DUCK AND MUSKRAT FOODS

It is desirable that suitable aquatic vegetation be planted immediately and that the plantings be continued until the National Forests possess adequate seed beds of valuable food plants. It is best that permanent rice beds, etc., be established as soon as possible on each Forest in order to have available a source of seed for planting purposes on other lakes and streams within the Forest.

There are numerous waters in the Forests which would be suitable for duck and muskrat propagation areas if they were planted with rice, wild celery, pondweeds, etc., Many times, planting of these foods will produce a very productive breeding and resting ground. It is of primary importance now, in that most of the lakes and marshes which were once productive of muskrats and ducks are drained dry.

WILD RICE

Harvesting

Rice is ripe when it can be knocked off or shatters readily. All of the seeds do not ripen at the same time. A bed can usually be harvested four or five times. Ripened kernels sink readily into the waters; unripe kernels tend to float.

Wild rice is best harvested with the use of two light cedar sticks about two and one-half feet long. The ends of the sticks are pointed and widened back to handles that fit the hands comfortably. One man paddles the canoe from the bow while the other man sits in the stern seat and knocks off the rice with the aid of the sticks.

With the left arm the man harvesting the rice bends the rice over the left gunwale. One of the sticks held in his left hand enables him to bend over a considerable amount of rice. With his right hand in which he holds the other stick, he knocks the ripened rice into the canoe with a short sweeping beat. He does not use short choppy beats but runs the stick over the rice heads as he beats. After the rice on his left side has been knocked off he proceeds to harvest the rice on his right side, but this time uses the right arm to encircle it and the left hand to knock it off.

The man paddling the canoe should go just fast enough to allow the harvester to beat both sides. He should not go so fast that any patches of rice are skipped.

Storing

Wild rice may be planted as soon as it is harvested. If it is to be planted in the fall, it should be sown immediately after gathering so that the kernels do not have time to dry out. Once

they become dry, they lose their vitality. If it is not possible to sow the rice after harvesting, it should be stored in a condition as nearly natural as possible.

Select a place in a rather deep, slowly moving river, or along the shore of a lake, and construct a bin of heavily galvanized wire (fence). The meshes must be small enough to keep out muskrats. Make several racks which will divide the bin into horizontal sections. Place the wild rice into sacks which have a coarse weave. Loosely woven gunnysacks are very adaptable for this purpose. Fill the sacks with rice so that when they are laid face downward, the rice can be spread out to a depth of four inches. Put a layer of these sacks in the first rack and then another layer in the second, etc. The whole structure will have to be sunk below any probable ice level. Also, it must be securely staked or anchored so that it will not tip over or be swept away. Sand bags may serve to anchor it. A marker should be placed over the bins so that they can be readily found. Handles on each end of the rack will serve as an easy means of lowering and retrieving the racks. Rice should be taken from the bins as soon as the ice leaves in the spring, and planted.

Rice can be more easily and economically stored for short periods if kept in an ice house. It should be placed in sacks and wetted thoroughly. Put the sacks directly on the ice and cover well with sawdust. The sawdust should be continually wet.

If a flowing spring is present which will not freeze solidly over the winter, sacks of rice may be advantageously kept in such places without harm. Dig holes in the spring bed in which to lay the sacks and cover and surround the whole with galvanized screening to protect the rice from rodents. Water should be flowing over the tops of the sacks at all times.

Even if rice is to be stored for only one or two days, be sure that it is kept moist. Put rice in sacks which are wetted continually. Ice cakes placed in the sacks of rice are advantageous in keeping it in good condition.

Never put too much rice in a sack. It is a very good practice to place rocks in each sack so that the rice is somewhat separated and does not have a chance to become sour. Never fill a sack more than one-third of its capacity, and spread out the contents evenly.

If rice is to be shipped, send it by refrigerator car or by express in a moist condition.

NEVER ALLOW RICE TO BECOME DRY.

KEEP IN COLD, MOIST SURROUNDINGS.

Planting

Rice may be planted immediately after harvesting in the fall or during the following spring. In the latter case, it will have to be stored over winter.

Spring plantings are somewhat more desirable than fall plantings in that the rice has a greater chance of survival against ducks, etc., which will eat a considerable amount of it during the fall. However, rice can be planted just before the freeze-up and be safe from ducks. Plant in the spring immediately after the break-up.

Rice which is planted in the spring may be sprouted; in such cases, the kernels will have to be mixed with mud balls and sunk to the bottom. Otherwise, the sprouted rice will float and wash up on the shore.

Plant rice where there is a slow movement of water such as in slowly moving rivers or where waters leave or flow into lakes. Rice does best where there is a gradual water turnover. Plant in waters from 1/2 foot to 5 feet deep on a muddy bottom. It will not grow on gravel or sand. In planting rivers, start as far upstream as it is possible to sow the rice to make the initial planting. The seeds will then tend to be swept downstream every year and the planting will grow rapidly.

Not all the seeds will germinate the first year they are planted, but may wait another season before coming up. Therefore, a planting should not be judged until the second year. If a planting fails, determine the reason and make out a full report.

Reasons for Failure

1. Rice not properly cared for before planting
2. Planted well, but picked up by birds
3. Planted too deep
4. Planted too shallow (the lake may recede and expose the rice to animals grazing from the shore or the rice may be burned out)
5. Muskrats - these animals will destroy rice beds by cutting down the stalks for their food. The rats must be controlled.
6. Harvesting of the rice without leaving a sufficient seed stock
7. Planting on gravel or sand
8. Planting in stagnant waters
9. Rice allowed to ferment or become heated and sour before planting.

Protected bays and coves which possess mucky bottoms are very desirable for planting of rice if they are located on the

larger lakes where the waters are continually freshened by wave-action. Rice, however, will not grow where the shores are continually beaten by waves.

Fifty pounds of rice will plant one acre. The seed can be sown broadcast from boats. Plant well wherever an attempt is made. Do not attempt to plant a large area with an insufficient amount of rice.

Celery

Harvesting

Wild celery is found growing in waters from one to twelve feet in depth. It requires a constant turn-over of waters, and therefore grows best where rivers empty into lakes or where there is sufficient wave action to stir the waters. Celery usually grows in company with other plants such as chara and where pondweeds are scattered.

When the plant is fruiting one can readily determine its presence by noting the long corkscrew stem which bears the seed pod. This stem twists through the water and bears at its terminal end a long round pod filled with a gelatinous mass, in which small dark seeds are found. The pod on calm days may rest on the surface of the water, but as the seeds become ripe the pod is withdrawn from the surface by the corkscrew contraction of the stem. Leaves of the plant are peculiar and are easily recognizable. They are usually quite narrow and wavy, having the appearance of long ribbons. The ends may be somewhat twisted or serrated. Several leaves arise from the base of the plant. Three long parallel veins traverse the entire length of the leaves. These veins are connected by irregular cross veins.

The wild celery grows best where there is a muck or a marl bottom. It is seldom found growing on barren sand and never on rocky bottoms.

The plant propagates by three methods - seeds, winter buds and plant fragments. All portions of the plant are eaten by ducks. The buds are especially sought after by the divers, while the mallards, teal and other puddlers usually feed on the leaves.

Once a celery bed is located it is comparatively easy to harvest the plants. A fine-toothed rake with a long handle is the best tool to use. Several plants at a time can be raked up from the bottom. These should be immediately placed in a gunny sack which can be dragged through the water beside the boat. Just as in handling rice, wild celery must not be allowed to dry out. Any plants dislodged but not brought up on the rake will soon float to the surface and can be picked up.

Storing

Wild celery must be stored in cool, wet surroundings. If the plants are to be kept over a long period they can be stored in bins under water just as rice is stored. Never allow the plants to become dry or sour.

Planting

The seed pods are best planted by breaking them into half inch sections and sowing them broadcast. Forty pounds of the seed will plant an acre. Sow rather sparingly, as the plant spreads rapidly when once started.

Procure a forked stick for planting the whole plant. Throw a plant into the water and as it floats stick the crotch of the stick over the root system and force the plant into the lake bottom.

Winter buds and seed pods which float must be mixed with clay balls and sunk so that they do not wash up on the shore.

Duck Potato

One of the best of muskrat and mallard foods is the duck potato, which grows well along low-lying wet lands. This plant is more readily available to waterfowl if growing in shallow water. The bulb is much sought after by both ducks and muskrats. The plants reproduce by means of seeds, which are shed each fall, and also by means of their tubers. Both tubers and seeds may be collected during the fall and planted in favorable lakes and streams.

A fairly rich soil is preferred, but the duck potato will be found growing on wet sandy soils also.

Sago Pondweed

This is a very valuable pondweed which is capable of growing rapidly and affording abundant food for ducks. Both seeds and tubers can be collected for restocking purposes, but often the whole plants can be rooted up and replanted by forcing them into the bottoms of ponds with a forked stick.

Other Aquatic Foods

All other aquatic plants such as coontail, elodea, etc., should be gathered and planted wherever conditions warrant. All aquatic plants should be kept cool and moist when being stored or transported, and should never be allowed to become heated or dried out.

Cover Plants

Cover and food plants for muskrats and ducks, such as cattails, bulrushes, reeds, etc., should be planted in connection with these other foods in order that we may finally possess marshes which will produce a maximum fur and waterfowl crop.

