Even when better drugs than alpha-chloralose are found for catching turkeys, time spent in research and practice with alpha-chloralose will not represent time wasted because the compound will probably never be outmoded for certain situations and experience gained with alpha-chloralose will be useful in converting a trapping operation to similar drugs.

A Final Precaution

Not everyone who wishes should be permitted to use orally administered hypnotics on wildlife, even if they are permitted under state and federal laws to possess such drugs. We should not need to make the comparison between a novice trying to assemble a cannon net to catch turkeys and one stirring up a batch of narcotic bait. Orally administered drug techniques do not have the built-in safeguards against inexperience and ineptness that other methods have. Its careless use could be disastrous in some situations.

SUMMARY

Nearly 1,000 wild turkeys have been captured in Florida with orally administered narcotics during the past two years. About 833 of these were anesthetized with powdered alpha-chloralose applied to baits. The optimum dosage employed was 2 grams of alpha-chloralose per cup of bait.

The proper application of the capture method demands that careful attention be given to preparing for the capture attempt. Careful prebaiting is especially important. Trial-and-error experimentation with orally administered narcotics in Florida has provided a number of suggestions which can be followed by others who wish to catch wild turkeys with alpha-chloralose.

A faster-acting drug similar to alpha-chloralose, called methoxymol, promises to be better for capturing turkeys. It will be thoroughly field-tested soon.

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TECHNIQUE FOR CAPTURING CANADA GEESE WITH ALPHA-CHLORALOSE [1]

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Banding has become an important tool in Canada goose (*Branta canadensis*) research and management. The shortcomings of current capture methods have limited the realization of the full potential of banding as a research and management tool.

Goose trapping in North America began early in this century by

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use of large stationary bait traps with string released drop-doors of a type described by Miner (1936) and modified by Hanson (1949). Dill and Thornsberry (1950) revolutionized goose trapping with their cannon-net trap. Their method is probably now the most widely used in this country.

A drive trapping technique for capturing geese is described by Cooch (1953). This approach is useful for trapping large numbers of flightless young and adult geese on the nesting grounds, but the technique has limited application. A more effective technique for capturing geese on their wintering grounds would be useful. Orally administered narcotics may offer this possibility.

Alpha-chloralose ($C_8H_{11}Cl_3O_6$) is a sugar compound of chloral hydrate which anesthetizes the brain but has no effect upon the medulla, which is a visceral center. During the manufacturing process both alpha and beta isomers are formed, the alpha form being the active fraction (Lumb 1963).

According to Ridpath et al. (1961), J. L. Daude was the first to use chloralose on wildlife. He used the drug around 1940 to catch corvids and other birds harmful to agriculture in France. Also according to Ridpath et al. (1961), J. Giban described the first use of the drug in banding experiments in 1954.

Borg (1955) determined the average lethal doses for both isomers of chloralose in cage tests on hooded crows (*Corvus cornis*), magpies (*Pica pica*), and feral pigeons in Sweden. Some tests were also carried out on unspecified species of pheasants and geese. He concluded that the beta isomer possessed no soporific properties and that the alpha isomer was responsible for the sedative effect.

As far as we have been able to determine, the initial experiments with an orally administered narcotic in North America were by H. M. Wight (undated multilith, about 1953). He experimented briefly with Avertin (a tribromoethanol anesthetic by Winthrop Laboratories) on mourning doves (*Zenaidura macroura*) and quail and suggested further research on the capture of game birds with narcosis-producing drugs. Mosby and Cantner (1956) tried Avertin on turkeys (*Meleagris gallopavo*) and certain other species of animals with some success.

D. O. Trainer (personal communication) reported that in 1958 he and others tried alpha-chloralose on wild Canada geese and mallard ducks (*Anas platyrhynchos*) without notable success but concluded that further research was warranted.

Williams (1966) was the first in North America to develop a practical technique to capture wildlife with alpha-chloralose.

