

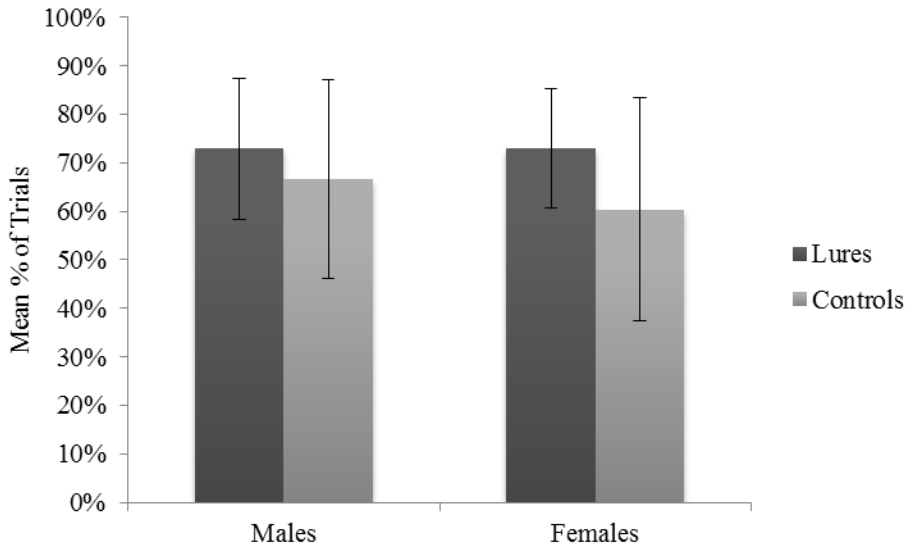

Figure 14. Mean percentage of trials with approach(es) by sex for lures and controls among 17 otters observed at 7 captive facilities from April – July 2010.

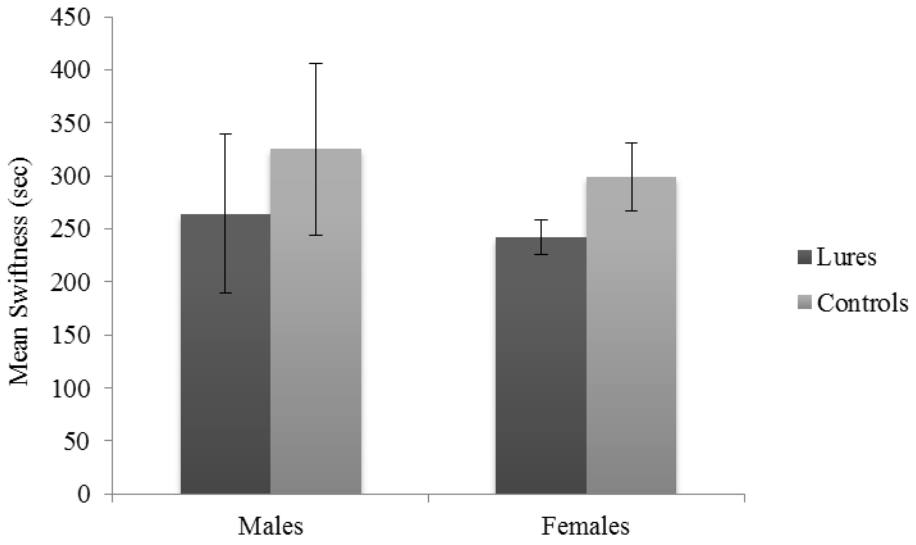

Figure 15. Mean swiftness of initial approach by sex for lures and controls among 17 otters observed at 7 captive facilities from April – July 2010.

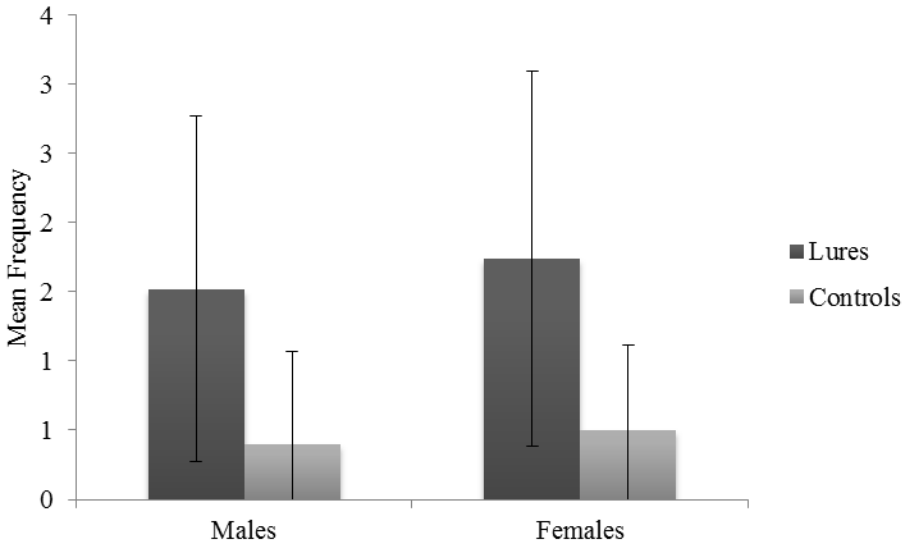

Figure 16. Mean frequency of approach(es) by sex for lures and controls among 17 otters observed at 7 captive facilities from April – July 2010.