The root stalks of these cover plants are the best means of propagating them. The roots can be dug up and broken into lengths which possess one or more nodes which may be planted in muck, sand or gravel in about one to twenty-four inches of water. May and June is the optimum planting time, according to the Wisconsin Aquatic Nurseries of Oshkosh, Wisconsin. They suggest planting the roots about three feet apart or approximately 1,000 to the acre. Plant well by excavating a shovelful of soil and slipping a root into place, and then by packing the excavated soil over the roots with the feet.

Chufa

Chufa is a good lake and river margin plant, acting as a cover and also providing excellent food seeds. It needs a fairly rich soil, but can withstand dry conditions very well, and therefore is useful to grow not only for waterfowl but turkey, quail and pheasant.

Plant the tubers four inches deep, in furrows eight inches apart, and cover. The seeds may be broadcast on broken ground, but best results are obtained by planting the tubers.

TABLE OF DUCK FOODS AND DUCKS FEEDING ON THEM°

DUCKS	FOODS											
	Wild Rice	Wild Celery	Pondweeds	Chara	Bulrushes	Smartweeds	Duck Potato	Coontail	Water Milfoil	Chufa	Wild Millet	
Divers												
Canvasback	X	X	X	X	X		X	X	X	X	X	
Redhead	X	X	X	X	X		X	X	X		X	
Little bluebill	X	X	X	X	X		X	X	X		X	
Greater bluebill	X	X	X	X	X		X	X	X			
Ruddy duck	X	X	X	X	X		X	X	X			
Golden-eye		X	X	X				X	X			
Bufflehead	X	X	X	X				X	X			
Ringneck	X	X	X	X	X				X		X	
Puddlers												
Mallard	X	X	X	X	X	X	X	X	X	X	X	
Black duck	X	X	X	X	X	X	X	X	X	X	X	
Green-winged teal	X	X	X	X	X	X	X	X	X		X	
Blue-winged teal	X	X	X	X	X	X	X	X	X		X	
Gadwall		X	X	X	X	X	X	X	X		X	
Shoveller			X	X	X	X	X	X	X		X	
Wood duck	X	X	X	X	X	X	X	X	X	X	X	
Pintail	X	X	X	X	X	X	X	X	X		X	
Geese												
Canada	X	X					X			X	X	Grass
Snow	X	X									X	Grass

°List partially compiled from Biological Survey findings

G
Fish & Game
Form 97 R-9

DUCK FOODS HARVESTING REPORT

Date _____ Forest _____

Lake or stream	T. R. Sec. Location	Pounds Harvested	Date	Remarks (species)

G
Fish & Game
Form 98 R-9

DUCK FOODS REQUIREMENT REPORT

Date _____ Forest _____

Due in R. O. not later than July 1 each year.

Lake or stream to be planted	T.R.Sec. Location	Pounds needed (State kind of food plants wanted)	Acres to be planted	Remarks Can total supply be obtained in forest? If not, how much do you want shipped in?

G
Fish & Game
Form 99 R-9

DUCK FOOD PLANTING REPORT

Date _____ Forest _____

Lake or stream	T.R.Sec. Location	Pounds Planted	Area planted in acres	Date	Remarks (species)

DISEASES OF WATERFOWL

Three of the many diseases of waterfowl kill thousands of the birds each year, and at times prove far more destructive than other agencies, such as hunting and depredations of predators.

1. Botulism (alkali poisoning, duck disease, Western duck sickness)

Causitive organism - Clostridium botulinum (Type C)

Previous research studies indicated the duck disease to be due to alkali poisoning, but subsequent and more recent investigations have definitely proved the sickness is due to a bacterium and its toxin. The first outbreak of duck disease occurred in 1910, in the marshes of the Great Slave Lake in Utah. There is little doubt that the causitive organism was endemic in North America long before the disease became epidemic.

Drainage and tampering with water levels has in many cases practically ruined thousands of lakes for waterfowl, and made many veritable death traps. Fluctuating water levels, as occasioned by power dams, etc., produce harmful conditions in many lakes because of the vegetation and animal life left to rot in the sun when waters are drained.

Ducks alighting on such bodies of water are liable to be infected by eating or drinking polluted material. The symptoms are:

1. Affected nerve centers or nerve terminals resulting in muscular weakness, which in extreme cases or prolonged sickness results in the total disability of the birds. Frequent paralysis of nictitating membrane is apparent.

2. A diarrhea is evident in some individuals when the vent is blocked and the cloaca becomes distended.

3. Subnormal body temperatures occur (around 100°F).

The degree of sickness in different birds is due to the amount of toxin which is ingested during feeding. If the amount of toxin taken into the system is small, the course of the disease will be mild and retarded, but if a large amount of the toxin is taken, the disease may strike in a very few hours and soon prove fatal.

Methods of Control

1. The best control is a preventative - prevent duck sickness by assuring clean, well circulated waters in lakes and marshes, control of fluctuating water levels and keeping a clear, well defined shore line. Where waters may become stagnant, water at least one foot deep should be kept in marshes, and all duck lakes should possess

deep water areas which can be whipped by wave action, and which will be large enough to dilute any concentration of toxins.

The disease is most prevalent in the early fall during a warm spell, when air temperatures rise to 98°F. If possible, waters should be changed often, and completely circulated by operation of dams, etc.

2. If the disease strikes and there is no way of stopping it, ducks must be scared away from the area by frightening them with the use of rifle fire. All dead birds should be picked up and burned or buried far from the lake, as their rotting bodies become foci for more of the bacteria.

Note: An excellent discussion of this disease is contained in the recent U. S. Department of Agriculture Technical Bulletin No. 411, which was printed in May, 1934. The authors are E. R. Kalmbach and Millard F. Gunderson.

2. Duck Malaria

Causitive organism - (Leucocytozoon anatis)

Recently, Earl C. O'Roke of the University of Michigan and his research department have discovered a malaria-like disease which is of such virulence and prevalence in certain areas that the propagation of ducks is virtually impossible.

The disease is carried by an alternate host, the black fly, (Simulium), and is transferred to ducks by its bite. The distribution points of the disease are confined to those areas possessing spring hatches of black flies.

Mortality rate is from 10 to 100% in ducklings, but less in adults. It appears that there is nothing we can do to protect wild ducks from the disease, although domesticated ducks can be placed under screens when the black fly season comes. Many of our wildfowl, however, do not hatch their young until the fly season is practically over, and this may account for the few ducks found nesting in the infected areas.

There is no doubt, according to the evidence, that the wild duck population is materially reduced or held below its normal rate of increase in the black fly zone.

3. Lead Poisoning

The deposition of lead shot around permanent blinds and shooting points is accumulating in an ever-increasing amount year after year. Most of our duck loads carry 1¼ ounces of shot, and a continued accumulation of the lead over a lake will result in a large quantity of it being deposited in a rather restricted place.

Lead poisoning of waterfowl has been noticed since the beginning of this century, but was rather restricted to shallow lakes and sloughs where the shot was easily accessible to the birds. Of late, due to drought and drainage, shot which before laid in deep water and was out of reach of ducks has become accessible. Swan Lake, near Nicollet, Minnesota, had been heavily shot over since early settlement, but on account of a fairly good depth of water where the spent shot fell no serious outbreak was noticed until the lake began drying up in 1931 and 1932, due to drought and extensive drainage projects throughout the surrounding country. Areas where concentration of shot fell were then no longer too deep for puddle ducks to reach, with the result that during the fall of 1931, conservative estimates state that over 2,000 mallards died of this affliction on Swan Lake. Shot was found in the stomachs of all, and those birds still alive when the investigation parties arrived showed typical symptoms of the malady.

Symptoms-

1. Lead poisoning causes a general disability of the muscles similar to that caused by botulism, but the nictitating membrane never is affected. Wing droop from the carpal joint is also a symptom, and in advanced cases the tail and breast will be declined. Spasms are common, and death may occur during excitement, due to a weakened heart.

2. A green watery feces is eliminated.

3. Body temperatures are usually normal (contrary to botulism poisoning.)

4. Appetites are excellent up to the time of death.

Puddle ducks feed on acquatic tubers and plants in shallow waters where they probe around for them in the mud. They will pick up anything hard and gritty and swallow it, and in this manner shot is ingested. Six No. 6 shot is a fatal dose for a duck, although two #6 shot may prove fatal with certain individuals.

Shot taken into the gizzard is ground up by the grinding or trituration of food in the gizzard, and as the small particles of lead escape into the intestinal tract they are absorbed and enter the blood stream. The lead, according to Dr. T. B. Magath of the Mayo Clinic, Rochester, Minnesota, causes necrosis of the liver and perhaps the nervous system. Marked anemia occurs, he says. Symptoms of this disease will appear in a few days if the dose is great, or they may not appear for weeks if only small quantities of lead are taken.

Also the reproductive powers of the afflicted birds are seriously curtailed, and though a bird may not be killed by a very small dose of lead, it may be rendered unfit for reproduction.

Corrective Measure -

1. A good depth of water, preferably 20 feet, should be kept over areas where shot falls after being shot from blinds or shooting points.

2. Suggest to sportsmen and others the desirability of shooting over deep waters or over land. Many times a blind can be changed a little and shot sent into safe regions.

3. Scaring birds away from affected areas after hunting seasons, when congregations are liable to be great on shot areas. These concentrations would not be present during the hunting season, as the birds would then be scattered or driven away.

Note: Under no consideration create refuges where shot concentrations are found in shallow water.