L. E. Williams provided recommendations and assistance throughout this study. Jim Brogdon, Marlin DeFoor, and Charles Turner assisted with field work. P. Midyette, R. Nicholson, and A. F. Rich generously permitted us to conduct field trials on their properties. Tom Atkeson and the staff at the Wheeler National Wildlife Refuge, Decatur, Alabama, assisted in capturing 65 geese there on 21 February 1966.

MATERIALS AND METHODS

Source of Materials

Alpha-chloralose was obtained for about $20.00 per pound from either Fisher Scientific Company, 690 Miami Circle, N. E., Atlanta, Georgia 30319; Nutritional Biochemicals Corporation, 21010 Miles Avenue, Cleveland, Ohio 44128; or British Drug Houses, Canada Ltd., Barclay Avenue, Toronto 18, Ontario. Corn and other materials were purchased locally.

Determining Initial Ratio

In order to determine a starting dosage for field trials with wild Canada geese, several different dosages of alpha-chloralose were force-fed and free-fed to domesticated mallard ducks. The results could not be

related directly to an optimum dosage for free-feeding wild geese, but in view of data already available from Williams' (1966) work with the wild turkey and dosage data incidentally obtained for other species during that study, 1 gram of alpha-chloralose per cup of bait was decided upon with full knowledge that our first test would not likely be exactly the optimum dosage. We considered that some data on over- and under-dosage would be useful to the study.

Choosing a Bait Site

Bait sites for the field trials were selected where local disturbances would be minimal and where goose flocks spent much of their time resting or feeding nearby. Geese fed more contentedly when the bait was near water—sites within 200 yards of water were usually chosen. To avoid risk of overdosage to small ducks which occasionally used the bait sites, some sites had to be located 400 yards or more from water. This usually eliminated use of the sites by ducks without unduly affecting the use of the bait by geese.

Knowledge of alternate resting and feeding areas routinely visited by the geese was an important consideration in site selection. These areas were discovered by close observation of movement patterns. Lightly narcotized geese which had flown to alternate resting sites were captured or watched until they recovered.

Sites offering good visibility from an observation point were chosen. Geese were observed through binoculars or spotting scopes at least 1/8 mile from the bait.

Pre-Baiting

Randomly scattered ear corn and whole kernel shelled yellow corn were placed in piles about three cups in size to attract geese to the site. Bait piles were distributed in long lines. When geese had become accustomed to using the site, baiting with ear corn was discontinued and the shelled corn pile size was reduced to one to two cups. Bait piles were spaced approximately 15 feet apart to segregate family units, and to disperse the group over the area. This seemed to minimize social intolerances and reduced the discontentment that prevailed when the group fed on piles more closely spaced. Piles of bait could be easily removed when necessary.

Preparing the Bait

The amount of bait to be prepared was governed by the number of geese to be caught. No regard was given to the amount to be consumed by each goose, but to arrive at the quantity to be presented, the bait was proportioned at approximately ½ cup per goose. Corn was usually soaked in water and excess drained off, then divided into 12-cup batches in three-gallon plastic containers. The gram weight quantity of alpha-chloralose powder was thoroughly stirred into each batch with a spatula. The bait was mixed about three hours before use to avoid drying and flaking off of the powder.

Presenting the Bait

The bait was presented in the following manner:

1. On the day preceding the capture attempt, the site was cleared of all bait if the geese had not eaten it all the day before.

2. Treated bait was laid on the site just before dawn in one- to two-cup piles at approximately 15-foot intervals across the site.

3. Foreign objects such as bait containers were removed.

4. The observer retreated to the observation point before the geese arrived.

5. After narcotized geese were picked up, all remaining bait was retrieved with a shovel and broom and usually buried to avoid the risk of animals becoming accidentally narcotized.

Handling during Recovery

Narcotized geese were put in burlap-lined poultry wire cages in the rear of a pickup truck and transported to the banding location. A portable banding table similar to one described by Sherwood (1965) was used. The sphincter muscles of the vent were relaxed. Age and sex could be easily determined on birds under sedation. Geese were weighed, measured, and banded without struggling. No injuries occurred during handling.

