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AN EVALUATION OF RECOVERY DATA FROM ARTIFICIALLY SEEDED LEAD SHOT ON CATAHOULA LAKE, LASALLE PARISH, LOUISIANA

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ABSTRACT

Paired plots, seeded with four sizes of lead shot, were established at three locations in an effort to better understand the lead shot problem associated with waterfowl using Catahoula Lake. Half of the plots were treated with a known number of shot in the fall of 1965 and the remainder were similarly treated in the spring of 1966. Soil samples were to be taken in October every two years.

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In 1967 soil samples were taken and the shot collected were separated according to size and counted. Analysis of data from these samples indicated very little difference in the number of shot recovered when location and plots were considered separately. However, an interaction was apparently responsible for the significant difference detected in the number of pellets recovered. This was probably due to the degree of hog rooting found in the outside plots. The size of shot, or the effect of livestock, apparently had no influence on the depth at which shot were recovered. The largest amount of shot was found between the two and six inch depth levels, with the largest portion being found in the two to four inch level. There is some indication that the depth of the hardpan probably determined shot depth more than any other factor during this sampling period.

INTRODUCTION

Catahoula Lake is a major wintering area for waterfowl in the Mississippi Flyway. It plays an important role in the abundance and distribution of waterfowl for Central and Northeast Louisiana. Also, many waterfowl transient to Louisiana use this lake for a brief resting and feeding area before migrating further south.

Hunters have annually deposited heavy doses of lead shot on the lake bed. A recent survey by Wills and Glasgow (1964) has shown that the lake bed contains an average of 6.2 shot per square yard, or 30,000 shot per acre.

Minor outbreaks of lead poisoning in ducks on the lake have been reported by local residents. Serious outbreaks were reported by Kalmbach (1930), Lynch (1951), Yancey (1953), Wills and Glasgow (1964), and Newsom (1966). Murry (1968) reported ducks containing lead shot were collected on the lake. Wycoff (1970) found ducks sick and dying from lead poisoning, but the magnitude of the outbreak was not determined.

The major waterfowl food on the lake is chufa tubers (*Cyperus esculentus*). Lead pellets are dispersed among the tubers causing ducks, especially mallards, to consume many shot while feeding. The limiting factor in managing the lake for maximum utilization of the food supply by waterfowl is the presence of large quantities of lead shot over part of the lake bed. It is generally believed that the lead pellets sink rapidly in the soft soils, but remain available to waterfowl on the firmer soils for some time.

Also, it is not known what influence hog rooting has on the availability of shot to waterfowl. A knowledge of these problems would permit the formation of better waterfowl management plans for the lake.

This study was designed to determine how rapidly lead shot sinks in the different soils of the lake bed and what influence the rooting of hogs has on the availability of lead shot to waterfowl.

DESCRIPTION OF STUDY AREA

Location and Description.

Catahoula Lake is located in Central Louisiana approximately 20 miles northeast of Alexandria in LaSalle and Rapides Parishes. This important wildlife area lies on the western border of the Mississippi River alluvium in the Red River backwater complex and was structurally formed. It is a large, shallow, poorly drained sump area that is subject to drastic seasonal water fluctuations. It is approximately 14 miles long, 3 miles wide, and contains about 20,000 acres of open lake bed. During high water periods the lake contains some 30,000 acres. There is about a three foot difference in elevation from the tree line to the lowest elevation on the lake. The lake is bordered on the north by land that rises abruptly to a height of 20-30 feet above the high water stage, and on the south by low, relatively flat land that is subject to annual overflow.

Little River and numerous small streams flowing from the north and west are the major source of water for Catahoula Lake at the low water stage. During high water periods, drainage is to the east and south through Old River, French Fork of Little River, and several small bayous, while at the low water stage, the only outlet is through French Fork of Little River. The lake receives "overflow" or "backwater" through a complex of systems associated with the Red, Black-Ouachita, and Mississippi Rivers. The water level is dependent on the seasonal stages of these rivers. Inundation begins when the water from these river systems enters the lake via normal drainage channels, as well as over the lowland areas, from a southerly direction.