COMPETITORS AND PREDATORS OF DUCKS

Waterfowl have to contend with many animals which either prey upon them or destroy their food supply. While most of the aquatic fur bearers and even some of the terrestrial animals, such as skunk and raccoon, will occasionally find and eat eggs and young of the ducks, their depredations are not as detrimental as the following species:

1. Snapping turtle (Chelydra serpentina)
2. Great Northern Pike (Esox lucius)
3. Crow (Corvus brachyrhynchus)
4. Duck hawk (Falco peregrinus anatum)

The carp (Cyprinus carpio), while not a predator, is fully as destructive, or more so, to ducks than many of the predators.

Snapping Turtle

Some ornithologists believe the distribution of the waterfowl has been largely influenced by their attempt to escape the presence of snapping turtles and other southern vermin such as snakes and alligators. Although this theory is rather far-fetched and probably lacking in evidence, there is no doubt that the snapping turtle destroys many ducks.

"Snappers," more numerous as one reaches southern waters, but not uncommon on our Northern Forests, not only devour many young ducklings, but are also capable of pulling down and drowning full-grown ducks. Even geese may be killed and eaten.

Control-

"Snappers" can be controlled efficiently by several methods, all of which have been tried and proved successful.

During the winter large numbers of turtles congregate in small spring-fed streams or spring holes. Often they are found clustered under roots of trees or debris in small streams. When theweather turns cold they migrate to these places where they will not be destroyed by ice and will not be suffocated. In deep lakes they will often bury themselves in the mud and remain there during the winter.

Streams where turtles are wintering can be investigated, and with the aid of a steel hook on a long pole a search of their hiding places made, and if turtles are present they can be jerked out on the land and dispatched with a small hand-ax. In some localities the turtle population can be easily controlled by this method, especially where the range of the turtle is limited to very shallow sloughs which must be left every fall.

Many snapping turtles and their eggs can be disposed of by finding them during the nesting season. They will deposit their eggs in a safe place where they have made a depression with their hind feet. Nests may be as far as 500 yards from the shore. A dog can be trained to locate the trail of the turtles during this period.

The use of a .22 caliber rifle is a good method of eliminating these pests, and a careful stalk around a turtle-infested lake will sometimes yield as many as a dozen.

Wherever fishermen clean fish, turtles will be attracted, and if chunks of fish are impaled on hooks, the turtles can be easily caught. Use a large, well-sharpened hook, with a two-foot flexible wire leader on a heavy trot line. Attach the line to a large block of wood, but not to anything solid, as the large "snappers" are powerful enough to tear away if they can get a good footing. Procure a string long enough to allow the block to float on the surface of the water. It is then a simple matter to locate the blocks and destroy the turtles.

Great Northern Pike

This fish, as well as large bass, is capable of destroying great numbers of young waterfowl. The Great Northern Pike is by far the greatest maurader on waterfowl of any other predator in our Northern Forests. In large fish, half-grown loons are repeatedly found, and muskrats and mink have been found in their stomachs.

If possible, keep pike from duck lakes. It is often a saving to the ducks and pike both, as many good-sized fish are caught in shallow lakes after spring runs, and suffocate during hard winters. If a newly formed duck lake and its dams are not hindering a natural migration route of fishes, under no circumstances should this fish be introduced.

Carp

Carp have ruined many good duck lakes by destroying the vegetation and forcing the birds to go elsewhere. Carp root up aquatic plants by using their noses as pigs do their snouts. Lakes become muddy and in time the carp will destroy practically all of the attached vegetation.

Wherever carp are destroying aquatic vegetation in this manner, Conservation Departments should be contacted and arrangements made to seine out the carp. Never endeavor to kill carp by chemical means. They are easily seined during the spawning season, when they may be found in overflowed meadow lands, in shallow bays or in rivers.

Always be careful when introducing fish in lakes that young carp are not included in the planting.

Crow

The crow is a nest robber, and will often take and devour young birds not able to fly. In Saskatchewan some observers believe the crow destroys half the eggs and young of the waterfowl.

During migrations in the spring and fall, great numbers of crows can be shot by organization of teams for crow hunts. To make it interesting, prizes may be given to the winning teams.

Successful hunting of crows is dependent upon keeping out of sight by locating a good blind on some high hill on their flyway or near their roosts. Get a crow call or develop the voice to give the imitations of the various crow calls, and if the flight is good, excellent sport will be enjoyed. Hang a few dead birds to trees by their heads to act as decoys. A good set and a good shot will garner many crows. Crows' nests can be easily destroyed and young killed during the nesting season if time is taken to locate them.

While the crow is a predator of game birds, it would not be desirous to exterminate him entirely, but due to his uncanny wariness this seems hardly possible, and if adequate control measures are taken the birds will always be with us but not capable of doing much harm. We are desirous of eliminating concentrations of these birds and so reduce their numbers that they will not concentrate on duck-breeding areas.

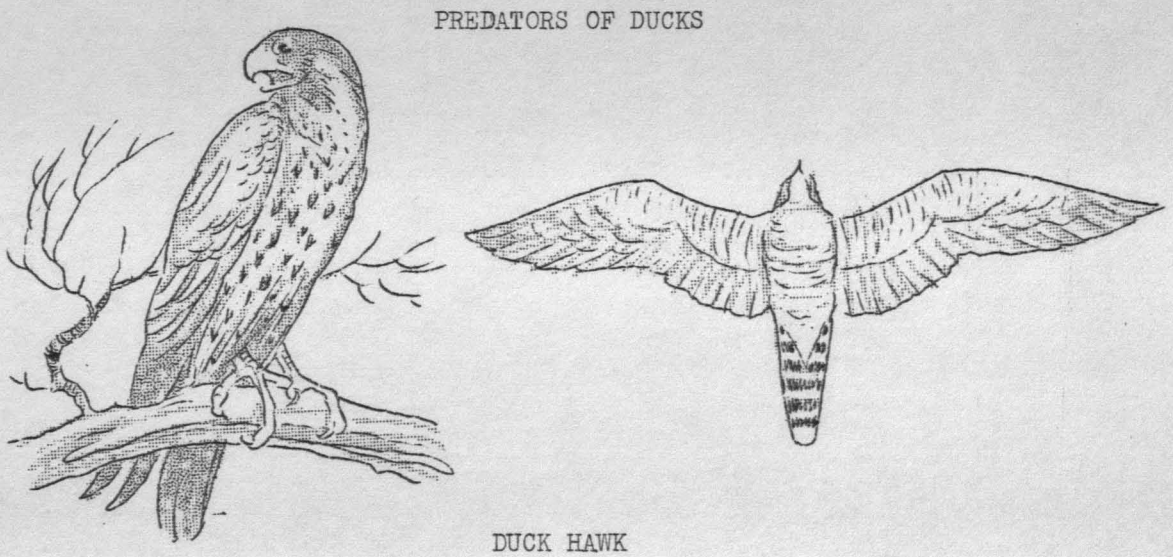
Duck Hawk

This hawk is a relentless persecutor of ducks, following them at all seasons. However, the total sum of their kills are rather small when compared to other causes of duck mortality. These birds can be controlled by shooting, but only experts who know them from other hawks should be allowed to hunt them, for many of our larger broad-winged hawks are quite harmless on the whole, and they should not be shot by mistake.

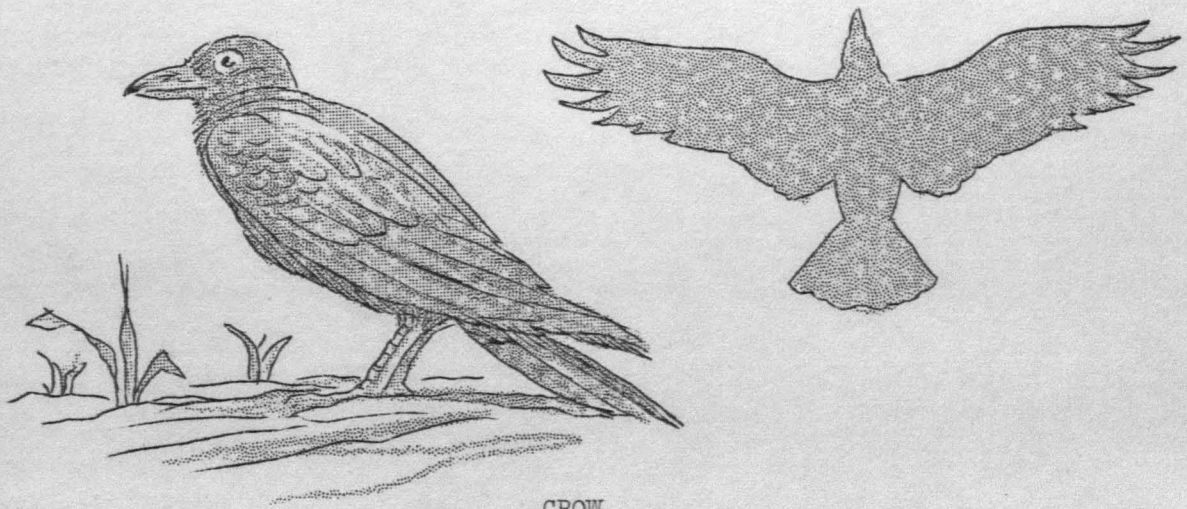
The duck hawk has a body the size of a crow and nests on rock ledges, whereas the sparrow and pigeon hawks possess bodies no larger than robins.