After banding, geese were held overnight in a predator-proof poultry wire recovery pen. Recovery time for each bait ratio is listed in Table 1. Birds were kept overnight to assure that full wariness had been regained. The door of the holding pen was opened the next morning and the birds were permitted to walk out and fly away.

RESULTS

Dosage Trials

On 4 February 1965, alpha-chloralose was mixed with whole kernel corn at the rate of one gram per cup and offered to about 100 wild geese and 50 ducks in a free-feeding experiment. Forty-six Canada geese and 35 ducks of several species, blue-winged teal (*Anas discors*), green-winged teal (*Anas carolinensis*), mallard, and American widgeon (*Mareca americana*), were captured (Table 1). General anesthesia was reached within 45 minutes after the bait was taken and seven of the geese and 17 of the ducks died, indicating that the dosage was too high. To prevent heavily anesthetized geese from drowning, rescue activities had to be initiated. Five geese were frightened prematurely from the site and settled on a lake 1½ miles away. One of them was killed by a farm laborer, the remaining four were captured (Table 1).

On the second trial the drug to bait ratio was reduced to .75 gram per cup. With it 49 geese were caught. The mortality rate was still too high (Table 1).

On the third trial the dosage ratio was reduced to .33 gram per cup. Five geese were caught on the site with this mixture. Approximately 25 individuals left the bait site and were subsequently found resting on a lake about two miles away. They had left the site to join about 200 geese leaving a nearby corn field. Because no rescue attempts were made, three of the 25 drowned; the rest recovered.

A further reduced ratio of .25 gram per cup was tried and seven geese were captured. No mortalities resulted and normal alertness was regained in about eight hours. This ratio seemed satisfactory because muscular control was maintained throughout narcosis. Additional dosage reduction to .20 gram per cup and .16 gram per cup were tested to find the lower threshold of effectiveness. These dosages produced subeffective sedation. Of an undetermined number of geese taking the baits, one became lightly narcotized on the .20 gram per cup mixture. The .20 gram per cup ratio resulted in the capture of six coots (*Fulica americana*) without mortality. No ducks fed at this site that day.

The .16 gram per cup ratio caught 43 ducks and one coot but no geese were affected. Among the ducks caught were 40 mallards, one green-winged teal, one American widgeon, and one pintail (*Anas acuta*). No duck mortality occurred.

Further trials with .25 gram per cup of bait indicated that this ratio was effective with only 2.6 percent mortality (Table 1). Further tests with slightly varying drug to bait ratios did not seem warranted. Attention was therefore devoted to capturing and banding activities.

DISCUSSION

No attempt was made to catch more than 25 to 50 geese until the dosage had been tested and confidence in the technique had been gained. Finally, sufficient bait quantities to capture up to 150 geese were used.

An average capture was about 40 geese. The largest capture was 140 geese of which 121 were retrieved from a lake an estimated 400

TABLE 1. RESULTS OF TRIALS WITH SIX DESCENDING AMOUNTS OF ALPHA-CHLORALOSE TO BAIT, JANUARY-MARCH 1964-66.

Drug to Bait Ratio	No. Geese Captured	Over-dosage Mortality No.	Over-dosage Mortality Percent	Drowning Mortality No.	Drowning Mortality Percent	Other Mortality No.	Other Mortality Percent	Total Mortality No.	Total Mortality Percent	Number Recovered No.	Number Recovered Percent	Approximate No. of Hours Recovery Time
1.00g/cup*	46	4	8.7	2	4.3	1	2.2†	7	15.2	39	84.8	10-15
.75g/cup*	49	14	28.6	2	4.1	0	—	16	32.7	33	67.3	10-15
.33g/cup	8	0	—	3	37.5	0	—	3	37.5	5	62.5	10
.25g/cup	475	1	0.2	9	1.9	2	0.4‡	12	2.5	463	97.5	6- 8
.20g/cup	0	0	—	0	—	0	—	0	—	0	—	—
.16g/cup	0	0	—	0	—	0	—	0	—	0	—	—
Totals	578	19		16		3		38	6.6	540	93.4	

* Volumetric measurements converted to gram weight with estimated conversion error of ±0.1 gram.