High water normally prevails from late winter to early summer. Variations in the water cycle occur from year to year, but generally follow a distinct pattern. Inundation begins with a gradual rise of water levels in November and December, increases sharply in January, remains at a high level through June, and recedes in July. The lake is dewatered to pool stage about the first week of August, exposing some 15,000 acres of mud flats. Pool stage consists of approximately 5,000 acres of permanent marsh, with water levels normally ranging in depth from 1 to 12 inches. Soils over much of the lake bed are composed of fine sedimentary materials, being primarily silty loam and silty clay loam. Stranded low sandy ridges are found along natural levees of associated streams and parallel the perimeter of the lake. A clay or hardpan exists at variable depths below the soil surface.

Plants.

Catahoula Lake exhibits a unique water cycle in that it is inundated for only about six to seven months out of the year. The water level fluctuation varies a great deal during this period, and at its peak reaches a depth of 15 to 25 feet. The winter rise and summer drop are normally gradual. Due to the size of the lake, shallowness of the water, and softness of the bottom, wave action maintains a turbid condition. Few plants are adapted to the aforementioned conditions; therefore, the number of plant species associated with the lake is limited. As a result, the lake bed is covered by vast acreages of uniform plant types after it is dewatered.

Plant zonation, which is pronounced, is correlated with the lake bed contour, the length of time of flooding, and the length of the growing period. Although zonation is fairly definite, an intermediate area between zones exists.

Woody plants occur primarily around the perimeter of the lake, with water elm (*Planera aquatica*) and swamp privet (*Forestiera acuminata*) being the major species found. Cypress (*Taxodium distichum*), water locust (*Gleditsia aquatica*), and buttonbush (*Cephalanthus occidentalis*) are scattered throughout this zone. Water elm is slowly encroaching into the lake bed.

The vegetation on the lake bed is made up primarily of herbaceous plants. The first plant zone is located on the outer contour of the lake. This area is higher, the soils are firmer, and it is dewatered first. Chufa is the dominant plant associated with this zone, but some spike-rush (*Eleocharis* sp.), heliotrope (*Heliotropium* sp.), and cocklebur (*Xanthium* sp.) occur. When this zone is dewatered early, the aforementioned broadleaf plants spread and occupy a far greater area than normal. Chufa makes up approximately 85 percent of the vegetation in this zone (Wills, 1970).

The next concentric zone is occupied predominantly by sprangletop (*Leptochloa filiformis*) and teal grass (*Eragrostis repens*); however, some chufa is found here.

Millet *Echinochloa* sp.) occupies the next vegetative zone, but does not exhibit the same degree of concentric zonation. Although it is scattered thinly over much of the lake bed, pure, dense, tall stands occupy the more marshy, seepy areas where some humus is found in the soils. Millet stands occupy "pockets" rather than concentric zones.

The lowest elevation on which plants occur is considered a marsh type. This area has a very soft bottom and water is retained on this portion of the lake. Extensive stands of bull tongue (*Sagittaria* sp.), mud plantain (*Heteranthera limosa*), dwarf spikerush (*Eleocharis parvula*), and scattered water hyssop (*Bacopa rotundifolia*) are associated with this type. Plant density and composition varies from year to year, depending primarily on the water cycle. In years that the lake dewaters early, dense luxuriant stands of these plant species occupy this zone.

Utilization.

Waterfowl. Catahoula Lake had a yearly average of 20,369,000 duck days reported by biologists of the Louisiana Wild Life and Fisheries Commission for a 10 year period, 1960 through 1970 (Waterfowl Inventory, La. Wild Life and Fisheries Comm., 1970). Pintail, mallard, teal, baldpate, and gadwall were the most abundant species found, with ringneck, scaup, canvasback, and wood ducks occurring in lesser numbers. A few geese and coots are present. Species composition and abundance on the lake are influenced by water levels and migrational movements. Waterfowl are most abundant in the fall when water levels range from 6 to 8 inches. At this depth, the major source of food (chufa and millet) is most available to puddle ducks. Vast acreages are disturbed by intense rooting of feral hogs in search of chufa tubers which probably improves feeding conditions for waterfowl.