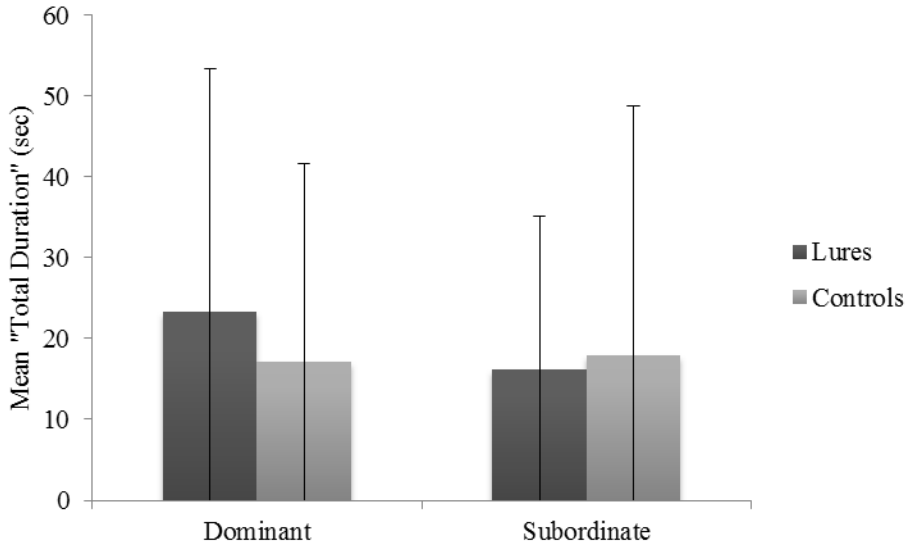

Figure 17. Mean "total duration" of approach(es) by social rank for lures and controls among 17 otters observed at 7 captive facilities from April – July 2010. Statistical significance detected at (F = 4.78, 1 df, P = 0.049).

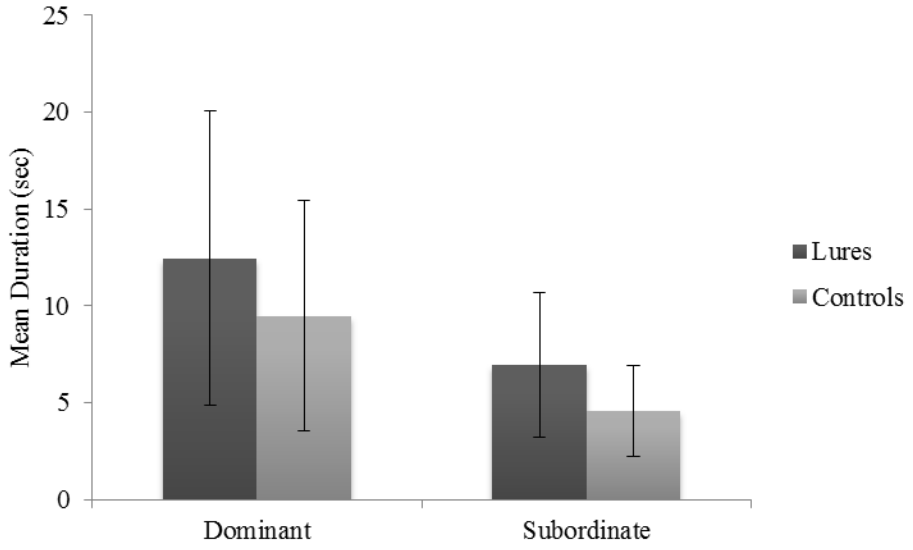

Figure 18. Mean duration of approach(es) by social rank for lures and controls among 17 otters observed at 7 captive facilities from April – July 2010.

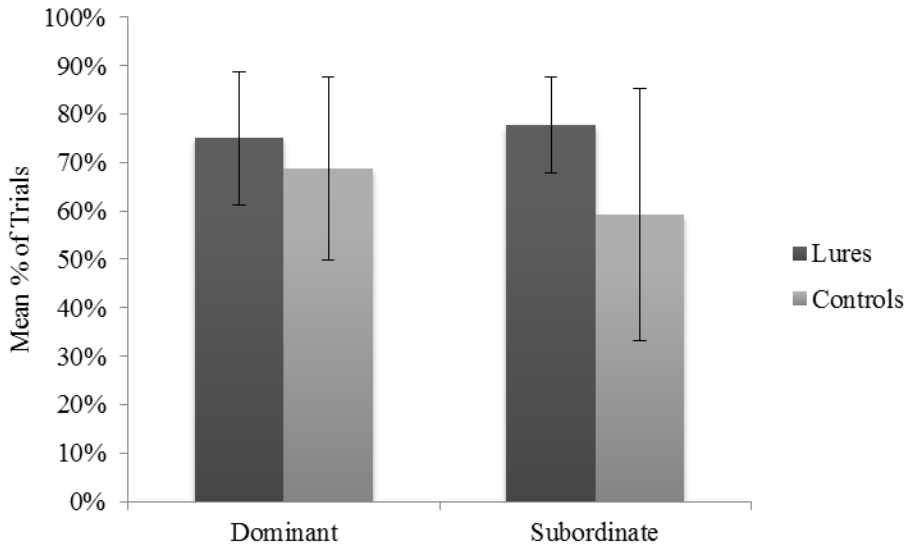

Figure 19. Mean percentage of trials with approach(es) by social rank for lures and controls among 17 otters observed at 7 captive facilities from April – July 2010.

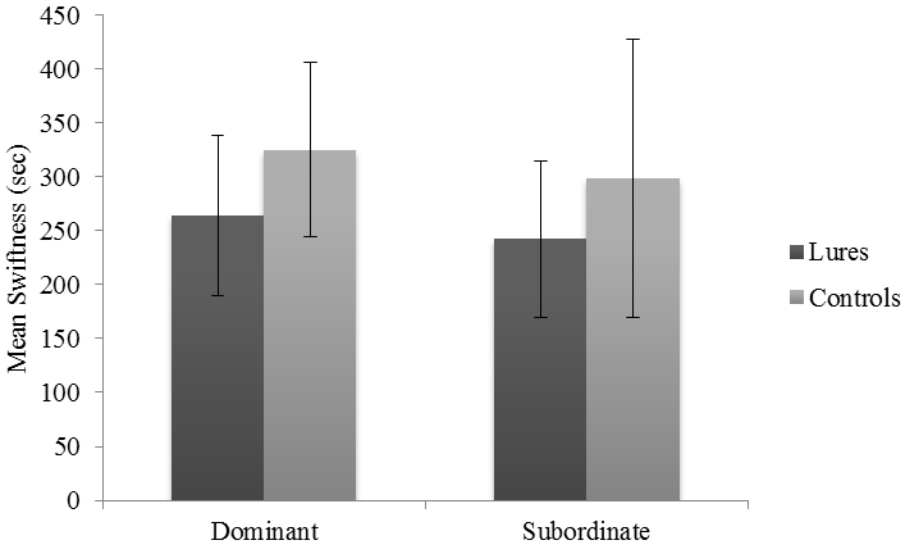

Figure 20. Mean swiftness of initial approach by social rank for lures and controls among 17 otters observed at 7 captive facilities from April – July 2010.

