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Human Dimensions

Efficacy of Firearms for Bear Deterrence in Alaska

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ABSTRACT We compiled, summarized, and reviewed 269 incidents of bear–human conflict involving firearms that occurred in Alaska during 1883–2009. Encounters involving brown bears (*Ursus arctos*; 218 incidents, 81%), black bears (*Ursus americanus*; 30 incidents, 11%), polar bears (*Ursus maritimus*; 6 incidents, 2%), and 15 (6%) unidentified species provided insight into firearms success and failure. A total of 444 people and at least 367 bears were involved in these incidents. We found no significant difference in success rates (i.e., success being when the bear was stopped in its aggressive behavior) associated with long guns (76%) and handguns (84%). Moreover, firearm bearers suffered the same injury rates in close encounters with bears whether they used their firearms or not. Bears were killed in 61% ($n = 162$) of bear–firearms incidents. Additionally, we identified multiple reasons for firearms failing to stop an aggressive bear. Using logistic regression, the best model for predicting a successful outcome for firearm users included species and cohort of bear, human activity at time of encounter, whether or not the bear charged, and if fish or game meat was present. Firearm variables (e.g., type of gun, number of shots) were not useful in predicting outcomes in bear–firearms incidents. Although firearms have failed to protect some users, they are the only deterrent that can lethally stop an aggressive bear. Where firearms have failed to protect people, we identified contributing causes. Our findings suggest that only those proficient in firearms use should rely on them for protection in bear country.

KEY WORDS Alaska, bear deterrence, bear–human interactions, black bears, brown bears, firearms, grizzly bears, polar bears, *Ursus americanus*, *Ursus arctos*, *Ursus maritimus*.

People who work and recreate in North American bear habitat often fear bear encounters. Although the vast majority of bear–human interactions are benign, some yield a variety of adverse outcomes including destruction of property, injuries, and fatalities to both bears and humans (Herrero 2002). Bear attacks are of great interest to the media and can result in negative consequences for bear conservation (Craighead and Craighead 1971, Miller and Chihuly 1987, Loe and Roskaft 2004). In 1967, for example, 2 human fatalities in Glacier National Park led some to call for the elimination of grizzly bears from America's national parks (Moment 1968, 1969). Ultimately, bears were seen as an integral part of ecosystems and remained (Herrero 1970, Craighead and Craighead 1971), but ongoing bear–human interactions and attendant consequences persist.

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Until the advent of bear spray in the 1980s, firearms were the primary deterrent for safety in bear country (Smith et al. 2008). Even now, private, state, and federal agencies in North America often require employees to carry firearms while working in bear country. Although bear safety manuals acknowledge the value of firearms, they also caution that users must be proficient under duress (Shelton 1994, Smith 2004, Gookin and Reed 2009). Furthermore, data regarding firearm performance in aggressive bear encounters are lacking. In fact, we could find little published information quantitatively addressing the effectiveness of firearms as bear deterrents.

Herrero (2002) noted that firearms have their place in protecting people from aggressive bears, but did not present data regarding firearm use or efficacy. Similarly, Bromley et al. (1992) discussed many aspects of firearm use as bear deterrents, but provided no supporting data. The United States Fish and Wildlife Service (2002) stated that people using firearms in bear encounters were injured 50% of the time, but no data or references were provided as support for this figure. Similarly, Meehan and Thilenius (1983) presented data regarding bullet performance at short range with reference to bear attacks, but did not present ballistics information from actual bear encounters.

Hence, a study of bear–human conflicts involving firearms has not been conducted. Moreover, firearm efficacy in resolving bear–human conflict has not been quantified and remains speculative. Our specific objectives for this paper were to 1) review and summarize Alaskan bear–firearm incidents and 2) identify factors associated with successful use of firearms in bear–human conflicts in order to promote both human safety in bear country and bear conservation.

STUDY AREA

Alaska is located in the northwestern portion of North America and occupies an area of 1,530,699 km^2. The human population in Alaska was estimated to be 698,473 in 2009. The brown or grizzly bear (*Ursus arctos*) ranges throughout the state with the most recent estimate at 31,700 (Miller 1993). Black bears (*Ursus americanus*) are found in most forested areas of Alaska. Formal population estimates do not exist for black bears, but an Alaska Department of Fish and Game (ADFG) biologist roughly estimated them to number more than 50,000 (Harper 2007). Polar bears (*Ursus maritimus*) are marine mammals that rarely venture onto land (Amstrup 2003). In Alaska, polar bears from both the Chukchi and Southern Beaufort Seas subpopulations occasionally range up to 80 km inland, primarily for maternal denning. Recent estimates put their numbers at about 3,800 (Amstrup 2003).