Hunting. Approximately 1,500 duck blinds were used on Catahoula Lake for an estimated 30,000 hunter efforts during the 1970-71 waterfowl season. In addition, many people hunt the brushy edges without constructing blinds. An estimated 80,000 ducks were harvested on Catahoula Lake during the 1970-71 waterfowl hunting season (La. Wild Life & Fisheries Commission, 1971, Unpublished Report).

Cattle-Hogs. Cattle and hogs graze on the grasses and sedges produced on the lake bed. Cattle usage occurs over a 3 to 4 month period during the latter part of the summer, while hog usage extends over a 4 to 5 month period during the summer and fall (Wills, 1970).

PROCEDURES

Paired plots, each measuring 20 x 38 feet, were established on three soil types in the chufa zone of the lake bed. The three sample sites were Big Bend (Location 1), Willow Springs (Location 2), and Stock Landing (Location 3). Plots were oriented so as to generally face in a northwesterly direction, or toward the center of the open lake. Plots were constructed in October of 1965. At each site, cattle and hogs were excluded from one plot by a fence, but were not restricted from the adjacent plot. As shown in Figure 1, each plot contained 18 sub-plots being 4′ x 4′ square. Each sub-plot contained eight segments having dimensions of 1′ x 1′. A two foot walkway was located between each sub-plot. There was a total of 144 sampling units or sub-plot segments per plot. Each sub-plot was permanently marked within its designated plot by 3/8″ construction rods driven at each corner with one being placed in the center. The sub-plot segments were determined by placing a ladder type device containing four one foot squares over the corner rods.

Four standard sizes of lead shot, No. 2, No. 4, No. 6, and No. 8, were used in this experiment. Shot size for each sub-plot segment was randomly assigned with two replications of each size being used per sub-plot. Lead shot were placed in plastic bags to simplify seeding procedures. Pellets per bag varied according to size of shot used, Shot Nos. 2, 4, 6, and 8 contained 400, 800, 1200, and 2000 shot, respectively. Shot were counted and weighed so as to establish a number/weight ratio to minimize bagging operations. One bag of shot was placed uniformly over each 1′ x 1′ sub-plot segment. A mechanical device was used to evenly distribute the shot.

Shot were distributed or seeded in sub-plots at two times of the year, one being in the fall to simulate shot that are deposited by

