Capabilities of Hunters to Shoot and Retrieve Free-swimming Alligators

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Abstract: Wildlife agency personnel monitored 70 hunters using centerfire weapons and shotguns to take free-swimming American alligators (*Alligator mississippiensis*) at a managed freshwater marsh in southeast Texas. One or more shots were fired by 64 hunters at 117 alligators of which 43 alligators were killed and retrieved; a minimum of 17 were visibly hit but not retrieved. There was no association between the outcome of a specific shooting event and the method of hunting, size of the alligator, or distance at which shots were initiated. There was an association between outcome of an event and the type of weapon used; shotguns resulted in more hits without retrieval. Despite better performance than shotguns, centerfire weapons caused a minimum 22% nonretrieval rate. These data, combined with past Texas alligator hunter surveys concerning likelihood of firearm use, indicated that a harvest involving firearms and other currently legal methods could result in 6% to 12% increased mortality due to unretrieved loss beyond annual harvest.

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The annual alligator harvest quota in Texas is established within a sustained-yield harvest strategy (Thompson et al. 1984). Quota calculations are derived primarily from night count survey data using procedures described by Chabreck (1966) and from the estimation of nesting populations described by Taylor (1980). While these procedures continue to evolve (Taylor and Neal 1984), the general premise of the quota system is that harvest mortality will be within the sustainable loss limits of the size classes subject to harvest. Hunting methods that result in unretrieved loss of alligators can compromise the quota system unless losses can be estimated and the quotas revised.

As expansion of alligator harvest occurs, it is expected that alligator hunting

will involve a larger number of people with interests in a variety of hunting methods, including use of firearms to take free-swimming (freeranging) alligators. While use of firearms to take alligators would benefit recreational hunters, that method could increase unretrieved loss. There were no data to predict estimated loss if use of firearms was authorized, and views in Louisiana and Florida were divergent regarding potential loss (T. Hines, pers. commun., T. Joanen, pers. commun.). Unretrieved loss is important in Texas where the annual quota is small (925 in 1985) and any loss would be large in proportion to harvest.

This study was conducted to measure the effectiveness of hunters to shoot and retrieve free-swimming alligators, to record causes of non-retrieval, and to estimate potential non-retrieval loss if shooting of free-swimming alligators were authorized for the general harvest in Texas.

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Methods

The study was conducted on the J. D. Murphree Wildlife Management Area (JDMWMA) located southwest of Port Arthur, Jefferson County, Texas. The area included 5,100 ha of fresh to intermediate coastal marsh of which 3,440 ha was managed as freshwater marsh within 12 leveed compartments. Marsh vegetation within these compartments was predominated by marshhay cordgrass (*Spartina patens*), with scattered California bulrush (*Scirpus californicus*), cattail (*Typha latifolia*), and reed (*Phragmites australis*). Scattered perennial lakes supported stands of white water lily (*Nymphea odorata*), American lotus (*Nelumbo lutea*), najas (*Najas guadalupensis*), and other submergents. Borrow ditches on the inside of the levees provided access around the interior of compartments. Ditches were 1.2 to 1.8 m deep and supported heavy growth of alligator weed (*Alternanthera philoxeroides*) and pennywort (*Hydrocotyl* sp.).

Hunters were selected through a computer-based random hunter selection process from a pool of 374 applicants responding to the hunt announcement. Ninety-seven successful applicants were drawn, of which 73 applicants paid fees, and ultimately 70 participated in the hunt conducted 6–18 September 1985.

Hunters were allowed to hunt singly or in a party of 2 depending on their preference as shown by the hunt application. Hunters were required to provide all equipment including a boat suitable to transport them and a Parks and Wildlife Department (PWD) observer. Any shotgun or centerfire rifle fired from the shoulder was allowed to represent a broad array of weapons and to evaluate types of weapons and ammunition that hunters judged effective prior to the hunt. Handguns were prohibited.