METHODS

Compilation and Summary

We compiled information on bear attacks from readily accessible state and federal records, newspaper accounts, books, and anecdotal information that spanned the years 1883–2009. We defined an incident as a single bear–firearm event that involved 1 or more people and 1 or more firearms. For each incident we recorded the following variables to the extent data were available: date, time, month, year, location of incident, number of people, sex of people, activity at time of interaction, whether or not people were making noise prior to the encounter, probable cause of encounter, distance to bear at time of encounter, bear species and cohort (age–sex class), whether or not the bear charged, minimum distance to the bear, presence of fish and/or game meat, type of firearms used, number of shots fired, warning shots, firearm efficacy, firearm ratio (number of firearms/number of people), distance to bear when shot, visibility of habitat (subjectively rated poor, fair, good based on terrain and vegetation), reasons for firearm ineffectiveness, extent of human injuries, and extent of bear injuries. To overcome problems associated with missing or unclear information, we limited the contributions of each record to what we deemed were the most trustworthy pieces of information. The review process was subjective, but we feel confident that we limited our inferences to a minimum while gleaning useful information for analysis.

For each of these incidents, we also used the following categories to characterize probable causes for bear–human encounters: surprised (people startled the bear), curiosity (the bear's motivation appears to have been curiosity), provoked (e.g., a photographer crowding it or a hunter pursuing it), predatory (the bear treated the human as potential prey), and carcass defense (the bear defending a food source). We also subjectively evaluated injuries as follows: slight injuries included nips, limited biting, and scratches where hospitalization was not required; moderate injuries required hospitalization to some degree, and included punctures, bite wounds and broken bones; and severe injuries resulted in extended hospitalization and often permanent disability.

We defined a charge as an agonistic behavior typified by a sudden rush, or lunge, toward the perceived threat. Some charges terminated prior to contact (i.e., bluff charges) whereas others resulted in contact. For distance to bears, we regrouped values into broad categories (i.e., $<$10 m, 10–25 m, 26–50 m, and $>$51 m) based on specificity in the accounts. We used reported distances for greater accuracy (e.g., distance to bear when shot) whenever possible.

We deemed use of a firearm successful (response coded as 1) when it stopped the offensive behavior of the bear. These successes included incidents where bears no longer pursued a person, broke off an attack, abandoned attempts to acquire food or garbage, were killed, or turned and left the area as a result of firearm use. Conversely, firearm failures (response coded as 0) occurred when the bear continued its pursuit, persisted in attempts to acquire food or garbage, or showed no change in behavior after firearm use. We excluded incidents from our analysis where firearms were available but no attempt to use them was made.

Statistical Analysis

We used the *G*-test of independence (Dytham 2003) when we had 2 nominal variables, each with 2 or more possible values, and we wanted to compare frequencies of one to the other. We also tested the equality of sample means with a 2-sample *t*-test. We used the *Z*-test to compare the proportions from 2 independent groups to determine if they were different. We set significance at $P < 0.05$.

To understand the relationship between variables and incident outcomes, we used logistic regression where the response variable was success (1) or failure (0) of firearms. We identified candidate models representing different hypotheses related to firearm success as a function of bear, human, firearm, and spatio-temporal factors (Table 1). Our analysis followed several steps. First, we evaluated the number of records and odds associated with different categories of our explanatory variables to determine which should be collapsed or combined. Second, we used Akaike's Information Criterion adjusted for small sample sizes (AIC_c) to rank models (Akaike 1973, Burnham and Anderson 2002) for each variable type (i.e., bear, firearm, human, spatio-temporal). We then used the top model and competing models ($\Delta AIC_c < 2.0$) within each type in the third stage of analysis similar to Doherty et al. (2008). Here we combined variables and ranked models based on smallest AIC_c to

Table 1. Description of variables used in models of firearm success in bear incidents in Alaska, USA during 1883–2009.