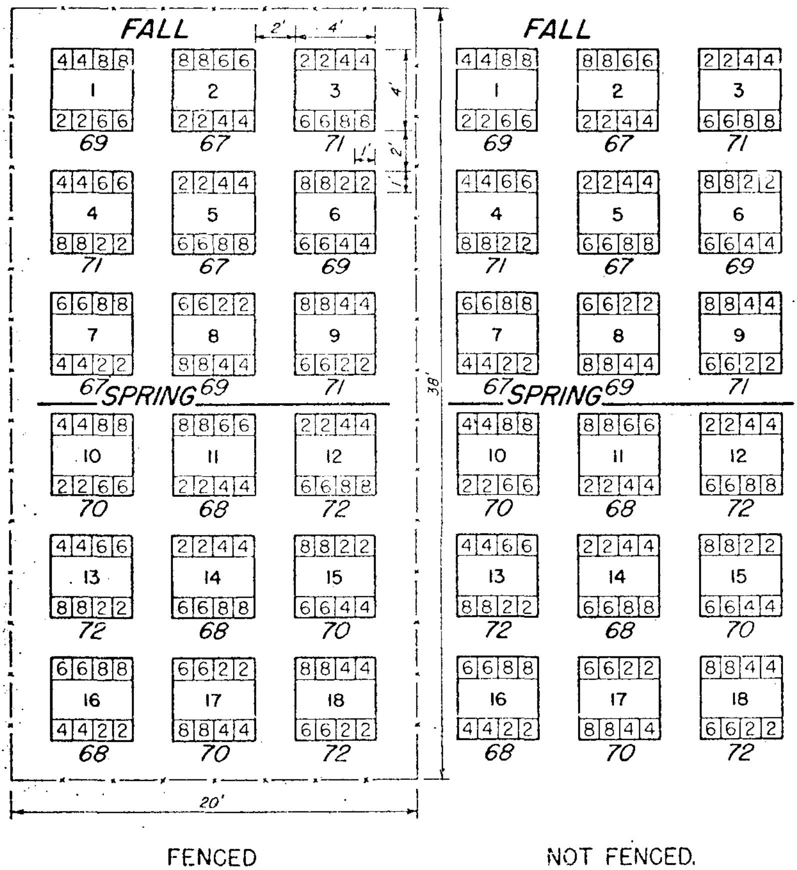

FIGURE 1. Diagram of sample plots for Catahoula Lake Lead Shot Study

hunters, and the other in the spring when the lake bed is relatively smooth and free of vegetation. The fall sub-plots were seeded in December, 1965, and the spring sub-plots were seeded in April of 1966.

Soil Samples were to be taken in October every two years from three randomly selected sub-plots within each plot on three different soil types. The fall samples were scheduled to be taken in 1969 and 1971, in addition to those taken in 1967. The spring samples were to be taken in 1968, 1970, and 1972. Eight soil cores four inches in diameter and eight inches deep were to be removed from each sub-plot. One soil core was to be removed from either the center of each sub-plot segment or the highest point within the 1′ x 1′ section, whichever position gave the greatest volume of soil, should the sub-plot segment have an irregular surface.

All samples were taken with the aid of a sampler four inches in diameter driven to a depth of eight inches with a sledge hammer. The sampler was then dug out with a shovel, not disturbing the adjacent area. The sampler was taken apart by loosening two bolts on each side which hold the halves together. Each soil core was cut into four two inch sections, tagged, and placed in quart plastic bags. The four two inch portions were then placed in a larger plastic bag bearing the sub-plot number, thus completing the sample.

After completion of the sampling, all samples were stored until analyzed. Each two inch section was washed independently through a series of screens to recover the lead shot. The shot were then placed in small plastic vials with tags and put in a labeled 4″ x 4″ polyethylene bag.

Lead shot samples collected in October, 1967, and washed in March, 1968, were separated according to shot size and counted. Data obtained from these samples were analyzed by the Experimental Statistics Department of Louisiana State University. Additional assistance was obtained from the Louisiana Cooperative Wildlife Research Unit at Louisiana State University.

An analysis of variance was performed to test for significant differences in all combinations. As a result of the method of seeding the various shot sizes at different rates, data were expressed as "Percent shot recovered." Since data were expressed in this form, the arcsin transformation table was used to assign suitable values for an analysis of variance to be computed.

RESULTS AND DISCUSSION

A total of 144 soil cores (4″ x 8″) were taken on Catahoula Lake in October, 1967, from Big Bend, Willow Springs, and Stock Landing. Recovered lead shot by location, area, shot size, and depth is presented in Table 1.

Results of analysis of variance (Table 2) show no significant difference was found when location and area are considered separately. In more simple terms, there was little difference in percent shot recovered when both fenced and unfenced plots were combined at the three different locations and there was little difference found when the values of the fenced versus the unfenced plots for all three locations were considered (Table 3).

TABLE 1. Lead Shot Recovered from Sample Plots on Catahoula Lake, October, 1967.

Location	Depth Inches	AREA 1 Fenced Shot Size No. 2	No. 4	No. 6	No. 8	AREA 2 Unfenced Shot Size No. 2	No. 4	No. 6	No. 8
	0-2	17	27	25	78	35	9	18	45
1	2-4	127	479	733	775	42	111	165	361
Big Bend	4-6	1	65	10	49	6	106	84	109
	6-8	0	0	8	19	1	0	1	6
	0-2	79	31	175	102	2	6	100	4
2	2-4	154	262	149	626	24	191	368	1011
Willow Springs	4-6	12	61	35	104	85	136	252	428
	6-8	38	3	9	0	0	0	4	3
	0-2	0	2	14	10	2	4	11	23
3	2-4	33	42	105	341	21	41	29	187
Stock Landing	4-6	81	423	634	1106	121	54	80	474
	6-8	4	4	77	166	28	15	8	5