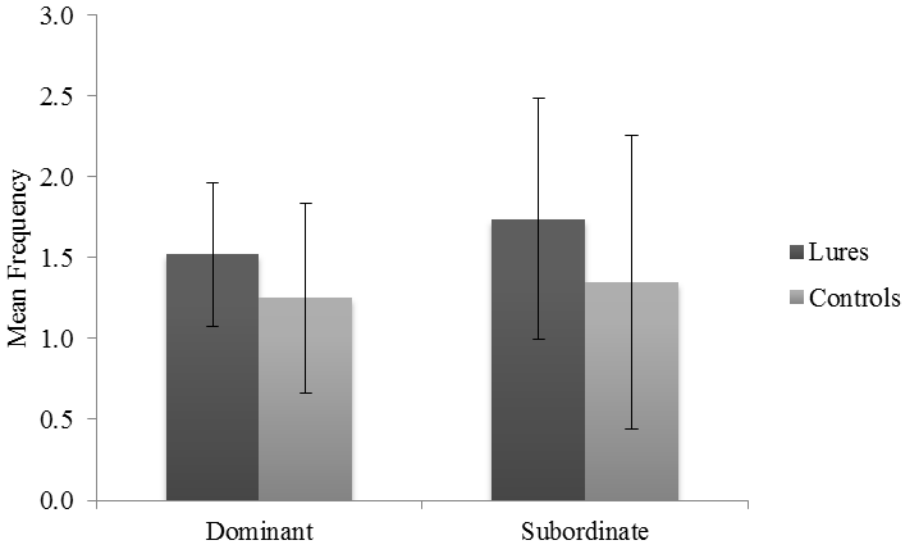

Figure 21. Mean frequency of approaches by social rank for lures and controls among 17 otters observed at 7 captive facilities from April – July 2010.

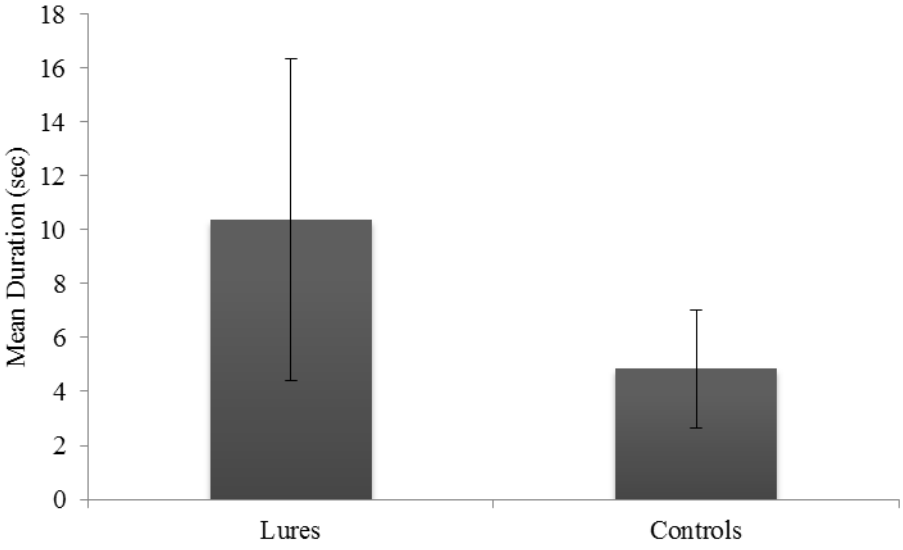

Figure 22. Mean duration of seeking behavior for lures and control among 17 otters observed at 7 captive facilities from April – July 2010.

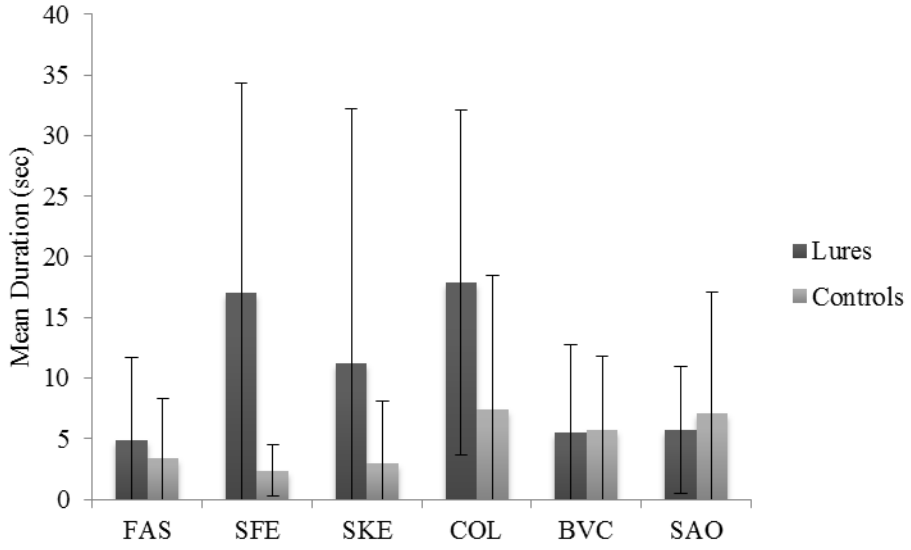

Figure 23. Mean duration of seeking behavior among lures and control among 17 otters observed at 7 captive facilities from April – July 2010.

