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COMPARISON OF PYROTECHNICS VERSUS SHOOTING FOR DISPERSING DOUBLE-CRESTED CORMORANTS FROM THEIR NIGHT ROOSTS

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ABSTRACT: Roost dispersal using pyrotechnics has been an effective program for reducing serious cormorant predation problems at catfish farms in Mississippi. Under a recent cormorant depredation order, catfish farmers are also allowed to shoot cormorants at their farms, but not at roosts. To potentially enhance cormorant roost dispersal programs and obtain data about shooting in roosts, I compared pyrotechnics versus shooting for dispersing cormorants from their night roosts. Five pairs of roosts were sequentially selected based on their similarity in numbers of birds and area occupied. By random selection each roost in the pair was harassed simultaneously using either pyrotechnics (screamer sirens and bird bangers) or shooting to kill with steel shot. Harassment of each roost took place during 1.5 hours before sunset and continued for up to three nights to disperse >90% of the birds from the site. During harassment efforts we recorded the number of pyrotechnics and shotgun shells used as well as the amount of time of actual harassment. We then monitored each roost for up to 10 days to assess how quickly birds returned to these sites. We found no difference ($P>0.05$) between treatments in the amount of time and shells used to disperse cormorants from their night roosts, or in the number of days post-treatment until birds returned to these sites. However, fewer shotgun shells ($\bar{x}=286.6$, SE=46.56) than pyrotechnics ($\bar{x}=429$, SE=81.3) were generally used. Despite deploying only skilled marksmen to shoot cormorants in roosts, relatively small numbers ($\bar{x}=45.4$, SE=11.14) of cormorants, comprising <5% of roosting populations were killed during consecutive nights of harassment. I conclude that shooting is at least equally effective as pyrotechnics for dispersing cormorants from their night roosts and if included under the cormorant depredation order is unlikely to result in a large number of birds killed.

KEY WORDS: catfish depredations, double-crested cormorant, shooting, pyrotechnics, roost dispersal

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INTRODUCTION

Wintering populations of Double-crested Cormorants (*Phalacrocorax auritus*) in the lower Mississippi Valley increased dramatically during the 1970s and 1980s (Alexander 1977-1990). Since 1990, the wintering cormorant population in this region has more than doubled from approximately 30,000 birds to in excess of 60,000 birds (Glahn et al. 2000a). This increase parallels the rapid growth of breeding populations, particularly in the Great Lakes region (Dolbeer 1991; Tyson et al. in press; Weseloh et al. 1995). Since the early 1990s, Breeding Bird Survey data for cormorants in the Mississippi flyway indicate a mean annual increase of 22% (Sauer et al. 1997) and the number of nesting pairs in the Great Lakes Region has more the doubled from 1991 to 1997 (Tyson et al. in press).

The corresponding growth of the catfish industry in the lower Mississippi Valley has also contributed to increased wintering populations (Glahn and Stickley 1995) and possibly has increased the over-winter survival of these birds (Glahn et al. 2000b). The economic impact of these cormorant populations on the catfish industry in Mississippi has been under continuous investigation over the past decade (Glahn and Brugger 1995; Glahn et al. 1995; Glahn et al. 2000a; Stickley et al. 1992). Recent estimates from bioenergetic projections suggest that cormorants remove approximately 48 million catfish fingerlings annually, with a replacement cost of approximately $5 million (Glahn et al. 2000a).

In response to cormorant depredations on the catfish industry in the delta region of Mississippi (Glahn and Brugger 1995; Glahn and Stickley 1995; Reinhold and Sloan in press), U.S. Department of Agriculture, Wildlife Services, in conjunction with catfish farmers, initiated a region-wide cormorant roost dispersal program during the winters of 1993-94 and 1994-95 (Mott et al. 1998). This program involves the simultaneous harassment of all known cormorant roosting sites with pyrotechnics in the evening (Mott et al. 1998). Because of the success of this program in shifting roosting cormorants away from intensely farmed areas (Glahn et al. 2000a; Mott et al. 1998), this program continues as an operational program carried out by catfish farmers in Mississippi and Alabama.

Also in response to increased complaints about cormorant depredations on aquaculture, the U.S. Fish and Wildlife Service (USFWS) issued a depredation order for the Double-crested Cormorant, that allowed aquaculture producers in 13, mostly southern, states to shoot unlimited numbers of cormorants seen causing depredations at their farms (USFWS 1998). This order eliminated the need for farmers to apply for individual depredation permits, a practice widely used to supplement non-lethal harassment techniques (Belant et al. in press; Mastrangelo et al. 1995). In the summary of public comments concerning this order, Wildlife Services and most aquaculturists requested that the depredation order be expanded to allow the lethal take of cormorants in conjunction with roost dispersal activities. Their contention was that shooting would make it easier to disperse birds and increase effectiveness by extending the period of roost abandonment. The USFWS responded that they would consider this request in conjunction with a research study designed to determine if lethal take increased the effectiveness of roost harassment.