However, when location and area are combined, the interaction between the two yield a significant difference at the 5% level of probability. This possibly could be explained by the fact that in Locations 1 and 3, more shot were recovered from the fenced areas (Area 1) than from areas not fenced (Area 2). This could possibly be due to the considerable hog rooting in Area 2. However, the reverse was true for Location 2, where Area 1 yielded less shot than did Area 2. When plots were sampled it was noted that hogs had rooted extensively in Area 2 at both the Number 1 and 3 locations, and very little in Area 2 at the Number 2 location on Catahoula Lake.

TABLE 2. Analysis of Variance of Lead Shot Samples from Catahoula Lake, October, 1967.

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
Location	2	23.575790	11.787899	0.26780584
Area	1	84.413269	84.413269	1.91776048
Location x area (Error a)	2	88.033188	44.016586	5.85952165*
Sample error = Plots/location x area	12	90.14371200	7.51197600	0.39025932
Shot size	3	53.136688	17.712219	0.92017847
Area x size (shot)	3	13.172763	4.3909206	0.22811544
Location x size; Location x area x size } Error (b)	12	230.984135	19.24867792	2.65320070*
Sample error = (Plots/loc. x area) x shot size	36	261.17603	7.2548895	....
Interval	3	3045.7593	1015.2529	18.23681394**
Shot size x interval	9	154.00134	17.111252	0.30736649
Area x interval	3	131.26933	43.756439	0.78598942
Area x shot size x interval	9	101.28520	11.253912	0.20215209
Location x interval; Location x shot size x interval; Location x area x interval; Loc. x area x size x interval } Error (c)	48	2672.18492	55.67051917	3.33802979**
Sample error = (Plots/loc. x area) x size x interval	144	2401.5840	16.677658	....
TOTAL	287	9350.7148	....	....

* Statistically significant at the 5 percent level of probability.
** Statistically significant at the 1 percent level of probability.

TABLE 3. Comparison of percent shot recovered by location and area.

	Location 1 (Big Bend)	Location 2 (Willow Springs)	Location 3 (Stock Landing)	Total
Area 1 (Fenced)	1.00	.92	1.3	3.22
Area 2 (Outside)	.55	1.10	.56	2.21

Statistical analysis revealed that there was no significant difference between the plots at the different locations within their respective areas. This relates that the three 4′ x 4′ plots within the fenced or unfenced areas at the three locations were synonymous with each other.

The different shot sizes were tested to determine if size of shot had any influence on depth at which pellets were recovered. It was found that no significant difference occurred between the sizes of lead shot. However, depth at which shot were recovered was significant at the 1% level of probability. The majority of shot recovered was found in the two to four inch and the four to six inch intervals, with the most of the shot being collected between two and four inches (Table 4). The zero to two inch depth contained more shot than did the six to eight inch section.

TABLE 4. Percent shot recovered by depth.

Percent Shot Recovered Depth in Inches			
0-2	2-4	4-6	6-8
0.26	2.7	1.7	0.07

It is felt that shot distribution is probably more associated with the depth of the clay or hardpan than any other single factor. Depth of the hardpan was obtained for some of the soil cores and, when compared with the number of shot recovered for these samples, there appeared to be a correlation between the two.

In conclusion, it is felt that the degree of hog rooting does have an effect on the number of shot recovered. This may have resulted from 1) lateral movement of shot from the sample area, which is the more probable; 2) hogs possibly ingest shot while feeding on chufa tubers; or 3) lead shot are made more available to waterfowl because ducks generally feed more heavily on areas where hog rootings have exposed the chufa tubers. This study verifies that lead shot seeded in the chufa zones of Catahoula Lake remain readily available to waterfowl after being deposited for two years.