† Killed by farm laborer.

‡ Turkey vultures (*Cathartes aura*) killed one anesthetized goose on the site, the other died of wounds that occurred when it flew into a tree limb while under Stage III.

yards from the site. They had flown to the lake before narcosis set in, when approximately 300 geese that had not fed on the drugged bait returned to the resting area.

Two geese were once recaptured at the same site the day following their release. Geese did not seem to avoid a bait site after being captured there. Several geese color marked on the cheek with yellow airplane dope were observed on the capture site the day after being released. A similar unwariness of the capture site was pointed out by Murton, Isaacson, and Westwood (1965) in their work on anesthetizing woodpigeons (*Columba palumbus*) near nests.

The physiological effects of alpha-chloralose on geese have not been studied. L. E. Williams (personal communication) found that penned wild turkeys which had been drugged with alpha-chloralose several times produced eggs with normal hatchability. A wood-pigeon was found to have small young after being caught twice in two consecutive years (Murton et al., 1965).

Narcotic Effects

The period after alpha-chloralose bait was ingested (usually about 30 minutes) and before narcosis begins is referred to as the pre-induction period.

Stage I. The first sign of induction was usually noted about 30 minutes after feeding began. This narcotic stage was characterized by slowly blinking eyes, sluggish reflexes, and relaxed wings. Stage I could usually be recognized by experienced observers only. In this condition geese were still able to fly and could be easily frightened, particularly if fear was shown by geese in the group that had not eaten sedative amounts of the bait.

Stage II. Signs indicating stupification and awkward posture were observed after about 40 minutes. During this stage individuals would sway forward and backward. Flight ability was usually maintained at this stage and geese often walked meanderingly over the site.

Stage III. Gradually deepening narcosis was characterized by frequent periods of dozing with closed eyes and impaired balance. These symptoms were associated with brief periods of alert, motionless, erect posture. This stage occurred about 50 minutes after feeding began. Geese could be caught in the last phase of this stage if carefully approached from behind with a long-handled dip-net.

Stage IV. This stage was usually reached within one hour after feeding began and lasted for about four hours. At this point most geese came to rest on their breast and could be captured by hand.

During the first two hours of a capture operation, geese representing all stages of sedation were usually present on the site. This was because they did not all begin to feed at exactly the same time, and some individuals did not consume a sufficient dosage to progress beyond Stage II, regardless of the time of arrival at the site and feeding begins. In view of the relatively slow rate of induction with alpha-chloralose and the prolonged period of narcosis, it is desirable to permit geese to remain on the bait site undisturbed until two conditions are met: 1) geese taking sufficient dosages have reached Stage III, and 2) geese not taking sufficient dosages to reach Stage III can be easily distinguished by their alertness and ability to fly. The minimum time required under normal circumstances for these conditions to be met is two hours.

During Stage IV, geese were incapable of purposeful movement. But on water they did not drown. Even during rather deep anesthesia geese exhibited a reflex of lifting their heads from the water to breathe. Often geese rested their heads on their backs or on debris floating in the water. In cases of very heavy anesthesia this reflex was lost and some drowned.

The greatest weakness in the technique is the time period lapse between feeding and Stage III. Geese that leave the bait site, frightened or voluntarily, during this period require special attention. Cap-

turing conditions can be chaotic even though most of the geese will settle and can be subsequently caught within ¼ mile of the bait site. Some geese during pre-induction may fly up to three miles from the site before they are affected. Observations were made on over 200 individuals of those which left the general observation area, none were known to have died. This fact raised the hypothesis, that if a goose having eaten aplha-chloralose is capable of flying a half mile or more, he probably will not drown and will fully recover within eight hours. This would minimize the technique's weakness, but additional study will be required to prove this assumption.