Variable	Category	Description
Species	Bear	Species of bear involved in event (black, brown, polar)
Cohort	Bear	Cohort of bear involved in event (unknown, pairs, female with young, female, and male)
Charge	Bear	Bear charged (yes, no, unknown)
Group size	Human	Group size (count of people present)
Activity	Human	Activity code of humans (active, intermediate, sedentary, unknown)
Fish/game	Human	Presence of fish or game (no, game, fish, unknown)
Noise	Human	Noise associated with activity (no, yes, unknown)
Firearm type	Firearm	Firearm type (handgun, long gun, both, unknown)
No. of shots	Firearm	Number of shots fired
Warning shots	Firearm	Number of warning shots fired
Firearm ratio	Firearm	Number of guns divided by number of individuals in group
Distance	Spatio-temporal	Distance from bear when firearm discharged (<10 m, 10–20 m, 21–30 m, 31–40 m, >40 m)
Visibility	Spatio-temporal	Visibility at site (poor, good, unknown)
Season	Spatio-temporal	Season of incident (spring, summer, fall, winter, unknown)

identify a best approximating model. We then evaluated these models and their associated variables to identify any uninformative parameters that did not improve AIC_c and discarded them (Arnold 2009).

Because the best approximating model had high AIC_c weight ($w_i = 0.96$), we used it to evaluate the direction and strength (odds ratios) of associations between explanatory variables and firearm efficacy. To test for lack of model fit, we calculated Hosmer and Lemeshow's (2000) goodness of fit statistic. We also used the top model in a 5-fold cross validation exercise where we withheld 1/5th of the data and estimated model coefficients. We then used the estimated coefficients to predict incident outcomes for the withheld data. We calculated the proportion of outcomes accurately predicted (estimated probability of success >0.50 for successful outcomes and ≤ 0.50 for unsuccessful outcomes) for the withheld data and repeated this process until we obtained a prediction and accuracy for each observation.

RESULTS

A total of 444 people were involved in 269 incidents. At least 357 bears, including dependent offspring, were involved in 269 incidents, including 300 brown bears (84%), 36 black bears (10%), 6 polar bears (2%), and 15 of unknown species (4%). Bear-inflicted injuries occurred in 151 of 269 (56%) incidents (see Supplemental Information available online at www.onlinelibrary.wiley.com for additional details regarding characteristics of bear incidents).

Success rates by firearm type were similar with 84% of handgun users (31 of 37) and 76% of long gun users (134 of 176) successfully defending themselves from aggressive bears ($Z = 1.0664$, $P = 0.2862$). When we compared outcomes for people who used their firearm in an aggressive bear encounter ($n = 229$) to those who had firearms but did not use them ($n = 40$), we found no difference in the outcome ($G_2 = 0.691$, $P = 0.708$), whether the outcome was no injury, injury, or fatality. However, we found a difference in the outcome for bears with regard to firearm use: 172 bears died when people used their firearms, whereas no bears were killed when firearms were not used.

Firearms failed to protect people for a variety of reasons including lack of time to respond to the bear (27%), did not use the firearm (21%), mechanical issues (i.e., jamming; 14%), the proximity to bear was too close for deployment (9%), the shooter missed the bear (9%), the gun was emptied and could not be reloaded (8%), the safety mechanism was engaged and the person was unable to unlock it in time to use the gun (8%), people tripped and fell while trying to shoot the bear (3%), and the firearm's discharge reportedly triggered the bear to charge that ended further use of the gun (1%).

With respect to efforts to model firearm efficacy, we classified 156 incidents as successful. Our initial evaluation of the number of incidents assigned to each category and associated odds (Appendix 1) suggested (95% CI on odds ratio included 1) collapsing the species category to black bears and other (brown, polar, and unknown bears). This same evaluation suggested our initial breakdown of cohorts and seasons could be collapsed to female and other (pairs, males, unknown). Similarly, we combined seasons into 2 categories for summer and other (spring, fall, winter, unknown).

The best model for firearm success relative to bear variables included species, cohort, and whether the bear charged (Table 2). For firearm variables, 2 models received enough support ($\Delta AIC_c < 2.0$) to be advanced to the third stage of analysis. These models included firearm ratio, number of warning shots, and success of warning shots. We found little support for models that included firearm type (Table 2). Analysis of human and spatio-temporal variables indicated activity, distance, group size, noise, presence of fish or game, season, and visibility influenced firearm success (Table 2).