Figure 35

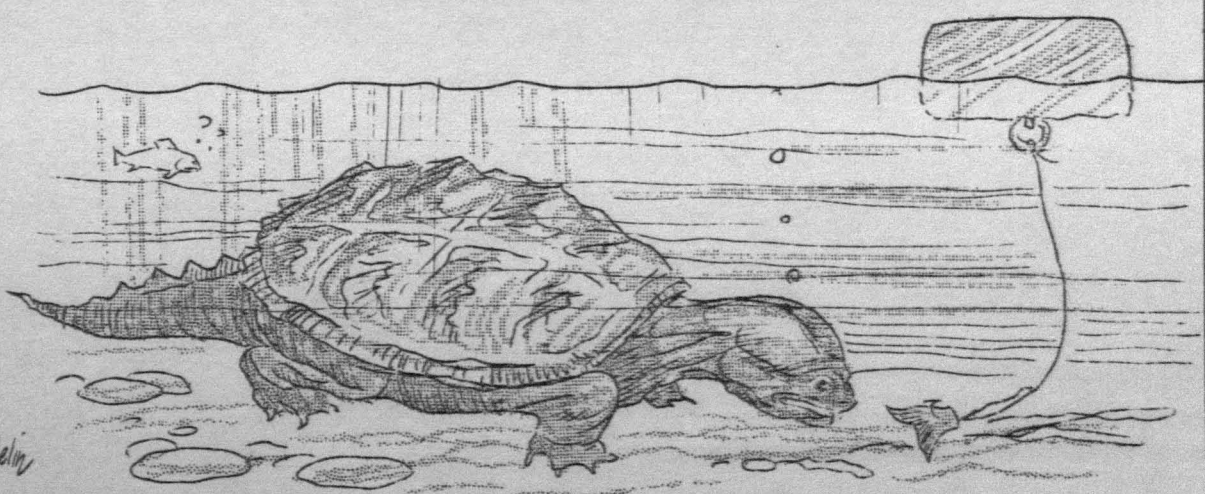
PREDATORS OF DUCKS



DUCK HAWK



CROW



SNAPPING TURTLE

RELATION OF BEAVER TO DUCKS

Beaver dams have in many places impounded suitable ponds for the propagation of ducks. Newly formed ponds are undesirable for waterfowl, but after several years during which the terrestrial plants and sod have rotted down and aquatic life becomes established, the possibilities of raising ducks on them is excellent.

Black ducks, teal and wood ducks have used beaver ponds extensively in the Lake States, and where such beaver ponds do not conflict with propagation of trout on good trout streams, they should be perpetuated.

Below these beaver dams earthen dams or log crib dams can be built. Very often when old beaver dams wash out, a high fire hazard is left due to snags and grass, and it will be a great saving in money to perpetuate these water areas.

Rice and other duck foods can be advantageously planted in beaver ponds, provided circulation of waters is not poor and acid conditions do not develop.

THE DEVELOPMENT AND MAINTENANCE OF WATER AREAS ON THE NATIONAL FORESTS FOR WATERFOWL OR FISH PROPOGATION

All drained lakes and marshes which have proved useless for the purpose for which they were drained or would be more useful if restored to their natural conditions should be investigated.and their waters restored.

Due to the fact that waterfowl face a serious reduction in their numbers because of the destruction of their habitat through farming, drainage and drought, it is of utmost importance that favorable breeding areas be created for them. Forests must appeal to the bird conservationist as well as those concerned with the preservation of timber resources. It has been noticed that on every forest a serious shortage of breeding grounds exist. Those that have been destroyed must be restored and new ones created if possible. Also, many fine fishing lakes have been ruined by receding water levels and the installation of dams of sufficient height at their outlets will often retain the desired head of water.

Preliminary Work

A survey of each ranger district should be made and the possibilities of the creation of suitable duck lakes determined. Very often dams may be built across small creeks, thereby flooding large meadow lands. Also, ill-advised drainage projects should be investigated. Marsh or lake conditions which can be created will lessen fire hazards and insure sport. It will also raise the general water levels and therefore create a faster tree growth.

Before the actual installation of the dams the following steps must be taken:

1. Determine the area of the pond at the established high water level. A compass and Abney survey will suffice. for this determination. A topographic map should also be made of the site to indicate the depth of the water when the pond is full. This may readily be accomplished by taking cross-sections of the area to be submerged and checking the contours from the elevations so taken.

2. Determine the ownership of the land surrounding the area to be flooded and either procure easements from the private land owners or arrange to buy their lands which will be affected.

3. Investigate the soil conditions in regard to imperviousness to water. If there is a porous top soil determine how far down the impervious substratum is located. Use a well auger, post hole digger or a shovel. The core of

the dam must reach this impervious subsoil if possible. Sand or gravel will not hold water, but clay, gumbo or a mixture of clay and gravel will. Where no impervious soil exists within a reasonable distance and excessive seepage is liable to occur, all of the marsh site or a portion of it should be lined with clay to a depth of one foot and puddled. This method will retain water at all times.

An average water depth of three feet will prove the most desirable for the propagation of waterfowl, but if there is excessive seepage or evaporation an excess of water must be collected during periods of flood conditions. A much greater depth of water must be kept for fishing lakes - (10' - 20').

Evaporation may be guarded against by:

1. Secondary catch basins above the lake - these to be deep and capable of being drained completely into the lake.

2. Improving the water supply by tapping new sources, constructing ditches, etc. Also pumping plants may be installed and underground waters reached.

Silting may be guarded against by providing catch basins into which turbid waters may be led before entering the lake. Such catch basins must be constructed in areas where silting is known to occur. A series of catch basins, one leading into the other, can be constructed. These catch basins may be used to store excess waters as a guard against drought or seepage. Check gullying by simple rip rap and planting of trees, etc. Provide a long flat inlet to the lake if possible to prevent silting.

Seepage accounts for a great loss of water in many of our lakes. Excessive seepage may be guarded against by the following methods:

1. Remove all pervious material such as gravel and sand if such material is liable to invite seepage. Cover such areas with clay to a depth of one foot and puddle.

2. A series of reservoirs will provide an excess of water which may be let into the lake as needed.

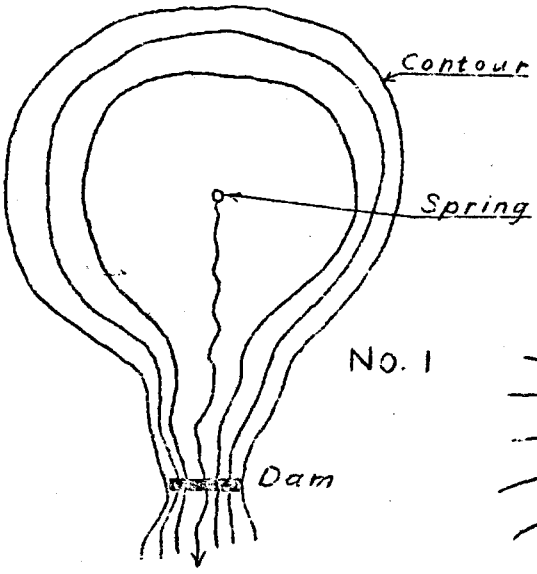
CONSTANT WATER LEVELS SHOULD BE MAINTAINED AT ALL TIMES IF POSSIBLE.

Fluctuating water levels prove disastrous to duck foods and to fish life. Provide for an even level of water.

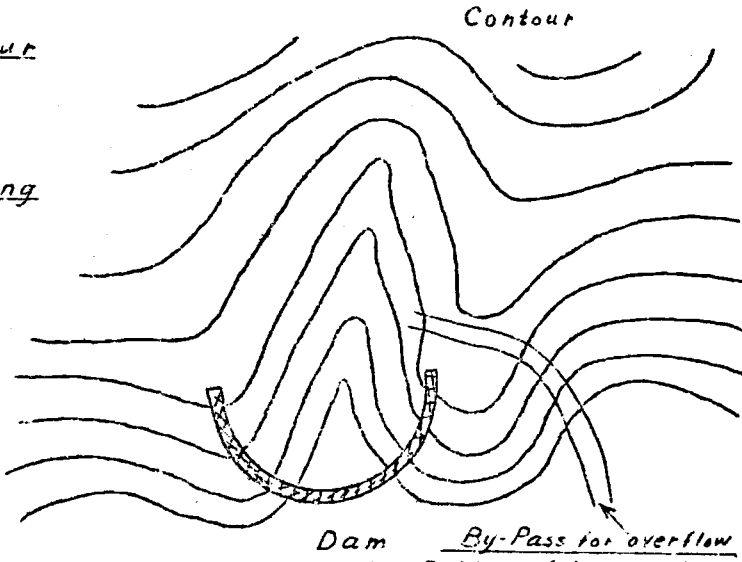
For wildfowl propagation, do not flood lakes up to high or wooded banks. Leave a three chain strip of low grassy shore line which will make suitable nesting sites.

Due to various State laws regarding damming and controlling of waters, it will be necessary to fill out the attached form for all proposed dam sites and submit three copies to the Regional Office for checking and approval°.

°One copy will be sent to the State Conservation Department; one will be retained by the Regional Office and one returned to the Forest Supervisor.