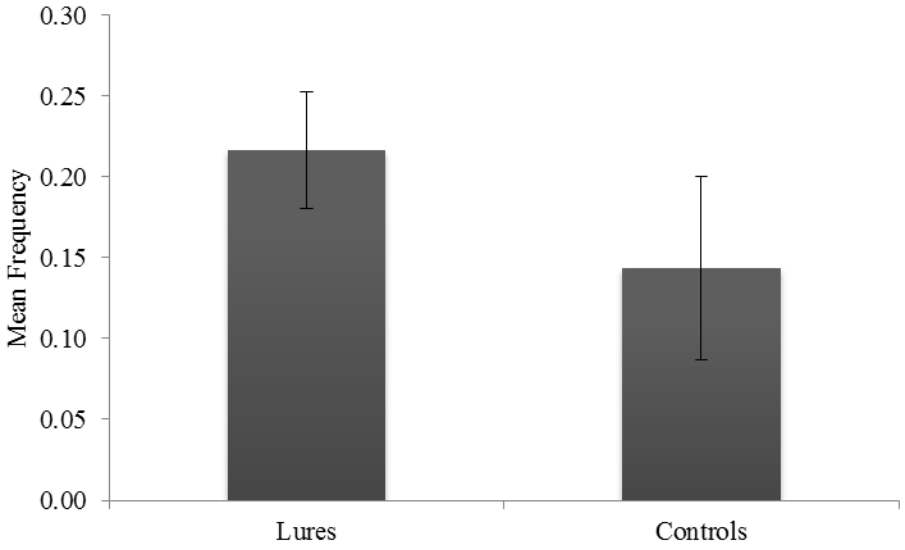

Figure 24. Mean frequency of scent-marking within 1 m of lures and controls among 17 otters observed at 7 captive facilities from April – July 2010.

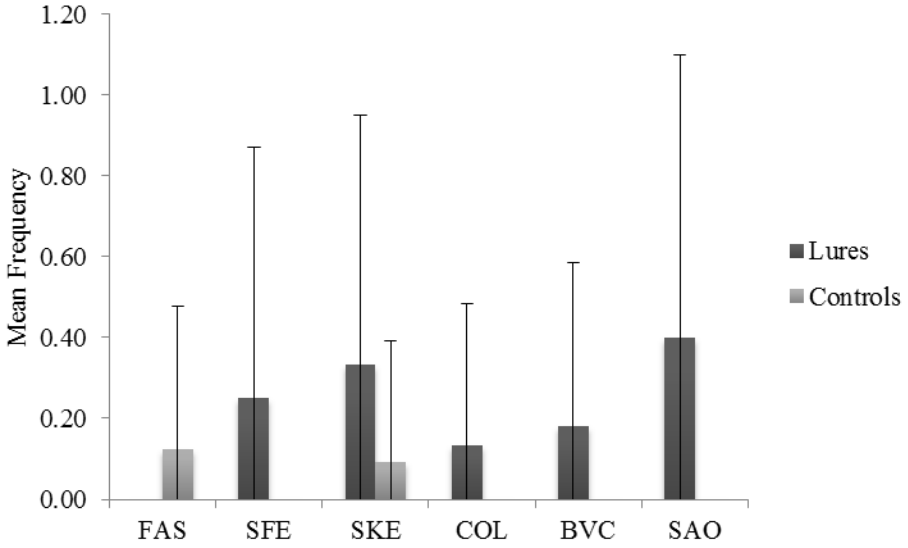

Figure 25. Mean frequency of scent-marking within 1 m of lures and controls among 17 otters observed at 7 captive facilities from April – July 2010.

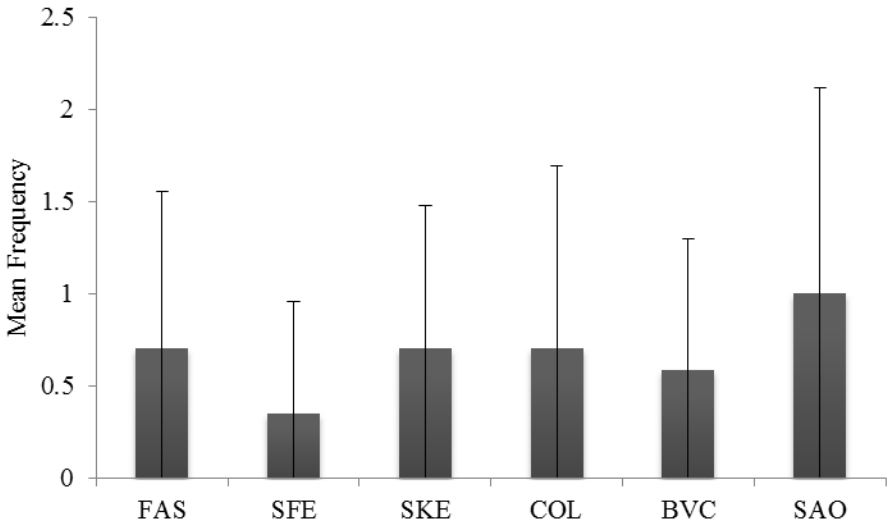

Figure 26. Mean frequency of scent-marking during trials for each type of lure among 17 otters observed at 7 captive facilities from April – July 2010.

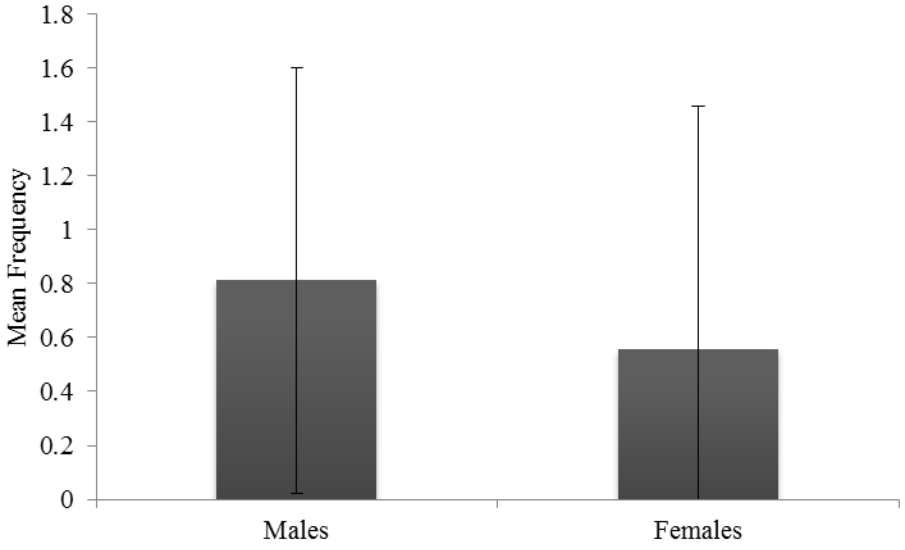

Figure 27. Mean frequency of scent-marking by sex for lures and controls among 17 otters observed at 7 captive facilities from April – July 2010. Significance detected (X^2 = 5.82, 1 df, P = 0.016).