After combining variables across categories, a model including species, cohort, whether the bear charged, group size, human activity, noise, and presence of fish or game had the greatest AIC_c weight. Because separate removal of group size and noise improved (reduced) the AIC_c values compared to removal of other variables, we considered them uninformative and eliminated them from the top model. These same 2 variables also had 85% confidence intervals that spanned zero—further suggesting they were uninformative (Arnold 2009). The resulting top model accounted for 96% of the AIC_c weight and was more than 6 ΔAIC_c better than the next competing models (Table 3). Hosemer–Lemeshow's good-

Table 2. Ranking of supported models ($\Delta AIC_c < 10.0$) describing firearm success as a function of bear (species, cohort, charge), firearm (firearm type, no. shots, warning shots, firearm ratio), human (group size, activity, fish/game, noise), and spatio-temporal (distance, visibility, and season) influences in Alaska, USA during 1883–2009.

Model structure	AIC_c [a]	ΔAIC_c [b]	w_i [c]	K[d]	Deviance
Bear					
Success ~ Species + Cohort + Charge	296.30	0.0	0.97	5	286.05
Success ~ Species + Cohort	303.82	7.5	0.02	3	297.72
Success ~ Species + Charge	305.51	9.2	0.01	4	297.35
Firearm					
Success ~ No. shots + Firearm ratio + Warning shot	321.31	0.0	0.40	7	306.85
Success ~ No. shots + Firearm ratio	322.34	1.0	0.24	4	314.18
Success ~ Firearm type + No. shots + Firearm ratio + Warning shot	324.23	2.9	0.09	10	303.31
Success ~ No. shots + Warning shot	324.45	3.1	0.08	5	314.20
Success ~ Firearm ratio + Warning shot	325.80	4.5	0.04	6	313.45
Success ~ Firearm type + No. shots + Firearm ratio	325.98	4.7	0.04	7	311.52
Success ~ No. shots	326.28	5.0	0.03	2	322.23
Success ~ Firearm type + No. shots + Warning shot	327.12	5.8	0.02	8	310.52
Success ~ Firearm ratio	327.22	5.9	0.02	3	321.11
Success ~ Warning shot	328.83	7.5	0.01	4	320.67
Success ~ Firearm type + Firearm ratio + Warning shot	328.93	7.6	0.01	9	310.18
Success ~ Firearm type + No. shots	329.78	8.5	0.01	5	319.53
Success ~ Firearm type + Firearm ratio	331.32	10.0	0.00	6	318.97
Human					
Success ~ Group size + Activity + Fish/Game + Noise	305.27	0.0	0.59	10	284.35
Success ~ Group size + Fish/Game + Noise	307.91	2.6	0.16	7	293.45
Success ~ Activity + Fish/Game + Noise	308.16	2.9	0.14	9	289.41
Success ~ Group size + Activity + Fish/Game	310.27	5.0	0.05	8	293.67
Success ~ Fish/Game + Noise	311.11	5.8	0.03	6	298.76
Success ~ Group size + Activity + Noise	313.03	7.8	0.01	7	298.57
Success ~ Activity + Noise	314.12	8.8	0.01	6	301.77
Spatio-temporal					
Success ~ Distance + Visibility + Season	300.26	0.0	0.74	7	285.79
Success ~ Distance + Season	302.36	2.1	0.26	6	290.01

[a] Akaike's Information Criterion adjusted for small sample sizes.
[b] Change in AIC_c from top model.
[c] Model weight.
[d] Number of estimable parameters.

ness of fit statistics ($P = 0.26$) provided no evidence of lack of fit. Similarly, 5-fold cross validation using the top model produced an accurate prediction of incident outcomes on withheld data for 71.9% of incidents—further suggesting adequate fit.

When the animal involved in the incident was a black bear, odds of firearm success were more than 38 times greater than when the bear was a brown, polar, or unknown bear (Table 4). Similarly, females without young were associated with a nearly 7-fold increase in odds of firearm success (Table 4). Conversely, odds of firearm success were negatively associated with human activity level and charging behavior by involved bears. Odds of firearm success were 12 and 24 times greater for intermediate and sedentary activity levels, respectively, compared to people considered active (Table 4). Once a bear charged, odds of firearm success decreased nearly 7-fold (Table 4). Interestingly, the presence of fish or game meat was associated with increases of 4 and 8, respectively, in odds of firearm success.

DISCUSSION

Brown bears were disproportionately involved (81%) in these encounters, a finding that is consistent with the widely held perception that brown bears are considerably more aggressive and hence, more likely to be involved in bear–human conflict leading to injury, than the other 2 species (Herrero and

Table 3. Ranking of supported models ($\Delta AIC_c < 10.0$) describing firearm success as a function of bear, firearm, human, and spatio-temporal influences in Alaska, USA during 1883–2009.