No. 1



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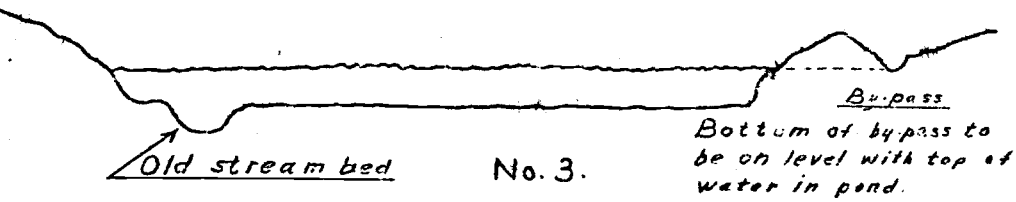
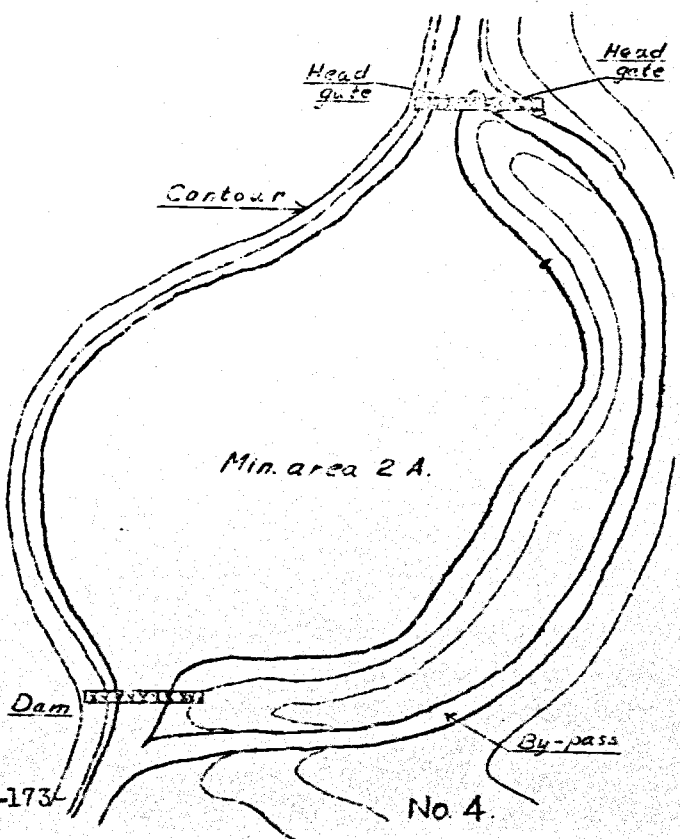


No. 3.

1. Pond formed by damming small spring.
2. Pond formed by damming small blind valley and catching run-off.

3-4. Method of making a lake where a large stream or a stream liable to flood is to be used.

Note: Minimum limit of ponds 2 acres.



No. 4.

Figure 36
DAMS AND PONDS

G
Fish & Game, R-9
Form No. 113-R-9 (Rev. 3-25-35)

Project No. _____
(To be assigned by RO)

REGION NINE DATA SHEET FOR DAMS

Forest _____ Unit _____ State _____

Location: Sec ___ T ___ R ___ Name of Stream or Lake _____

Purpose of the project _____

Type of dam proposed _____

°Present water elevation _____ Date _____ °Normal water elevation ____

°Ordinary high water elevation _____ °Proposed water elevation _____

Has a limiting elevation been established by any Federal or State statute ___

If so, by what statute _____

What is the elevation fixed by the statute _____

Does the proposed water elevation comply with that fixed by the statute ___

Area of tributary watershed _____ A. Area of lands to be inundated _____ A.

Ownership of lands to be inundated _____

Must inundated lands be purchased or will an easement be granted _____

Is spillway to be in or around dam ____ °Crest elevation ___ width _____ ft.

How will impounded waters be released _____

Freeboard of non-overflow parts of dam above impounded water elevation ___ ft.

Type of foundation soil at site _____

Kind of soil available for borrow _____

Remarks _____

_____

If plans have been prepared a complete set, including inundated land data, must be submitted with this form.
If plans have not been prepared submit complete survey information, topographic, map, profile and suggested structure as called for on the reverse of this form.

Estimated cost of inundated lands. $ ____ Estimated cost of dam $ _____

Field work by _____ Date

Recommended _____
Chief of _____ Date

Recommended _____
State or Forest Officer Date

Approved _____
Regional Forester Date

Approved _____
State Conservation Dept. Date

SUBMIT THREE COPIES OF THIS FORM

Note - All elevations marked with a ° must be on the same datum.

INSTRUCTIONS FOR SURVEY AND MAP

1. Survey - (a) If available use Government bench mark; otherwise set a bench mark at convenient point at dam site and assume elevation of 100.0 ft. Refer all elevations to datum used.

(b) Run Abney level profiles across stream or lake along:

(1) the center line of the dam

(2) parallel to (1) and 200 ft. downstream

(3) parallel to (1) and 200 ft. upstream. Extend profiles well beyond both ends of dam.

(c) Ascertain the present, normal and ordinary high water elevations at dam site

(d) Locate outline of present stream or lake within area to be inundated, Locate outline of water at proposed pond level.

(e) Tie one point on survey to nearest legal subdivision corner

(f) Dig or make soil auger test holes near each bank of stream or lake on center line of dam and 50 ft. each side. Also make test holes near each end of the dam.

II. Map - On a sheet of cross section tracing paper plot the following:

(a) Profile: On a scale of 1" equals 10' plot profile I-b-I and show existing and proposed water elevations.

(b) Topographic Site Map: On a scale of 1" equals 40' plot a topographic map of area included between profiles I-b-2-and I-b-3 showing contours at a 1' or 2' interval, all topographic features and the position of the bench mark and each test hole.

(c) Test Hole Logs: On a vertical scale of 1" equals 10' plot a graphic log of each test hole showing elevation of ground at top of hole and soil classification at various levels.

(d) Project Map: On a scale of 1" equals 100' plot a map showing present water edge, proposed water edge, property lines, legal subdivision lines, ownership of land, location of dam, cover types, etc.

III. Suggested Structure - (a) Show typical cross section, downstream elevation, spillway, etc., of dam suggested. Use a convenient scale and show all water levels in proper position.

Additional Remarks

UPLAND GAME

Upland game includes all the species of birds and mammals that are pursued by man for sport or meat not included under waterfowl or furbearers. For convenience this large group can be broken into two subdivisions including, big game or the larger mammals;and small game , including the smaller birds and mammals.

The species included under big game in this region are, the white-tailed deer, moose, caribou and black bear.

The species included under small game are bobwhite quail, ruffed grouse, pinnated grouse, sharptailed grouse, pheasants, wild turkey, woodcock, rabbits, hares and squirrels.

Factors in Animal Productivity

The number of animals that may be utilized by man is determined by the result of two opposing forces working on the animals in question. One force involves the capacity of the species to reproduce and is known as the " biotic potential". The opposing forces which are constantly working to reduce the numbers of animals are known as the "resistance of the environment". The factors included under biotic potential include the number of primary oocytes produced by a female, capacity of a female to nourish the young or incubate eggs etc. Some of the factors of environmental resistance are: adverse weather, lack of foods, predatory animal activities etc.

THE WHITE-TAILED DEER

The white-tailed deer is without question our most important big game animal. Deer have probably been present in this part of North America long before its discovery or settlement, but it is believed by many that logging operations and the partial clearing of the land has increased their numbers greatly. Through management Pennsylvania brought back deer to high populations after they had been almost exterminated. Many examples are on record where uncontrolled populations have been allowed to the extent that they have almost destroyed their food supply.

Objectives

The estimate as to how many acres of forest it takes to support a deer varies from as low as seven acres to as high as 100 acres. It is believed that in a forest of mixed conifers and hardwoods 66 acres will support a deer. In general, then, it should be the objective of the Forest Service to maintain one deer for each 66 acres of forest land designated as deer range.

Leopold° believes it is safe practice to remove one-fifth of the deer crop each year. In an area having a maximum stocking of ten deer per section it should be possible to remove two deer per year.

The "take" will have to be based on the total area rather than any one section however, and will vary with different years and different types of country. The recommendation for utilization should be based on census figures and be determined in advance of the hunting season.

The management of deer involves a series of operations and the collection of data for:

1. Establishment of Refuges for Deer
2. Correlation of Timber Management Activities in Relation to Deer
3. The Deer Census
4. Utilization of Deer
5. Deer Mortality
6. Analysis of Deer and Moose Wintering Yards to Determine the Condition of the Browse Plants
7. Deer Yard Conditions
8. Miscellaneous Management Practices on Restocking. Culling of the Herd, Diseases, Supplementary Feeding, etc

Deer Study Areas

In order that observations may be made in a systematic manner, an area of approximately thirty-six sections should be designated as a deer study area. This sample should contain samples of all of the forest types found in that particular forest.

° Aldo Leopold - "Game Management, 1933."

I. ESTABLISHMENT OF REFUGES FOR DEER

Pennsylvania has developed a system of refuges which has helped to increase their deer kill from 200 legal bucks taken in 1907 to 22,822 legal bucks taken in 1929. It seems logical, then, to use the experience of this state as a basis for deer refuges on the National Forests. It is believed that refuges of four to eight sections are approximately correct if conditions of water, forage and wintering grounds are to be found on this size of area. Does will go approximately two miles for water during the fawning period but should not be required to go farther than this. Likewise where snow conditions are such that deer are forced to yard during the winter period (snow from 24 to 48 inches deep) a considerable area of suitable yarding territory should be included in the refuge. (See winter yarding grounds as described under "Analysis of Deer and Moose Wintering Yards.")

It is believed that one refuge for each 144 square miles or four townships is about right for deer. This, of course, will depend upon the demand for hunting and the presence of natural refuge areas. Where the lack of roads make large areas back from roads inaccessible to hunters, or where other types of refuges are present, it will not be necessary to establish new refuges on the National Forests.

For additional information, see the part of the Manual on "Refuges for Wildlife".