Thus, the objective of this study was to address this research need by comparing the use of shooting versus pyrotechnics for dispersing cormorants from their night roosts. Specifically, I examined the effort required to disperse cormorants with these methods and the effectiveness of each method in prolonging roost abandonment.

METHODS

The study was conducted during the winter of 1999 in northwest Mississippi, commonly referred to as the delta region of Mississippi. We located active roost sites for treatment based on biweekly aerial surveys of the region (Glahn et al. 1996). Pairs of active roost sites exceeding 500 birds were selected for study based on similarity in geographical extent, number of birds estimated from aerial counts, and their accessibility for harassment. Roosts in each pair were separated by at least 20 km to assume independence of treatments and randomly assigned to receive either of two treatments, pyrotechnics or shotgun shooting. The pyrotechnic treatment involved approximately equal numbers of screamer-sirens and bird bangers fired from a 15 mm pistol launcher (Reed-Joseph Int., Greenville, MS). The shooting treatment involved the use of 3" magnum BB steel shot shells fired by skilled marksmen from 12 gauge shotguns. These high quality shells were used because they had been previously found to humanely kill cormorants quickly (Glahn et al. 1995). On either the evening or morning before roost harassment was to begin, the number of birds utilizing each roost site was determined by counting cormorant flocks entering or leaving the site during the last 2 hours before sunset or the first 2 hours after sunrise (Glahn et al. 1996).

On the evening following the pretreatment roost censuses, we started simultaneous harassment of the paired sites. Two people entered each roost site by boat and harassed birds from 2.5 hours before sunset until sunset, as needed. Both teams recorded the number of rounds fired, the actual time firing rounds and in the case of shotgun harassment the number of cormorants killed. Harassment continued for up to three nights or until ≥90% of the cormorants were dispersed from the site. To assess the need for further harassment after the first night, harassment teams entered the edge of the roost by boat 2.5 hours before sunset on the following day and counted birds entering the site until 1 hour before sunset, by which time most birds have typically entered the roost (Glahn et al. 1996; Aderman and Hill 1995). If more than 10% of the pretreatment population entered the site based on this count, we continued harassment until sunset on days 2 and 3 of treatment. To assess the period of roost abandonment we conducted ground and aerial counts to monitor the number of cormorants utilizing each roost site for up to 10 days post-treatment or until populations returned to at least 90% of pretreatment levels.

We used a paired $\underline{t}$ test to compare differences in the number of rounds fired, the minutes of actual harassment, days needed to disperse roosts and days to return to 90% of pretreatment levels from 5 pairs of roosts harassed during the study.

RESULTS

Paired roost sites varied somewhat by extent of habitat and numbers of cormorants counted but were comparable in most respects (Table 1). All roosts were successfully dispersed after 1 to 3 nights of harassment with either shotguns or pyrotechnics (Table 2) and there was no difference ($\underline{t}=0.408$, $\underline{P}=0.704$) between treatments in the number days needed to disperse roosts. Actual minutes of harassment was considerably more variable (Table 2), but did not differ ($\underline{t}=0.985$, $\underline{P}=0.380$) between treatments. In general, more rounds of pyrotechnics were fired ($\bar{x}=429$, SE=81.3) than shotgun shells ($\bar{x}=286.6$, SE=46.56), but rounds fired varied among sites (Table 2) and did not differ ($\underline{t}=1.52$, $\underline{P}=0.177$) between treatments. At a cost of approximately $0.35 per round for pyrotechnics and approximately $0.50 per round for good quality shotgun shells, the average cost of supplies for dispersing a roost was almost identical at approximately $150 per roost. Despite the number of shotgun shells fired, relatively small numbers of cormorants were killed, comprising <5% of initial roosting populations (Table 3). However, a few more cormorants were estimated to have been wounded but not killed.

For the most part, cormorants did not return to 90% of pretreatment levels within 10 days after treatment (Table 4), and there was no difference ($\underline{t}=0.469$, $\underline{P}=0.663$) with respect to treatment used. However, with the exception of two sites, >500 cormorants did reoccupy these sites during the monitoring period (Table 4).

DISCUSSION

Consistent with previous studies (Hess 1994; Mott et al. 1992; Mott et al. 1998), cormorants were effectively dispersed after 1 to 3 evenings of harassment with pyrotechnics. However, the average number of pyrotechnics needed to disperse a roost by skilled technicians in our study was less than half the 1,110 devices per roost reported to be used by catfish farmers (Mott et al. 1998). Our study shows that shooting to kill with live ammunition was equally effective as pyrotechnics, but clearly not more effective. Although fewer rounds were fired with shotguns, use of high quality ammunition did not appear to be more cost-effective than pyrotechnics.