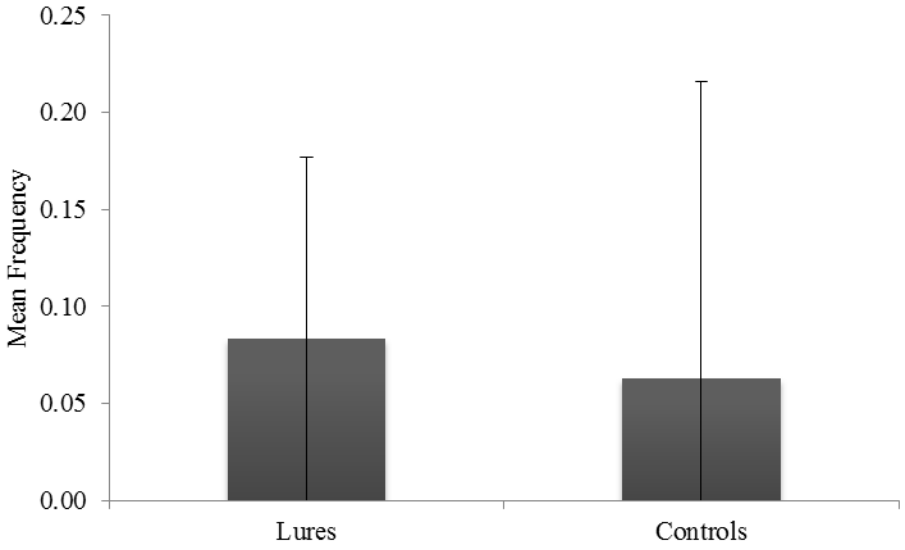

Figure 28. Mean frequency of rubbing within 1 m of lures and controls among 17 otters observed at 7 captive facilities from April – July 2010.

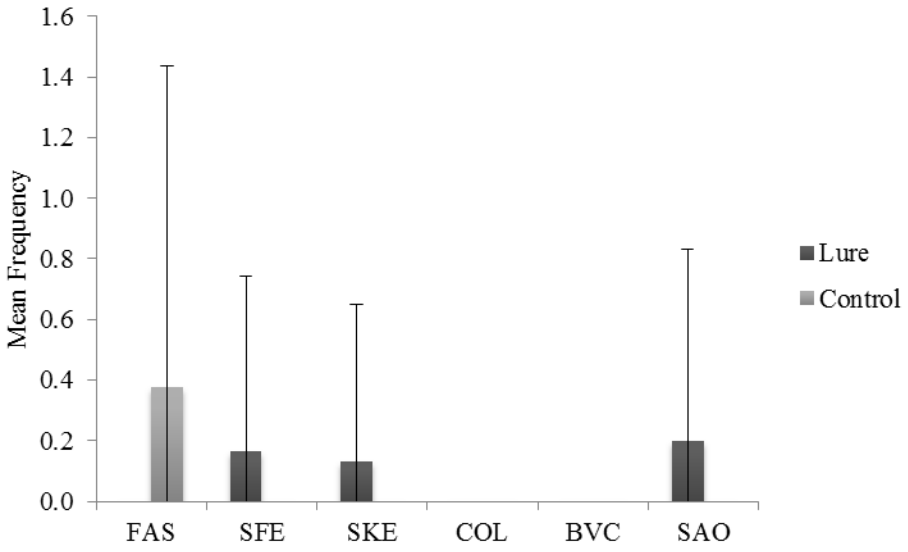

Figure 29. Mean frequency of rubbing within 1 m of lures and controls among 17 otters observed at 7 captive facilities from April – July 2010.

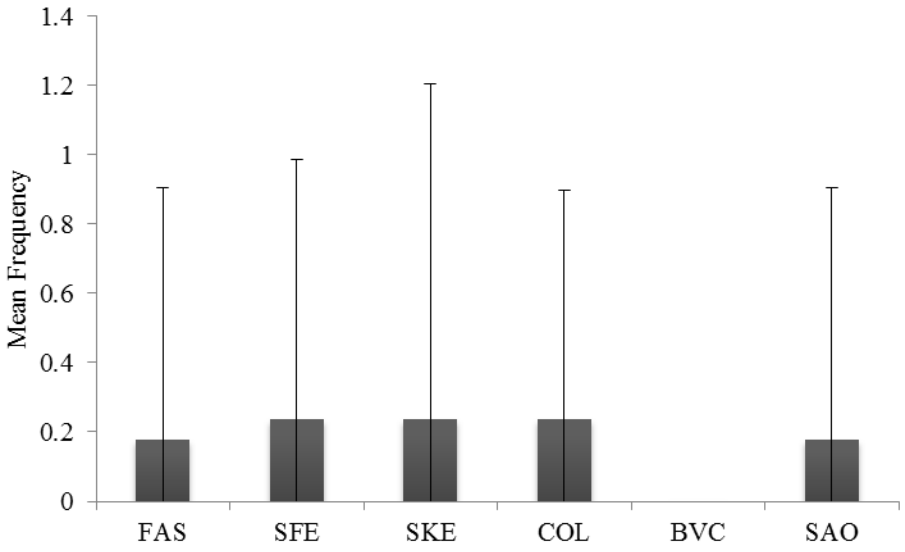

Figure 30. Mean frequency of rubbing during trials for each type of lure among 17 otters observed at 7 captive facilities from April – July 2010.