Model structure	AIC_c [a]	ΔAIC_c [b]	w_i [c]	K[d]	Deviance
Success[e] ~ Species + Cohort + Charge + Activity + Fish/Game	276.11	0.0	0.96	11	253.00
Success ~ Species + Cohort + Charge + Distance + Visibility + Season	282.93	6.8	0.03	11	259.82
Success ~ Group size + Activity + Fish/Game + Noise + Distance + Visibility + Season	285.28	9.2	0.01	16	250.94

[a] Akaike's Information Criterion adjusted for small sample sizes.
[b] Change in AIC_c from top model.
[c] Model weight.
[d] Number of estimable parameters.
[e] Reduced model after removal of group size and noise which were uninformative.

Table 4. Logistic regression coefficients, standard errors (SE), odds ratios, and 95% confidence intervals from the highest ranked model (Akaike's Information Criterion adjusted for small sample sizes (AIC_c) weight = 0.96) of firearm success as a function of bear, firearm, human, and spatio-temporal influences in Alaska, USA during 1883–2009.

Coefficient	Estimate	SE	Odds ratio	Lower 95% CI	Upper 95% CI
Intercept	−0.984	1.017			
Black bear	3.652	1.180	38.56	5.92	855.38
Female	1.916	0.718	6.79	1.93	34.80
Charge	−1.921	0.783	0.15	0.02	0.58
Charge unknown	−3.283	0.980	0.04	0.00	0.22
Intermediate activity	2.485	0.912	12.01	2.40	97.04
Sedentary activity	3.180	0.983	24.04	4.11	216.71
Unknown activity	2.141	1.140	8.51	1.01	97.67
Game	1.427	0.482	4.17	1.67	11.21
Fish	2.109	0.690	8.24	2.40	38.86
Unknown	0.662	0.366	1.94	0.95	4.02

Higgins 1999, 2003; Herrero 2002). Female bears with dependent young comprised the second-most common cohort involved in firearm incidents. Surprise encounter was the reason most often given for conflict with this cohort. Brown bear family groups suddenly confronted by people were commonly aggressive-defensive, as they protected their cubs from a perceived threat. Too few incidents involving black and polar bear family groups ($n = 4$ and 1, respectively) occurred to support meaningful conclusions, but Herrero (2002) reported that black bears rarely attack people in response to sudden encounters. Single bears comprised the most common cohort involved in firearms incidents, a reflection of the relative frequency of that cohort in North American bear populations (Jonkel and Cowan 1971, Schwartz et al. 2003) and the fact that single bears are the most hunted cohort.

Although firearms were successful (84% handgun; 76% long gun) in deterring aggressive bears in the records we studied, we do not claim that these rates represent the outcome for all bear–firearm incidents throughout Alaska. When we initiated this study in the late 1990s, we had access to the Alaska Department of Fish and Game's defense of life or property (DLP) records. However, privacy laws restricted our access to records from 2001 to present. This incomplete record potentially affects 3 findings: the number and type of human injuries, the number and type of bear injuries, and firearm success rates. First, because bear-inflicted injuries are closely covered by the media, we likely did not miss many records where people were injured. Therefore, even if more incidents had been made available through the Alaska DLP database, we anticipate that these would have contributed few, if any, additional human injuries. Second, including more DLP records would have increased the number of bears killed by firearms. Finally, additional records would have likely improved firearm success rates from those reported here, but to what extent is unknown.

Our modeling results indicated that models with firearm variables had very limited support (Tables 1 and 3). The type of firearm, number of shots taken, whether or not the people fired warning shots, and how many firearms were present in the group had minimal influence on the outcome. Success was best predicted by a model that included species and cohort of bear, whether or not the bear charged, human activity level, and if fish or game meat were available. These findings coupled with odds ratios from univariate analyses (Appendix 1) affirm some of the conventional advice for avoiding bear encounters: hike in a group, avoid areas of poor visibility, be more cautious when in brown bear country, and make noise to avoid startling females with dependent young (Herrero 2002, Smith 2004).