Each hunting party was assigned to a specific hunting compartment for hunt

sessions from 1400 to 2000 hours one afternoon and 0630–1200 the following morning. A PWD biologist or technician accompanied each party during all hunting activity, and details on hunters activities, firearm use, and retrieval attempts were recorded. The PWD monitor ensured that hunting parties located the assigned hunting compartment but provided no assistance or advice during the hunt except when safety of the hunters or monitor appeared to be in jeopardy. Hunters were allowed to hunt from boats and walk or stand in the marsh or on the inside edge of levees surrounding their hunt compartment. Hunters were allowed multiple opportunities to take alligators depending on the outcome of each attempt, but the bag limit was 1 alligator comprised of the first alligator successfully retrieved. The PWD monitor for each hunting party was the sole judge of when to terminate hunting activities if hunters displayed extremely deficient capabilities during several attempts to take alligators. Alligators taken were examined by PWD personnel prior to removal from the area.

PWD monitors received an orientation to the hunting areas and study design prior to data collection. Hunters completed the required alligator hunter orientation immediately prior to their initial hunt session. Hunters were checked in and out at the beginning and end of each hunt session. Each hunting compartment was examined from a fixed-wing aircraft 3 times during the hunt to detect alligators that may have died from hunt-related injuries. Alligators thus detected were examined on the ground to assess whether cause of death was attributable to the hunt.

Data summary and statistical analyses were performed using the Statistical Analysis System (SAS Institute 1982). Data were summarized by prior experience of the hunter, weapon category, hunting events, and retrieval success. Retrieval rates were calculated based on total hunters involved, total alligators visibly hit, and total events. An event was defined as 1 or more shots fired at an individual alligator and subsequent retrieval effort, if any. Retrieval rates categorized by weapon type, size of alligator, distance of shots, and hunt methods were analyzed by Chi-square goodness of fit tests to detect variables associated with event success or lack thereof. A probability level of $P \leq 0.05$ was used to indicate association between variables.

Potential loss associated with broader firearm use was estimated from characteristics of alligator hunter licensees and the proportion of hunters expressing interest in using firearms during a survey of alligator hunters following the 1984 harvest season (Johnson et al. 1985).

Results

Most (98.6%, $N = 70$) hunters were male (1 female). Fifty (71.4%) of the hunters were 20 to 39 years old, 27.1% were 40 or older; and 1.5% were <20 years old. Six of the hunters (8.6%) had previous alligator hunting experience and 98.6% had ≥5 years previous experience hunting a variety of other species.

Sixty-four hunters shot 1 or more times at 117 alligators; 6 took no shots (no events). Forty-three hunters (67.2%) killed and retrieved 1 alligator each. Alligators

involved in 37 of 117 events (31.6%) were missed by all shots. Seventeen alligators were visible hit but not retrieved. Twenty alligators possibly were hit, but observers were uncertain; none were retrieved. One alligator was found dead during the aircraft survey and was determined to have died from hunt-related injuries.

The 51:49 sex ratio (22 males, 21 female) of alligators taken was similar to the 45:55 ratio for 60 alligators taken by hook and line on the same area in 1984. However, the sex ratio observed during the firearm harvest was different from the 89:11 sex ratio for 53 alligators taken by experienced hunters with hook and line sets on JDMWMA in 1985 following this study.

There was no apparent association between outcome of all events and the hunt method, the distance at which shots were initiated, or the length of alligator involved (Table 1). Also, there was no association between the weapon used and the length of the alligator involved (Table 2).

There was an association between outcome of an event and the type of weapon used (Table 1). Events initiated with a shotgun were less successful than were events initiated with centerfire weapons (Table 1). The distance at which shots were initi-

Table 1. Characteristics of weapon, distance of shot, hunt method, and size of alligator relative to degree of success in taking alligators with firearms during a controlled study on the J. D. Murphree Wildlife Management Area, Texas, 1985.