Mott et al. (1998) observed dispersed cormorants returning to previously abandoned sites within one week. This is consistent with our finding that most roosts were reoccupied to some extent within 10 days. Considering that further harassment efforts would likely not be executed until reoccupation reached 90% of pretreatment levels, pyrotechnics and shooting were equally effective. Based on studies by Mott et al. (1998), the timing of reoccupation of harassed roosts is probably more a function of roost harassment efforts at other nearby sites than the type of treatment applied.

Although shooting was equally effective as pyrotechnics in dispersing cormorant roosts, it did not appear to make it easier to disperse birds or improve effectiveness of treatment by prolonging abandonment. The notion that shooting is more effective than pyrotechnics in scaring or harassing birds has rarely been

Table 1. Names of paired roost sites, approximate roosting areas and pretreatment aerial counts of double-crested cormorants (DCCO) harassed with either pyrotechnics or shooting from January through March 1999 in the delta region of Mississippi.

Roost Site Name	Roosting Area (ha)	DCCO Counted (aerial count)	Treatment Date[1]	Treatment Type
Bee Lake	40	2,000	1/20/99	Pyrotechnics
Eagle Lake	32	2,000	1/20/99	Shooting
Swan Lake	16	11,000	2/1/99	Pyrotechnics
Mathews Brake	20	11,000	2/1/99	Shooting
Dutch Brake	60	1,600	2/24/99	Pyrotechnics
McIntyre Scatters	80	2,500	2/24/99	Shooting
Ellison Lake[2]	20	5,000	3/8/99	Pyrotechnics
Tchula Brake	30	2,500	3/8/99	Shooting
Ellison Lake[2]	20	2,000	3/25/99	Pyrotechnics
Snake Creek	24	1,000	3/29/99	Shooting

[1]Roost sites with the same initial treatment date were considered paired in this study.
[2]The Ellison Lake roost was used as a study site twice in this study.

Table 2. Name of site, treatment and the number of days, actual minutes of harassment and number of rounds fired to achieve abandonments of the roost site by double-crested cormorants wintering in the delta region of Mississippi during the winter of 1999.

Roost Site Name	Treatment	Days Harassed	Minutes Harassed[1]	Rounds Fired
Bee Lake	Pyros	2	27	350
Eagle Lake	Shooting	2	76	235
Swan Lake	Pyros	3	43	493
Mathews Brake	Shooting	3	176	277
Dutch Brake	Pyros	3	49	500
McIntyre Scatters	Shooting	3	96	403
Ellison Lake[2]	Pyros	2	85	641
Tchula Brake	Shooting	1	9	146
Ellison Lake[2]	Pyros	1	7	161
Snake Creek	Shooting	3	20	372

[1]Actual time that rounds were fired.
[2]The Ellison Lake roost was used as a study site twice in this study.

Table 3. Number of cormorants (DCCO) killed, roosting populations during treatment and percent of roosting population killed during shooting treatments to disperse cormorants in the delta region of Mississippi during the winter of 1999.

Roost Site Name	DCCO Killed	Roosting Populations	Percent Killed
Eagle Lake	42	900	4.60
Mathews Brake	68	12,000	0.06
McIntyre Scatters	74	5,700	1.29
Tchula Brake	22	2,500	0.88
Snake Creek	21	858	2.44

Table 4. Days post-treatment that double-crested cormorants (DCCO) reoccupied dispersed roost sites in the delta region of Mississippi at numbers exceeding 500 birds and 90% pre-treatment levels after harassment with pyrotechnics and shooting during the winter of 1999.

		Days and Levels of DCCO Reoccupation	
Roost Site Name	Treatment	>500 birds	≥90% Pretreatment
Bee Lake	Pyros	2	2
Eagle Lake	Shooting	3	>10
Swan Lake	Pyros	3	>10
Mathews Brake	Shooting	2	8
Dutch Brake	Pyros	5	6
McIntyre Scatters	Shooting	>10	>10
Ellison Lake	Pyros	7	>10
Tchula Brake	Shooting	7	>10
Ellison Lake	Pyros	>10	>10
Snake Creek	Shooting	5	7

tested experimentally. However, Hess (1994) found that repeated shooting at selected catfish farms might be more effective in deterring cormorants when compared to farms with limited harassment or harassment with pyrotechnics only. Although the study may have been confounded by external factors, Hess (1994) also noted that cormorants were more wary on the farms where repeated shooting took place. The increased wariness reported by Hess (1994) has also be noted with waterfowl in hunting areas (Owens 1977). Because of this wariness, Hess (1994) found that catfish farmers were able to kill only 290 cormorants after 3,094 hours of shooting. This is consistent with our killing only a very small percentage of the roosting population, despite deploying only skilled marksmen. However, our shooting was restricted to the daylight hours and more birds could probably be taken after dark. Thus, if the standing depredation order were expanded to include shooting in roosts during daylight hours only, it appears that only a small percent of the wintering population would be killed.

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