Future research may indicate that oral anesthetic capture activities should be limited to cloudy, misty weather conditions for best results. Geese tended to remain on the site longer and feed more contentedly during such weather. There were no aircraft disturbances during cloudy conditions. Precipitation in the form of rain occasionally diluted or washed the drug from the bait, however.

Murton (1962) stated that the effectiveness of alpha-chloralose for wood-pigeons and several other species is governed by the speed at which a bird finds and eats the bait—a function of bait density—the drug to bait ratio, and the presence or absence of a crop. Increased feeding time produced by sparsely scattered bait increased his capture success. A bait density study to develop an effective capture technique for wild geese was not considered as important as tests on differing concentrations of drug to bait because of their wary and erratic feeding habits. The more time required for eating narcotic amounts of bait increases the chance of geese leaving the site prior to Stage III.

We suspect the approximately 30-minute non-reactive period of pre-induction is independent of increasing drug to bait ratios, feeding rate, and esophageal food storage. This period, most likely, relates to the solubility of alpha-chloralose and its absorptive rate into the blood. The bait ratio at .25 gram per cup of bait in piles was satisfactory because it allowed rapid feeding that produced an effective degree of anesthesia within mortality tolerance.

The primary need for improving the technique to efficiently capture larger numbers of geese at the bait is to determine a means to reduce the pre-induction period. Additional study is needed to prove whether or not duck mortalities on the .25 gram per cup ratio are tolerable and whether waterfowl have long-term physiological effects from the drug. Our recent research with faster-acting narcotics presented either separately or in combination with alpha-chloralose offers good possibilities with regard to reducing the pre-induction period. Studies with both geese and ducks on the same drug to bait ratio are favorable also. Future studies are planned relative to any long-termed physiological effects from narcosis-producing drugs. Until these factors are further tested and this technique further refined, we recommend that this method for capturing geese be used cautiously.

SUMMARY

During field trials in the winters of 1965 and 1966, 573 Canada geese and five blue geese (*Chen caerulescens*) were caught with alpha-chloralose, an oral anesthetic. The mortality rate was 2.6% in 475 geese captured with 0.25 grams of the drug mixed with each cup of bait.

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METHODS OF REPELLING DEER IN GARDENS, ORCHARDS AND FIELDS IN VIRGINIA

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INTRODUCTION

Deer damage complaints from landowners in the state of Virginia have increased the past few years. This has happened, oddly enough, in areas where the deer population has been reduced considerably through heavy hunting pressure and other causes.

The deer browse problem is not new and is statewide in all types of gardens, orchards and fields. The extent of damage differs with the area and type of crops involved. Methods of control and types of repellent have varied according to available materials. The degree of damage also varies according to the landowner. That is, some will not complain until a lot of damage has been done, while others call if one or two trees are browsed.

It had been the policy in past years to issue a permit to allow the nuisance animals to be removed. Because of the reduction in some of the deer herds, sportsmen complained if certain landowners were allowed to shoot the deer out of their fields. Consequently, considerable effort has been spent during the last four years trying to help the farmers and orchard men with their deer problems, by using some of the common deer repellents. It was interesting to learn that a personal discussion of the problem usually appeased the landowner and made further contact with him more agreeable. Some of them did not complain about deer damage again.

It should be pointed out here that we have not found the perfect technique to repel deer. With the exception of the tankage experiment in a peach orchard, that will be discussed later, no formal studies were set up to test the different repellents. In most cases the materials were distributed to landowners with advice on their use and the results were evaluated by County Game Wardens and Biologists at a later date. Admittedly, information gathered in this manner is often inadequate to lead to definite conclusions about the effectiveness of a product.

TYPES OF DAMAGE

Most of the deer damage in the western part of the state has been