	Events (%)		
	Unsuccessful	Successful	Overall
Sample size within event category	74	43	117
Firearm/ammo, initial shot[a,b]			
centerfire <0.30 cal.	10.8	34.9	19.7
centerfire 0.30 cal.	63.5	53.5	59.8
centerfire >0.30 cal.	5.4	9.3	6.8
shotgun with slug	2.7	0	1.7
shotgun with pellets	17.6	2.3	12.0
all centerfire	79.7	97.7	86.3
all shotgun	20.3	2.3	13.7
Distance at initial shot (m)[c]			
<5	1.4	7.0	3.4
5–20	58.1	46.5	53.8
21–50	39.2	39.5	39.3
>50	1.4	7.0	3.4
Hunt method[d]			
boat (manual or motor)	78.4	65.1	73.5
sit and wait	12.2	14.0	12.8
walk	9.5	20.9	13.6
Alligator length (cm)[e]			
<180	8.1	14.0	10.3
180–240	29.7	32.6	30.8
241–300	37.8	39.5	38.5
>300	24.3	14.0	20.5

[a]For the 5 weapons categories; $\chi^2 = 15.52$, $P = 0.004$, df = 4.
[b]For centerfire versus shotgun; $\chi^2 = 7.42$, $P = 0.007$, df = 1.
[c]$\chi^2 = 5.72$, $P = 0.13$, df = 3.
[d]$\chi^2 = 3.89$, $P = 0.14$, df = 2.
[e]$\chi^2 = 2.42$, $P = 0.49$, df = 3.

Table 2. Distance of initial shot and length of alligator involved compared to type of weapon used to attempt taking alligators during a controlled study on the J. D. Murphree Wildlife Management Area, Texas, 1985.

	Centerfire (%) (N = 101)	Shotgun (%) (N = 16)
Distance of initial shot (m)[a]		
<5	4.0	0
5–20	50.5	75.0
21–50	41.6	25.0
>50	4.0	0
Alligator length (cm)[b]		
<180	10.9	6.3
180–240	30.7	31.3
241–300	38.6	37.5
>300	19.8	25.0

[a]$\chi^2 = 3.77$, $P = 0.29$, df = 3.
[b]$\chi^2 = 0.48$, $P = 0.92$, df = 3.

Table 3. Potential injury and nonretrieval rates of alligators for centerfire weapons versus shotguns during firearm hunt evaluation on the J. D. Murphree Wildlife Management Area, Texas, 1985.

	Centerfire		Shotgun		Overall	
	N	%	N	%	N	%
No. hit and retrieved	42	–	1	–	43	–
Minimum no. hit but not retrieved	12	–	5	–	17	–
Minimum no. hit but not retrieved/ no. definitely hit[a]	54	22.2	6	83.3	60	28.3
Minimum no. hit but not retrieved/ total events[b]	101	11.9	16	31.3	117	14.5
Maximum no. possibly hit but not retrieved[c]	27	–	10	–	37	–
Maximum no. possibly hit but not retrieved/total no. definitely and possibly hit	69	39.1	11	90.9	80	46.3
Maximum no. possibly hit but not retrieved/total events	101	26.7	16	62.5	117	31.6

[a]Definitely hit represents alligators killed and retrieved plus those observed shot at least once but not retrieved.
[b]"Event" is defined in Methods.
[c]Represents alligators definitely hit but not retrieved plus alligators for which observers were uncertain if a hit occurred.

ated with shotguns was similar to distance categories for initial shots with centerfire weapons (Table 2). However, the overall effectiveness and effective range of centerfire weapons were greater as indicated by 42 kills and retrieval of alligators at ranges of 1 to 100 m (47.6% >20 m) compared to only 1 alligator killed during a shotgun event initiated at 10 m. For events involving a definite or possible hit, successful retrieval was less likely ($\chi^2 = 10.23$, $P < 0.002$, df = 1) with shotguns (Table 3).