Although bear spray, pyrotechnics, noise makers, and other deterrents may alter a bear's behavior, only a firearm provides a lethal force option. However, interviews revealed that some people were hesitant to use lethal force for fear of shooting the person being attacked, or because they did not want to have to skin the bear and pack out its hide, skull, and claws as required by law. Additionally, some people admitted that they were reluctant to shoot a protected species. In some cases, this reluctance proved detrimental when split second decisions were required for the person to defend themselves from an aggressive, attacking bear. The decision regarding which deterrent to use is a personal one, but the consequences of attempting to use lethal force should be carefully weighed.

Firearm type received very little support, suggesting that efficacy of the firearm was unrelated to whether people used a handgun or long gun. Considering the high intensity, rapidly unfolding, close-quartered, and chaotic nature of bear attacks, these results are not surprising. Hence, we cannot recommend one class of weapon over the other. We did not have data regarding the level of expertise associated with those who carried firearms. Regardless, a person's skill level plays an influential role in determining the outcome in bear–firearm incidents.

MANAGEMENT IMPLICATIONS

Firearms should not be a substitute for avoiding unwanted encounters in bear habitat. Although the shooter may be able to kill an aggressive bear, injuries to the shooter and others also sometimes occur. The need for split-second deployment and deadly accuracy make using firearms difficult, even for experts. Consequently, we advise people to carefully consider their ability to be accurate under duress before carrying a firearm for protection from bears. No one should enter bear country without a deterrent and these results show that firearms are not a clear choice. We encourage all persons, with or without a firearm, to consider carrying a non-lethal deterrent such as bear spray because its success rate under a variety of situations has been greater (i.e., 90% successful for all 3 North American species of bear; Smith et al. 2008) than those we observed for firearms.

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Appendix 1. Univariate analysis showing log-likelihood, odds, and associated 95% confidence intervals for firearm success in relation to bear, firearm, human, and spatio-temporal influences in Alaska, USA 1883–2009.

Category	Variable	Log-likelihood	Df	Odds	Lower 95% CI	Upper 95% CI
Bear	Species (polar)	−152.05	4	2.00	0.39	14.43
	Black			13.50	1.07	334.95
	Brown			0.65	0.09	3.40
	Unknown			2.75	0.26	30.43
	Cohort (single)	−157.26	5	1.19	0.79	1.80
	Female w/young			1.12	0.59	2.15
	Female			7.00	2.25	30.86
	Male			1.81	0.92	3.63
	Pair			1.68	0.31	12.56
	Charge (none)	−156.77	3	7.33	2.54	30.98
	Yes			0.23	0.05	0.69
	Unknown			0.07	0.01	0.28
Firearm	Type (handgun)	−163.40	4	2.44	1.16	5.60
	Long gun			0.64	0.27	1.44
	Both			0.27	0.03	1.91
	Unknown			0.76	0.27	2.05
	No. shots	−161.12	2	1.20	1.04	1.38
	Warning shot (none)	−160.33	4	1.63	1.22	2.19
	Success			2.05	0.60	9.37
	Unsuccessful			1.60	0.75	3.66
	Unknown			0.23	0.05	0.82
	Firearm ratio (1/group)	−160.56	4	6.33	2.16	26.96
	1/Person			0.22	0.05	0.67
	Unknown			0.31	0.07	1.03
Human	Group Size	−160.99	2	1.68	1.14	2.53
	Activity (active)	−157.41	4	0.30	0.07	0.98
	Intermediate			5.71	1.68	26.13
	Sedentary			11.33	2.86	58.44
	Unknown			2.86	0.55	17.52
	Fish/game (none)	−157.50	4	1.18	0.79	1.76
	Game			2.74	1.21	6.68
	Fish			5.94	1.89	26.32
	Unknown			1.25	0.70	2.24
	Noise (none)	−155.83	3	1.25	0.87	1.81
	Yes			4.16	1.99	9.40
	Unknown			1.01	0.55	1.83
Spatio-temporal	Distance (<10 m)	−151.90	5	1.20	0.81	1.78
	11–25 m			2.45	1.23	5.08
	26–50 m			1.91	0.93	4.10
	>51 m			13.38	2.58	246.08
	Unknown			0.44	0.17	1.07
	Visibility (poor)	−163.69	3	1.59	1.12	2.29
	Good			0.78	0.37	1.68
	Unknown			1.30	0.73	2.33
	Season (spring)	−154.04	5	1.17	0.54	2.57
	Summer			3.48	1.35	9.06
	Fall			1.25	0.51	3.01
	Winter			0.86	0.31	2.33
	Unknown			0.38	0.08	1.49