2. CORRELATION OF TIMBER MANAGEMENT ACTIVITIES IN RELATION TO DEER

Note - In applying the following procedures the Forest Officer should constantly keep in mind that an animal is like a plant in that certain conditions must be present if it is to develop and reproduce. All of the daily requirements of an animal must be found within its daily cruising radius which is approximately two miles. These requirements include a combination of adequate food, water, cover, bedding grounds and openings. If any of the conditions necessary for producing deer are lacking the area will be less productive than if all requirements were fully met.

In the past lumbering operations and fire have combined to keep sufficient openings in the forest to allow for an abundant growth of shrubs and ground cover. As large areas are now being planted to conifers and methods of fire prevention and suppression are improved it is believed that deer and other wildlife will ultimately decrease unless definite plans are developed with the requirements of deer and other animals in mind.

Openings

Openings in the forest serve many purposes as yet not understood by man. It is known, however, that areas which contain no openings are not productive of high populations of animal life. Such openings need not be large or regular in shape to be effective. Openings of one-half to two acres are sufficient to satisfy the needs of deer if enough are scattered through the area. For optimim production of deer it is thought at least ten percent of the area should be open. Abandoned farms and old fields may fill this need for openings and some of these open spaces should be left unplanted, particularly if seeded to domestic grasses or legumes. Roads, trails and fire lanes all help to meet the needs for openings, but the benefits from these are somewhat neutralized by making it easier for both poachers and legal hunters to shoot deer. Old log landings and orchards are particularly desirable as openings if they contain clover or scattering apple trees, both clover and apples being particularly desirable as food for deer. Openings which have a southern exposure will produce food earlier in the spring than north slopes. Where denuded areas are being planted some openings should be left on each section; where a 100% catch is obtained in planting it will probably be necessary to clear cut for the purpose of making openings. Stands of hardwood which are being underplanted should not be planted solidly and areas which have a poor planting chance should be left free from underplanting, as in the future it will probably be necessary to remove some of the less valuable native trees to provide openings as the coniferous underplantings close in. Hardwoods which have a low commercial value and are not underplanted will furnish some forage during the time of the year that the ground cover is not available.

Location of Openings

Probably sufficient openings will result if planting failures are not replanted but where the question of position of openings is involved the following rules should be followed:

a. South and east slopes preferred.
b. Openings near watering places.
c. Openings protected by good surrounding cover away from all traveled roads except where game is being used as a tourist attraction.
d. Openings containing clover, strawberries, raspberries and those adjoining oak or beech trees.

Providing for a Continuous Supply of Food Plants.

The production of food plants can be encouraged by the cutting of groups of trees so as to leave open spaces in the forest. Cutting should be done in accordance with accepted silvercultural specification systems as far as possible. In deer wintering swamps where food for deer is short, the cutting should be made during the winter and spring when the snow is deep and the deer are in need of supplementary food. Species which are of little timber value but of high food value for deer feed can be removed in this way and will serve the triple purpose of improving the stand, creating openings and furnishing food for deer during the late winter months. The limbs should be left on the trees until the deer have used the leaves and branches for food. Large dead logs and other debris should be salvaged or piled and burned according to Forest Service standard instructions. Ash piles in any openings are very desirable from the standpoint of nutrition as the plants which grow on these burned places seem to have a high mineral content and are much used by deer. The burning of dead material also has the effect of reducing fire hazards, as well as releasing vines and shrubs which are highly desired by game animals.

This plan for improving ground cover by creating openings may be worked on a broader scale in deer wintering swamps that have been browsed out or are otherwise lacking in ground cover and reproduction. Here enough trees should be removed so that ground cover and shrubs spring up abundantly. Clear cutting in strips or patches in which one-fourth to one-half of the stand is removed should be followed in marking for timber sales. Demonstration areas of one to 5 acres should be treated as outlined at once where deer wintering swamps are known to be short of food. Such a cutting will allow for a regeneration of the ground cover and shrubs and vines which are necessary for a productive deer yard.

Other cultural operations with the production of deer food as an objective resolves itself into four phases.

a. Leaving of trees desirable for deer food.
b. Coppicing
c. Planting of trees, commercial and otherwise.
d. Planting of grasses and legumes.

German foresters are now going to the expense of planting and fencing small groups of hardwood trees in order to make their conifer forests more suitable for game. Where we now have a mixed forest it would seem logical to plan to retain part of the area in hardwoods suitable for game maintenance and in others to plant hardwood species that are suitable for both game food and timber production.

Trees and shrubs furnish food for wild animals in two forms. These are:

A. Mast or seed products.
B. Leaves, buds bark and stems.

These trees which are important for their seed product or mast include the oak, beech and chestnut. Of this group white oak and beech are now being planted. Where other oaks are already present, provision should be made for maintaining at least 5% of the area for food purposes. A half acre in every ten should be sufficient for furnishing feed for a normal population of deer. Where old spreading beech trees are present at least two fruit bearing trees per acre should be left, unless beech of good form and productiveness are present.

Commercial trees important for browse for deer include hard maple, basswood, birches, white cedar and hemlock. Where plantings of these species are made for deer they should be arranged in small groups where the site is suitable, rather than in large blocks. Cedar can be used along streams or in wet places and serve the triple purpose of furnishing shade for streams, emergency food for deer, while producing a valuable timber crop. Willow and box elder are non commercial species which makes excellent food for deer and moose.

Stand improvements in hardwoods will result in coppice sprouts which are valuable as deer browse. Basswood is practically the only tree that will reproduce to commercial sizes from large stumps however. Aspen will produce suckers that are valuable for deer browse.

A partial list of trees, shrubs and other plants on which white-tailed deer are known to feed in Michigan (Bartlett) and on the Allegheny Forest in Pennsylvania (Ranger Varney) is as follows:

Michigan	Pennsylvania (Allegheny)
Ground Hemlock	Mountain Ash
Maples	Viburnum
Hemlock	Browse°
White Cedar	Chestnut
Basswood	Dockweed
Elderberry	Devil's Club
Mountain Ash	Elderberry
Juneberry	Apple
Birch	Bracken Fern
Dogwoods	Fire Cherry
Elm	Poke Weed
Beech	Service Berry
Poplar	Shrubs sp.°
Oak	Witch Hazel
Wild Cherry	White Oak
Ironwood	Thistle
White Pine	Huckleberry
Norway Pine	Hickory
Jack Pine	Red Maple
Tamarack	Red Oak
Tag alder	Gooseberry
Willows	Sumac

° Species not given

Pennsylvania (Allegheny)
(Continued)

Sassafras
White Pine
Plantain
Misc. Weeds
Willow
Birch
Black Cherry
Grass
Red Bush
Blackberry
Hemlock
L. T. Aspen
Sugar Maple
Sedge Grass
Aspen
White Ash
Beech.

The value of different natural foods has been indicated by an experiment carried on at Willsboro, New York.° John B. Burnham, Koort Burnham and Bob Darrow tested out different foods on deer in inclosures. The results were as follows:

Kind of food tried	Effect on Deer
Beaver - Meadow Hay	Nearly starved to death before diet was changed.
White Cedar) Yellow Birch)	Even better than alfalfa hay.
Balsam Browse	After first week deer lost weight and nearly starved to death before diet was changed.
Hemlock	Good.
Pine	Lost weight; of little value as food.
Spruce	Lost weight; of little value as food

Plants which can be planted in open spaces or along fire lanes are:

1. Alsike Clover
2. White Dutch Clover
3. Crimson Clover
4. Alfalfa - Hardigan and Grimm variety
5. Harbin Lespedeza

° By J. Victor Skiff, Licking Starvation in "Field and Streams" December 1934.

6. Yellow trefoil (Medicago lupulina)
7. Wild lupine
8. Flat Pea (Lathyrus silvertris var. wegneri)

The first five seeds listed can be obtained from any reliable seed source. At present an attempt is being made to discover a source of seed of yellow trefoil, wild lupine and flat pea.

The seed of yellow trefoil may be difficult to obtain except through other seeds in which the trefoil is a contamination. Seed analysts at the state capitol of each state, or the botany departments of the state agricultural colleges may be able to furnish this seed. Korean Lespedeza can be used in the Southern Forests of Region Nine, and will give a ground cover that will hold the soil as well as furnish forage for deer and other game.

In selecting the above species forest officers should be ruled partly by what is indigenous to the region. The plants which are not native to the region should be tried out experimentally on carefully marked plots along road banks or on fire lanes to determine their suitability to the soil and to climate conditions.

Seeding of these species should be made either early in the spring with a nurse crop such as oats or barley or sowed during the summer after the first rains in August. Where legumes are planted with a nurse crop the nurse crop should be cut before it begins to head out, as if it is allowed to head it takes large quantities of moisture from the soil. Where snow covers the ground before the ground freezes legumes will probably grow readily without freezinf out.

Alfalfa requires a soil that is either neutral or slightly alkaline. Where it is to be grown on an acid soil, ground limestone should be added to the soil several weeks before time to seed the alfalfa.

All of the forage plants should be seeded on a well packed soil and raked in lightly, being careful not to cover the seeds deeper than half an inch.

Danger of Attracting Game to Highways

Main highways are a hazard to game because of the danger from cars and from both legal and illegal hunting. This hazard will be neutralized somewhat as the scenic strip along the roadways develops. (See Recreation Handbook.)

Food patches back of these cover strips and away from the roads will help to lead the deer away from the dangor along the roads.

To Provide Cover

Cover is necessary to protect deer as they pass to and from their bedding grounds to obtain food, water and salt. Low swales which provide protection from the wind during the winter may be made more effective by placing conifer plantings around the borders and along the edges of gullies which are used by deer.