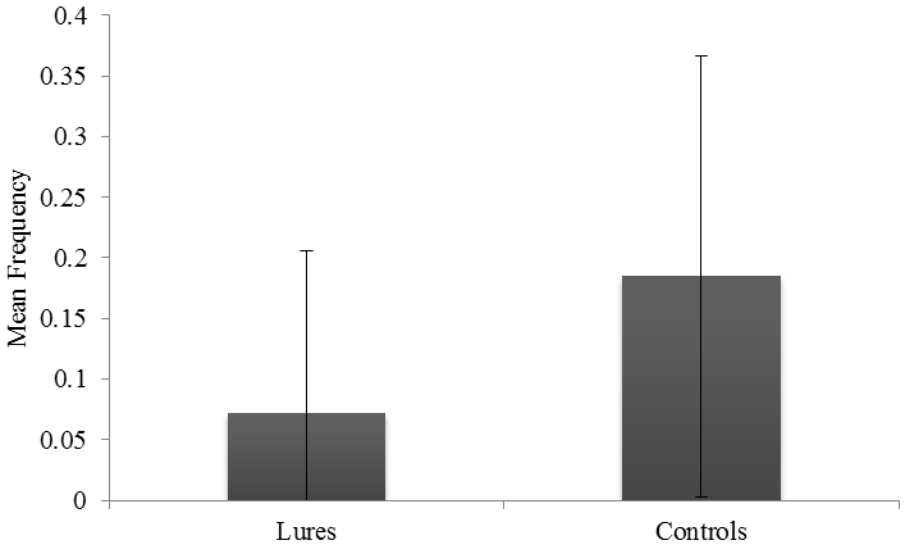

Figure 31. Mean frequency of playing for lures and controls among 17 otters observed at 7 captive facilities from April – July 2010.

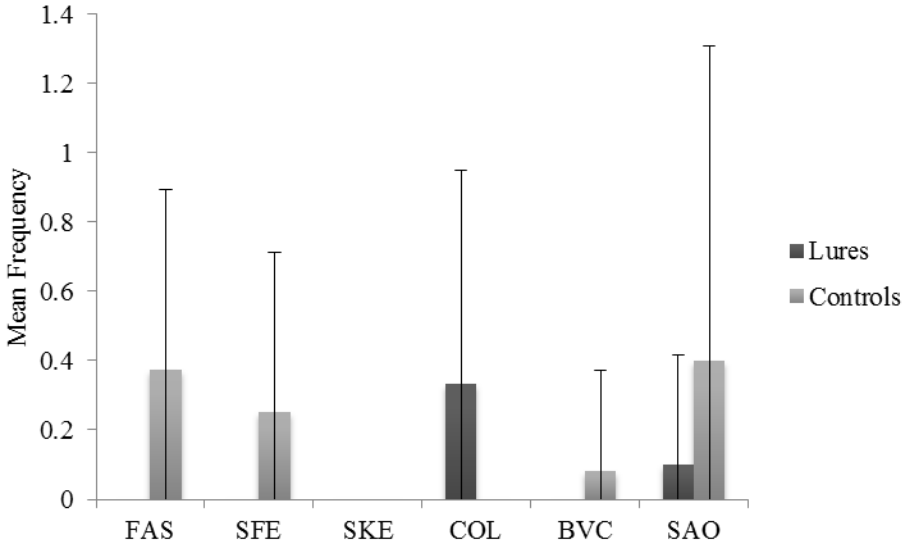

Figure 32. Mean frequency of playing for lures and controls among 17 otters observed at 7 different facilities from April – July, 2010.

APPENDIX I. River otter survey form used to interview anglers being assessed about their knowledge and opinions about river otters in North Dakota, May-October, 2011.

S#: ___ Date: _____ Survey Location: _____GPS: _____ Initial: _____

Demographics

Residence: State: _____ County: _____ City/Town: _____

Please indicate the primary reason you are here today: ☐ fish ☐ view wildlife
☐ other: _____

Gender: Male Female **Age:** _____

Race: ☐ white ☐ black ☐ Asian ☐ Hispanic ☐ other: _____
☐ Native American: tribe: _____

Highest formal education completed:
☐ less than high school ☐ some high school ☐ high school ☐ high school + vocational
☐ some college ☐ 2- year degree (associates) ☐ 4- year degree (bachelors) ☐ beyond bachelors

Occupation: ☐ student ☐ retired ☐ unemployed ☐ _____

Do you consider yourself to be a (check all that apply): ☐ hunter ☐ angler ☐ trapper ☐ none

River Otter Assessment

1. Have you ever heard of a river otter? Yes No Not Sure

   (If "No" or "Not Sure" did you?) ☐ Show picture ☐ Read blurb (only if don't recognize the animal)

2. Does North Dakota have an otter population? Yes No Not Sure

3. How do you know?
   ☐ personal observation ☐ family/friend told me ☐ TV ☐ Books/Brochures/Magazines
   ☐ internet ☐ other: _____

   Are any of those from North Dakota Game and Fish? Which ones?
   ☐ website ☐ ND Outdoors TV ☐ ND Outdoors Magazine ☐ other paper media from NDGF
   ☐ other: _____

4. Have you ever seen a river otter? Yes No Not Sure
   ☐ Zoo: (name(s) of zoo) _____
   ☐ In the wild: (where?) _____

5. Please indicate your overall attitude towards river otters:
   Strongly Like Like Neutral Dislike Strongly Dislike
6. Please indicate what river otters eat. Please be specific as possible:

_____
_____

Opinions of River Otters

	STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE	NO OPINION
I like having an otter population in North Dakota.	O	O	O	O	O	O

I would be happy if otters are near waterways I go fishing at.	O	O	O	O	O	O
I believe that otters prefer to eat game fish.	O	O	O	O	O	O
I would support the restrictions on trapping furbearing animals in North Dakota to protect otters from being accidentally caught.	O	O	O	O	O	O
I hope otter populations continue to expand to other suitable habitat in North Dakota.	O	O	O	O	O	O
If there is a viable population of otters in North Dakota, I would support having a trapping season of them.	O	O	O	O	O	O
Otters are NOT a threat to game fish populations.	O	O	O	O	O	O
Otters are important to the health of aquatic ecosystems.	O	O	O	O	O	O
I believe otters create problems for people.	O	O	O	O	O	O
A river otters' direct or indirect presence causes me to feel anxiety, stress, or fear.	O	O	O	O	O	O
It is important that future generations of North Dakota see otters in the wild.	O	O	O	O	O	O
I would be happy if I saw a living otter in the wild during my visit today.	O	O	O	O	O	O