Ocular observations of lead shot collected during this study period revealed that all shot recovered were encrusted with an oxide compound. Generally, it appeared that no difference in oxidation rate among shot size, location, area, or depth occurred in this study. The oxidation rate for lead is very slow and had no influence on shot availability to waterfowl during this test period.

SUMMARY

Catahoula Lake winters between 150 and 450 thousand waterfowl annually. Serious outbreaks of lead poisoning occur when water conditions and waterfowl migration patterns coincide. In an attempt to better understand this problem, paired plots were established at three locations and seeded with four sizes of lead shot. Half of the plots were treated with shot in the fall of 1965 and the remainder were seeded in the spring of 1966.

A total of 144 soil samples were taken in October, 1967. These samples were separated into two inch sections to determine the depth distribution of recovered shot. Samples were washed and the shot recovered separated according to size and counted. An analysis of variance was conducted to evaluate data collected during this study.

Results of this study indicated that no significant difference in shot recovered existed when location and area (fenced and unfenced) were compared separately. However, a significant difference at the 5% level of probability occurred when location and area were combined. This difference apparently was due to the amount of hog rooting in the unfenced plots.

The size of shot or the influence of livestock had no effect on the depth at which shot were recovered. However, there was a significant difference in depth at which shot were recovered. The two to six inch depth levels contained more shot than did the other intervals. The depth of the hardpan was obtained from some of the soil cores and there is some indication that this probably determined shot depth more than any other factor during this sample period.

Ocular observations of lead shot collected during this study revealed that all lead shot were encrusted with an oxide compound. It is felt that oxidation had no influence on the availability of lead shot to waterfowl during this study.

RECOMMENDATIONS

Information obtained in this study further substantiates our present water management plan for Catahoula Lake. The present plan calls for the flooding of the lake bed to a depth of six feet as soon as possible after the waterfowl season, lowering the water level during the growing season to enhance plant growth and then flooding to the desired depth just prior to waterfowl season. Since this study verifies the fact that lead shot are readily available to waterfowl two years after seeding, it is very important to wait as near the opening of the duck season as possible to start inundation and still have ample time for the desired flooding. This management implication does not eliminate lead shot poisoning of waterfowl on Catahoula Lake, but does greatly minimize it while allowing many hours of recreation.

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THE WOOD DUCK ROOST COUNT AS AN INDEX TO WOOD DUCK ABUNDANCE IN LOUISIANA

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INTRODUCTION

Wood duck censusing methods have been the subject to much research and discussion in recent years. The wood ducks' habitual use of secluded wooded areas with dense overhead cover precludes aerial censusing used in marsh areas. Hester (1965) stated that the elusive ways of wood ducks, together with lack of visibility in wooded bottomlands, almost completely eliminate the possibility of counting a representative sample of the wood duck population, so that the status of the population might be determined.

The roosting habit of wood ducks has been considered by many as a possible tool for censusing wood ducks. Haugen and Hein (1965) found autumn roosting flight counts useful as an index to annual changes in abundance of wood ducks in Iowa. The target date for counts in Iowa was September 20 plus or minus five days. Flight counts were found superior to float counts in Iowa (Hein 1966). Stewart (1958) states that among river float counts, brood counts, and evening flight counts, roosting flight counts were the best means of obtaining an estimate of wood duck populations in a restricted area such as a refuge. According to Stewart, counts of wood ducks on roosting flights were especially useful where a habitat island such as an isolated lake was being inventoried. Hester (1956) stated that the number of ducks using a roost would be expected to vary from year to year as the flyway population increases or decreases and correlation of changes in roosting numbers with changes in flyway populations would indicate reliability in the counts as a population index. Smith (1958) in Louisiana's vast areas of wood duck habitat, was hindered by the unknown effects of fluctuation in amounts of surface water.

A study from July to February 1971 was undertaken in Louisiana to evaluate the roosting flight count as an index to wood duck population trends in Louisiana. Attempts were made to isolate factors other than fluctuation in wood duck populations that affect numbers of roosting wood ducks.

STUDY AREA

The study was conducted at roosting sites throughout Louisiana. Ducks were observed roosting in sloughs, man made lakes, ditches, rice