Management of Yarding Grounds for Deer

The extent to which deer yard seems to be proportionate

to the depthsof snow that prevails over the winter periods. The yarding characteristic of each herd will need to be made with reference to snow conditions, timber, type, etc. The yarding areas should be classified into cedar yards and hardwood yards. The four principal tree species of each of these types should be indicated on the map.

Forestry practice for the improvement of deer wintering swamps should be based on the analysis of the swamp as determined by form #90 R 9.

3. DEER CENSUS

The deer census is one of the most difficult but most important activities in deer management. With an animal as valuable, both from the standpoint of the hunter and the general public, it is essential to keep the range stocked to the point where the forage is utilized to a degree that approaches 100%. It is equally important to give the hunter an opportunity to remove the increment above this amount and to insure that the deer population does not destroy the forest reproduction and ground cover. It is poor management to allow the deer herd to increase to the point where more than the annual growth of forage is consumed. Such a procedure is dangerous both to the forest and to the deer herd.

Experience of the past year has shown that the use of indices of various kinds for determining deer populations are not reliable. Likewise the differences in physical equipment on different forests combined with different weather conditions when the various methods have been used make the results unreliable.

The information needed on numbers of deer in connection with deer management is as follows:

1. Total number of deer present classified as to
   a. Adults and
   b. Fawns (Under one year old.)

2. Sex Ratio

It is obvious that all of the deer on even so small an area as the ranger district can not be counted. The problem then resolves itself into getting an accurate count on representative sample areas and then computing the total number on the basis of these samples.

The Census Area

If the areas used for ruffed grouse census plots are also representative for the deer range, then these marked plots can be used for deer drives. At least four sections should be used for each ranger district. If a larger sample can be used for the census it will give more accurate results. If the ranger district is made up of types of land with different carrying capacities for deer, select samples to represent each of these different areas. Do not pick the range which is carrying the most deer or that which has the least. Make the samples representative of the ranger district.

Time of Making the Census

October, preferably the last two weeks of the month, will give the best results for census work. This time is late enough so that the leaves are off from the trees and allows both "drivers" and "counters" a better opportunity to observe the game. It is also far enough in advance of the hunting season to allow the game to settle down before the hunting season actually starts. A count at this time will give the following data:

a. Total number of Deer on the Sample Area
b. Sex ratio of Mature Animals (but not fawns)
c. The number of Fawns

The fall has been selected because counts at other times have involved the following difficulties:

a. Possible injury to the Deer due to deep snow
b. Sexes are hard to distinguish because bucks have shed horns
c. Lack of physical equipment, as snow shoes, and differences of weather conditions.

Boundaries of Census Areas

The principle on which a game drive is conducted is to flush the game out of the census area and across roads, railroads, fire lines or rivers where men stationed for that purpose can count the animals as they cross the cleared space around the border. Therefore, other things being equal, areas where roads or other open spaces are available will be desirable for census purposes. If the census areas are not surrounded by roads or open lanes, an open space can be made by cutting an opening four to six feet wide along the borders. The sample need not be regular in shape so long as the exact area is known.

Working the Census Area

Game drives must be carefully organized previous to the time the actual "drive" takes place in order to get the best results and to insure the best use of the man-power involved.

Lines thru the area to be driven must be marked each 1/4 mile, the lines being run with the use of a compass so as to keep them parallel. Care must be used not to blaze trees which are of commercial value. The marking of non-commercial species is permissable however, provided it is on Federal land. If the drives are to be made on private land, permission must be obtained from the owners for making the drive and marking the lines. The marking activity must be performed far enough in advance of the time of actual driving so that the game will have time to settle down before the census takes place.

Organizing the Drive

A line of men is formed at intervals of not more than two chains. One chain intervals will give better results if enough men are available. Each spot where a driver is to start must be marked with a strip of white cloth. There must be a leader at each quarter mile along the line to keep the men travelling in the right direction and to hold the line straight and to keep the men at the correct space intervals. This is essential. The men on the drive line will need to be given a time designation as to exactly when to start the drive. Ample time should be given so that the "counters" have had time to properly place themselves before the drive starts. A constant check must be kept by conversation between the "drivers" and the foremen in the drive line, so that the line is kept straight and each driver kept at the proper distance from every other driver. The more noisy the driver can be, the more animals will be forced across the counting lines.

Each driver will need a slip of paper on which is a list of animals found on the area. Any animals which break back thru the line will be listed on the paper. It must be clearly understood among the men that only animals which cut back thru the line will be listed. Also, each driver must indicate to those next to him in line whenever he lists an animal so that the same animal is not listed by some one else. The slip for this tabulation will be as follows:

DEER CENSUS DRIVE Date_____

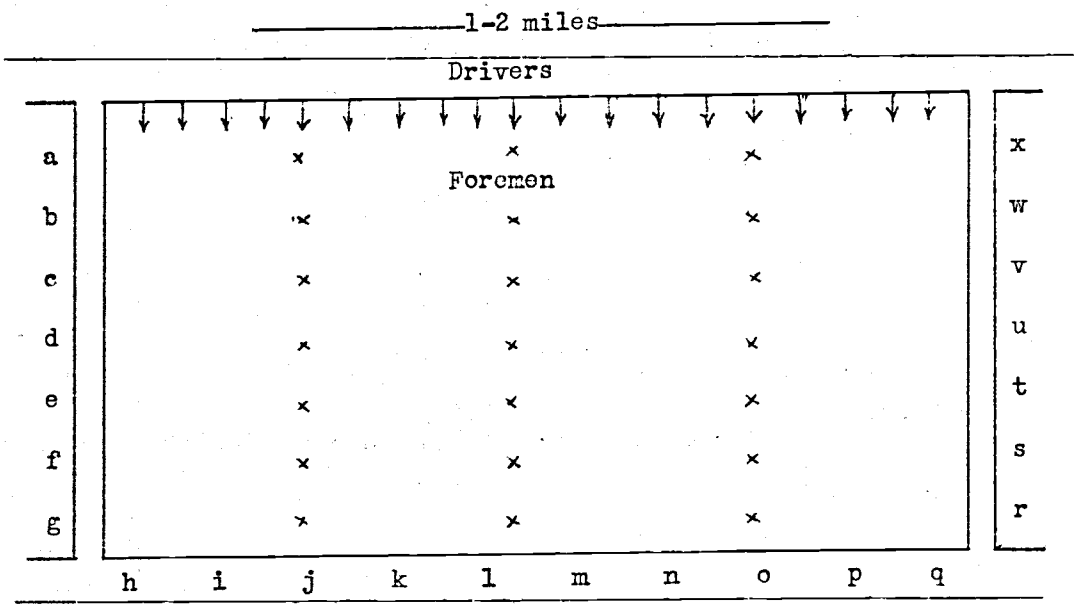
FOREST_____ NAME OF DRIVER_____
OR
RANGER DISTRICT_____ COUNTER_____

Deer			R. Grouse	Rabbits	Squirrels	Wolves	Coyotes	Dogs	Others
Buck	Does	Fawns							

Vary the headings according to the various animals to be found on the area. Hold each Foreman responsible for collecting the slips from the men in the line designated to him.

The "Counters."

The men designated as "counters" will take their position at previously marked stations on three sides of the census area. These situations will be close enough together so that a counter can see all of the open space between himself and the counter next to him and so he will have to look in only one direction. The "counters" should be warned to keep their position until the "drive" has passed them at least a half mile. They must be absolutely quiet and observe constantly the territory between himself and the next counter. There should be a reliable leader in charge of each half mile of road on which the counting is done. The counter slips should be collected by the foreman in charge of each part of the line.



The results of the deer census must be reported to the Regional Office on:

Summary of Fall Deer Census
Fish and Game Form 183 R-9

This form will replace the Summary of Form #73 R-9 and is due on November 10.

G
Fish & Game
183 R-9

FALL DEER CENSUS

Date _____

Due November 10.

Census Area T _____ R _____ S _____

Forest Ranger District Work Unit	Bucks	Does	Fawns	Uncertain	Total	Sex Ratio F	Sex Ratio M	Deer per Section Fall	Total Population Fall
	2	3	4	5	6	7	8	25	26

*Cross out Patrol Inventory on Form 128 R-9 Sheet 1 and insert "Fall Deer Census."

6. Sum 2-3-4 & 5. Insert "Total in place of "Miles per" in Form 128 R-9

7. F= $\frac{\text{Total Females X 100}}{\text{Total of Known Males \& Females}}$

8. M= $\frac{\text{Total Males X 100}}{\text{Total of Known Males \& Females}}$

9.) Insert "Census" for "Patrol." -128 R-9

10.) Use 9 for Month and 10 for Date - 128 R-9

23. Deer per Section = $\frac{\text{Total Number of Deer on Sample}}{\text{Total Number of Sections in Sample}}$ (Insert Fall in place of Spring in column 25 Form 128 R-9.)

24. Total Population = Total Number of Deer Calculated on Basis of Sample (Insert Fall in place of Spring in column 26 Form 128 R-9.)

EXPLANATION

The "Fall Deer Census" is replacing the "Patrol Inventory" as a census method. This should give accurate figures for a representative small sample area of each ranger district. Columns two to six will be used for tabulating the results of this census on the sample areas. Give the results as they are taken when reporting them from the ranger district to the Supervisor. The Forest Supervisor will list the various sample areas by ranger districts when reporting to the Regional Office. Column 25 is a very important figure and must be based on the fall census. Do not attempt to manipulate this figure. Base it on the deer drive. Column 26 will be calculated on the basis of the number of deer per section as found in column 25 multiplied by the number of sections of typical deer area on the ranger district. This should give the total number of deer in the ranger district.