View of River Otters

1. Do river otters affect other wildlife negatively? Yes No Unsure No opinion
   If so, which ones/how?: _____

2. Do you consider the otter to be a public safety concern? Yes No Unsure No opinion
   If so, how?: _____

3. Are otters important in your culture and/or beliefs? Yes No Unsure No opinion
   If so, how?: _____

4. What is your overall attitude towards the presence of otters in North Dakota?
   Strongly Like Like Neutral Dislike Strongly Dislike No opinion
5. Why you selected your overall attitude (above)?:

_____
_____

6. Would you like to learn more about RIVER OTTERS: (check all that apply)
   ☐ Ecology ☐ Avoidance trapping ☐ Pest management strategies
   ☐ Viewing options ☐ Other: _____

CIRCLE CORRECT ANIMAL IDENTIFICATION: 1 2 3 4

This is the conclusion of the survey and we thank you for your time. Your input is valuable and greatly appreciated.

APPENDIX II. ANIMAL PICTURES SURVEY PARTICIPANTS IDENTIFIED

The pictures below were shown to angler survey participants after the conclusion of their interview. The pictures were used to assess angler familiarity of animals in North Dakota.

APPENDIX III. BRIEF RIVER OTTER DESCRIPTION

The following informative statement was read to survey participants who stated "No" or "Not Sure" to the question: "Have you ever heard of a river otter?" and did not recognize the animal when shown the river otter from the "Animals in North Dakota" pictures (see Appendix B). The purpose of this statement was for survey participants to have basic general knowledge of river otters when responding to attitude questions about the animal.

River otters are a mammal approximately 3-4 feet long and 8-10 inches in height. They are distributed throughout the U.S. including North Dakota. River otters are a carnivorous animal and prey primarily upon fish and aquatic invertebrates.

Appendix IV

American Beaver Public Survey

Survey #:_____ Date:_____ Survey Location: _____ Initial: _____

Demographics

Residence: State: _____ County: _____ City/Town: _____

Please indicate the primary reason you are here today: ☐ *Fish* ☐ *view wildlife*

☐ Other: _____

Gender: Male Female Age: _____

Race: ☐ White ☐ Black ☐ Asian ☐ Hispanic ☐ Other: _____

☐ Native American: tribe: _____

Highest formal education completed:

☐ less than high school ☐ some high school ☐ high school ☐ high school + vocational

☐ some college ☐ 2-year degree (associates) ☐ 4-year degree (bachelors) ☐ beyond bachelors

What is your occupation: ☐ Student ☐ Retired ☐ Unemployed ☐

_____

Participation in outdoor recreation (circle):

Hunting: Never Rarely Sometimes Frequently

Angler: Never Rarely Sometimes Frequently

Wildlife Viewing: Never Rarely Sometimes Frequently

Trapper: Never Rarely Sometimes Frequently

Species trapped: _____

American Beaver Opinions

1. Have you ever heard of a beaver? Yes No Not sure
2. Does North Dakota have a beaver population? Yes No Not sure
3. Have you ever seen a beaver in North Dakota? Yes No Not sure

   If yes, how often do you come into contact with beavers?

   Often Frequently Sometimes Rarely Never
4. Have you ever seen a beaver elsewhere? Yes No Not sure
5. Please indicate your overall attitude towards beavers?

   Strongly Like Like Neutral Dislike Strongly Dislike
6. What, if anything, is good about beavers?

   _____

7. What, if anything, is bad about beavers?

   _____

	Strongly	Agree	Neutral	Disagree	Strongly	No
Beavers have a right to exist						
No beaver should be destroyed						
I like having a beaver population in North Dakota						
I would like a larger beaver population in North Dakota						
I like/would like having a beaver population near my residence						
I think beaver dams are attractive						
I like/want beaver dams on my property						

I like/want beaver dams on public property						
I support regulated beaver trapping in North Dakota						
I'm satisfied with North Dakota Game and Fish's management of beaver populations in North Dakota						
Beavers are damaging to property						
Residents near beavers should learn to live with some beaver related conflict						
I support efforts to decrease the beaver population in North Dakota						
It is important that wild beaver populations persist in North Dakota for future generations						
I would be happy if I saw a living beaver in the wild today						

Opinions on American Beaver Control

1. Do beavers create habitat for wildlife? Yes No Not sure

   If so, what wildlife? _____

2. Are you familiar with North Dakota laws pertaining to beaver regulation?

   Yes No Not sure

3. Do you have a beaver population near you residence? Yes: # _____ No Not sure

4. Do you consider beavers to be a pest species? Yes No Not sure

   If yes, how is the beaver a pest to you? _____

   If yes, what control methods, if any, are used? _____

5. Do you think the size of beaver populations need to be controlled in North Dakota? Yes No No Opinion

   a. Please indicate all responses you would support for controlling nuisance beavers:

      ____ 1. Lethal deterrents (i.e. traps, shooting, etc.) by government officials.

      ____ 2. Culling of correctly identified problem beaver by *myself.*

      ____ 3. Culling of correctly identified problem beaver by *recreational trappers.*

      ____ 4. General population reduction by recreational trapping

      ____ 5. Total eradication of beavers

      ____ 6. Non-lethal deterrents (live trap and relocate)

      ____ 7. Non-lethal deterrents (fencing trees)

   From the choices above, circle your most desired method for controlling beaver populations.

8. What is your overall attitude towards beavers in North Dakota?

   Strongly Like Like Neutral Dislike Strongly Dislike

9. In what ways have you gained information about American Beaver?

   ☐ North Dakota Game and Fish ☐ Local Newspapers ☐ Outdoor Magazines

   ☐ Personal Experience ☐ Other: _____

10. I would like to learn more about beavers: (check all that apply)

    ☐ Ecology ☐ Pest management strategies ☐ Viewing options

    ☐ Other: _____

11. Additional Comments?

    _____

    _____

    _____

    _____

Thank you!