Shotguns were used in 13.7% of all events and 13.8% of the events involving definite or possible hits but caused 29.4% of the alligators definitely hit but not retrieved (Tables 1, 3). By usual measures of unretrieved loss of hunted animals, shotguns performed worse than centerfire weapons for taking alligators (Table 3). Despite better performance than shotguns, centerfire weapons had an estimated 22.2 to 39.1% non-retrieval rate (Table 3). If firearms were the only method used for hunting alligators, these data indicate that the annual harvest-related mortality could be 28.3 to 46.3% more than the harvest quota (Table 3).

Discussion

The highly controlled nature of the hunts potentially influenced the outcome; the relatively short hunt period may have restricted opportunities to take, and the observer presence may have affected retrieval success by inhibiting or accentuating behaviors of hunters. However, these data would have been difficult or impossible to collect effectively in any other manner.

Attempts to define actual and potential loss of alligators were complicated by uncertainty about the outcome of some shots. This problem is common among studies of hunt-related losses in a variety of animals, whether using very controlled conditions or hunter reported data. Partitioning of potential loss factors was done in our analysis in accordance with McCaffrey (1985).

Another restriction of the study was that all hunting occurred within marsh compartments of JDMWMA which were shallow, having maximum depths of 2 m occurring only in ditches. Although JDMWMA offered a broad representation of conditions under which alligators are hunted, deeper water habitats in lakes, sloughs, and bayous elsewhere in Texas also were hunted. Allowance for use of firearms to take alligators in those habitats could be expected to cause greater non-retrieval because of the likelihood for escape of wounded alligators in larger areas of deep, open water.

Prior surveys indicated that 87.0% ($N = 106$) of licensed alligator hunters in Texas encountered the opportunity to take alligators with a firearm and at least 30.8% favored allowing firearm use to take free-ranging alligators (Johnson et al. 1985). Therefore, a harvest procedure authorizing firearms to take free-ranging alligators could be expected to result in at least 6.4% to 12.4% increased mortality beyond the retrieved harvest, based on minimum and maximum loss estimates, respectively. Firearm use, if authorized on a broader scale, would likely exceed the 30.8% assumed from past surveys as hunters became tempted with opportunistic shots. Thus, losses to wounding or unretrieved kills could be higher, approaching 28% to 46% in areas where most hunters used firearms. The relative amount of commercial versus recreational alligator hunting likely would influence this rate because of differing experience and equipment.

The potential vulnerability of females to the firearm hunt illustrated an additional consideration for wildlife managers. Alligator harvests traditionally are directed toward males and have tended to be 70% to 80% male (Palmisano et al.

1973, Johnson et al. 1985). Nesting was prevalent on the JDMWMA levee system, and many females that had recently completed nesting remained in the interior ditches which were primary travel lanes for a majority of hunters during the study. This distribution of females coupled with relative inexperience of firearm hunters in 1985 and some hook and line hunters in 1984 on JDMWMA, may have caused the higher percentage of female harvest. The more experienced hook and line crew in 1985, after the firearm hunt, was capable of greater selectivity in taking males. It is uncertain what factors led to the substantial female harvest with firearms on JDMWMA, but it warrants future attention.

Management Implications

Wildlife resource agencies in other states with alligator programs should consider during early development of regulatory and research activities the issue of using firearms to hunt free-ranging alligators. States with relatively restricted but huntable alligator populations and a substantial public interest in recreational hunting should be sensitive to these needs. Firearms should be authorized for taking free-ranging alligators only after careful scrutiny of the likely extent of use, estimation of potential non-retrieval loss, sex ratio objectives, and appropriate quota adjustment. Any provision for use of firearms to take free-ranging alligators should be limited to centerfire weapons; however, a safety hazard may exist with such weapons in many alligator hunting areas where shooting over open water may cause ricochets. Alternative hunting methods that improve retrievability through attachment of lines to the taking devices (i.e., hook and line, harpoon, archery tackle) have proven effective and selective in a variety of harvest situations in Florida, Louisiana, and Texas.

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