Appendix V

Residence: State: _____ County: _____ City/Town: _____

Gender: Male Female **Age:** _____

Race: ☐ white ☐ black ☐ Asian ☐ Hispanic ☐ other: _____

☐ Native American: tribe: _____

Highest formal education completed:

☐ less than high school ☐ some high school ☐ high school ☐ high school + vocational
☐ some college ☐ 2- year degree (associates ☐ 4- year degree (bachelors)
☐ beyond bachelors

Occupation: ☐ student ☐ retired ☐ unemployed ☐ _____

Do you consider yourself to be a (check all that apply): ☐ hunter ☐ angler ☐ trapper ☐ none

1. Please indicate your viewpoint for the following activities:

Hunting: Support Oppose Neutral No opinion / Not sure
Trapping: Support Oppose Neutral No opinion / Not sure

2. Please indicate the frequency you do the following activities during their respective season:

NEVER = 0 days/yr **RARELY**= 1-5 days/yr **SOMETIMES**= 6-20 days/yr **FREQUENTLY =** 20-40days/yr **OFTEN =** > 40 days/yr

Hunting: Often Frequently Sometimes Rarely Never
Fishing: Often Frequently Sometimes Rarely Never
Trapping: Often Frequently Sometimes Rarely Never

American Beaver Assessment

7. Have you ever heard of a beaver? Yes No Not Sure

(If "No" or "Not Sure" did you?) ☐ Show picture

8. Does North Dakota have a beaver population? Yes No Not Sure

9. Have you ever seen a beaver in North Dakota? Yes No Not Sure

If yes, how often do you come into contact with beavers?

Often Frequently Sometimes Rarely Never

10. Have you ever seen a beaver? Yes No Not Sure

11. Please indicate your overall attitude towards beavers:

Strongly Like Like Neutral Dislike Strongly Dislike

What, if anything, is good about beavers?

_____

What, if anything, is bad about beavers?

_____

Opinions on Beavers

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	No Opinion
Beavers have a right to exist	O	O	O	O	O	O
No beaver should be destroyed	O	O	O	O	O	O
I like having a beaver population in North Dakota	O	O	O	O	O	O
I would like a larger beaver population in North Dakota	O	O	O	O	O	O
Other wildlife benefit from habitats that are modified by beavers	O	O	O	O	O	O
I like/would like having a beaver population near my residence	O	O	O	O	O	O
I think beaver dams are attractive	O	O	O	O	O	O
I support regulated beaver trapping in North Dakota	O	O	O	O	O	O
I'm satisfied with North Dakota Game and Fish's management of beaver populations in North Dakota	O	O	O	O	O	O
Beavers are damaging to property	O	O	O	O	O	O
Residents near beavers should learn to live with some beaver related conflict	O	O	O	O	O	O
I support efforts to decrease the beaver population in North Dakota	O	O	O	O	O	O
I consider beavers to be a pest species	O	O	O	O	O	O
It is important that wild beaver populations persist in North Dakota for future generations	O	O	O	O	O	O
I would be happy if I saw a living beaver in the wild today	O	O	O	O	O	O

Opinions on American Beaver Control

1. Do beavers create habitat for wildlife? Yes No Not Sure

If so, what wildlife?_____-

_____

2. Do you know the present beaver state laws? Yes No Not Sure

If yes, do you agree with the present state laws on beaver regulation in the state of North Dakota?

Yes No Not Sure

3. Do you have a beaver population near your residence? Yes: #_____
No Unsure

4. How would you rate your overall viewpoints of beavers? Positive Neutral
Negative

If negative, what is the frequency? Often Frequently Sometimes Rarely
Never

5. Why did you rate your overall viewpoint response of beavers the way you did?
_____
_____

6. Do you consider the beaver to be a pest species? Yes No Not Sure

If yes, how is the beaver a pest to you?
_____
_____

7. If beavers are viewed as a pest species, how do you resolve the problems they may present?
_____
_____

12. Do you think the size of beaver populations needs to be controlled in North Dakota?

Yes No Opinion

9. How do you personally regulate beaver populations?
_____
_____

10. Please indicate all responses you would support for controlling beaver populations:

____ 1. Lethal deterrents (i.e. traps, shooting, etc.) by government officials
____ 2. Culling of correctly identified problem beaver by *myself.*
____ 3. Culling of correctly identified problem beaver by recreational *trappers*

11. From the choices above, what is your most desired method for controlling beaver populations?

1 2 3 No opinion

12. What is your overall attitude towards beavers in North Dakota?

Strongly Like Like Neutral Dislike Strongly Dislike

13. I would like to learn more about beaver: (check all that apply)

□ Ecology □ Pest management strategies □ Viewing options

□ Other: _____

14. Have you ever had damage to your property caused by beavers? Yes No Opinion
If yes, describe the damage.
_____
_____

Appendix VI

Dear Waterfowl enthusiast,

We are conducting a project through North Dakota Game & Fish to assess public attitudes towards the American beaver in North Dakota. We would be delighted if you would help us by completing the enclosed survey pertaining to your opinions about the beaver.

Enclosed is a self-addressed, stamped envelope for returning the form to the North Dakota Game & Fish. Your results will remain entirely anonymous.

Thank you very much for assisting me in this important project.

Sincerely,

Johanna Taylor
Project Coordinator
Survey.JohannaTaylor@gmail.com

Appendix IV

Dear North Dakota land owners,

I am conducting a project through North Dakota Game & Fish to assess public attitudes towards the American beaver in North Dakota. I contacted USDA Wildlife Services and they indicated that you have recently had problems with beavers. Consequently I am particularly interested in your opinions about this animal. I would be delighted if you would help me by completing the enclosed survey pertaining to your opinions about the beaver.

Enclosed is a self-addressed, stamped envelope for returning the form to North Dakota Game & Fish. Your results will remain entirely anonymous.

Thank you very much for assisting me in this important project.

Sincerely,

Johanna Taylor
Project Coordinator
Survey.JohannaTaylor@gmail.com