Unit Acres-Miles-etc	-Cost Data- Estimate			Accomplishment		
	Labor	Material	Total	Labor	Material	Total

On back of each data Sheet.

4. UTILIZATION OF DEER

Utilization is the purpose of production. In the case of deer this utilization has two forms; one, a game animal to be harvested by hunting and, two, a resource that is attractive to tourists. Groups utilizing deer by the first method are likely to forget the second group and the value of this second use. It is the forest officers' function to keep those two uses balanced according to the degree of demand of each and to see that both are served to the highest degree possible. It should not be forgotten that when deer are so numerous that large numbers can be seen along the roads, that the deer population has reached a point where the numbers of deer may be a menace to the forest cover.

Cooperative Hunting in the National Forests

Cooperative hunting involves the voluntary cooperation of deer hunters, State Conservation Officials, Forest Service Officers and local residents.

The presence of large numbers of work camps and forest workers in the National Forest increases the danger of accidents during the hunting season. Because of this increased danger the Forest Service must take every precaution to protect forest workers during the hunting season.

The purposes of cooperative hunting in the National Forests are:

a. To protect Forest workers from accidents during the hunting season.
b. To guard against the increased fire hazard because of many hunters in the forests.
c. To gather information on the number of deer and bear taken by hunting.

Protection of Work Camps and Forest Workers

It is believed that if the proper thought and preparation is made no hunting accidents to workers in the forests need take place. The responsibility of taking these precautions rests with the men in charge of camps and responsible for organizing work crews.

In order to take the proper precautions the following action should be taken:

a. Work personnel should be lectured by appropriate officers in camp on the dangers present during the hunting season and the proper precautions to take to prevent accidents during this time.

b. Signs should be posted not less than a mile from each camp on all roads leading into such camps. These signs should follow the specifications found on the next page.

c. The work in the woods should be organized so that workers are kept in groups. All groups should be warned of the danger and encouraged to make their presence known by being noisy during the hunting season.

d. Signs should be posted on roads at least half a mile from each work crew. These signs should indicate that groups of men are working within a half mile.

e. As far as possible, prevent men from walking through the woods singly. Where it is necessary for men to walk through areas open to hunting, see that each man is properly protected with conspicuous red coverings for his clothing.

f. Warn men not to use white handkerchiefs in the woods at any time during the hunting season. Such handkerchiefs may be mistaken for the white flash of a deer and an accident may result.

Increased Fire Hazard

The danger from fire depends on weather and the condition of the forest. If there is no snow and the weather has been dry the danger from fire will be greatly increased because of the hunters in the woods.

Number of Deer and Bear Taken by Hunting

It is very desirable that the Forest Service know the number of hunters that use the National Forests for hunting and the numbers of deer and bear that are taken out during the open season.

It is believed these results can best be accomplished by placing checking stations on all main roads that enter the forest, and by notifying residents within the forests of the manner in which camps and work crews will be protected. Local residents should be notified previous to the hunting season and should be questioned regarding the amount of game taken during the hunting season. It should be emphasized that the checks are not in connection with law enforcement.

The Checking Stations

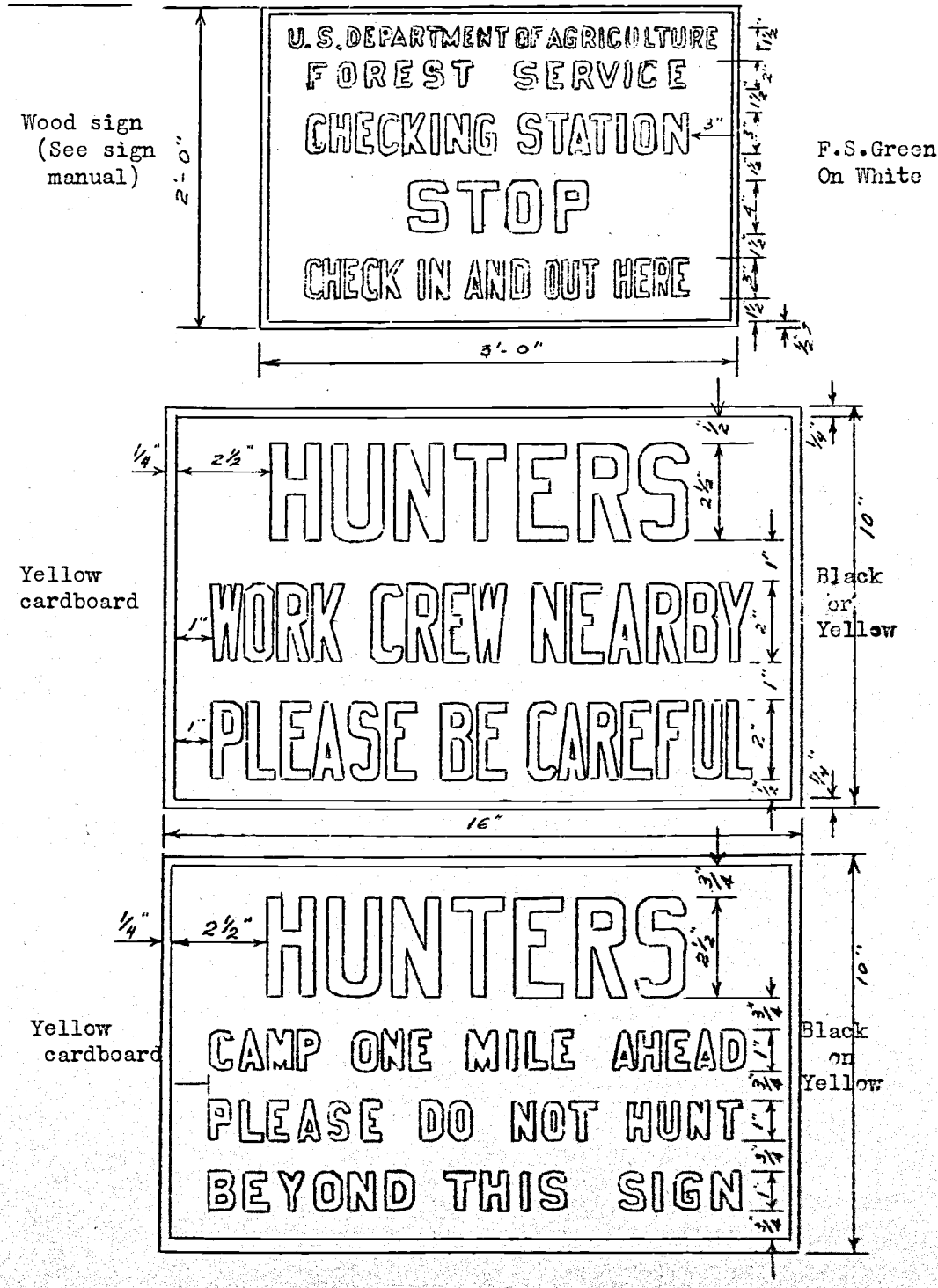
The purpose of the checking stations are to warn hunters of the danger of shooting forest workers and to determine the numbers of hunters and the number of deer and bears shot in the National Forests.

A checking station should consist of men stationed along the road just outside the boundary of the forest. The station attendants should be on duty long enough before the hunting season to warn hunters going in and to be kept on duty until all hunters are out of the forest. Checking stations should operate on a twenty-four hour basis where possible.

Signs as specified below should be placed so as to indicate that all cars should stop at a checking station 150 feet beyond.

Specifications for the various signs are as follows:

Materials



The attendant at each checking station should be selected for his ability to get along well with the public, and his knowledge of local conditions. Each should be instructed to be as helpful as possible to hunters in giving road directions, location of CCC camps, game conditions, etc. A map of the forest should be posted at the station for handy reference. The checking station man should be warned not to detain hunters longer than necessary and to be tactful with those who try to start arguments.

Each checking station should be given a number, as Huron 1, etc.

The duties of each checking station are as follows:

Hunters Going In -

a. Ask hunters if they are hunting within the boundaries of the National Forests. If they are hunting within the National Forest, place a small green sticker on the windshield.
b. Warn hunters of the presence of men working in the woods and of the location of CCC camps.
c. Tell them how the location of camps and work crews are indicated.

Hunters Coming Out -

a. The purpose of checking stations for hunters coming out is to determine the hunting pressure on the Forests and the number of deer and bear taken during the open season. The station attendant should have the tabulation sheet so that the material can be obtained rapidly and with the least possible loss of time.
b. Plans for placing of checking stations and station attendants should be worked out carefully before the hunting season begins. The attendant should be provided with a board or tatem holder with form # 91 R-9, so hunters are detained as little as possible.
c. Hunters should be asked for only the information that is not in evidence, such as residence, days hunted and the killing of camp deer. The camp deer should be recorded only for the man who shot it. Hunters should be asked their opinion on the increase or decrease of deer.
d. Hunters who go thru the Forests with deer taken from territory other than National Forest area, should be tagged with a small red sticker on their windshield as they enter the forest. Hunters, in cars so tagged should not be listed by the "checking out" stations. As far as possible, locate on a map the place where each deer was killed. The number of dead deer seen by hunters should be listed.

G.
Fish & Game, R-9

COOPERATIVE DEER HUNTING
Checking Station Blank

Forest _____ Date _____

Form 91 R-9 Number of Checking Station _____ Observer _____

COOPERATIVE DEER AND BEAR HUNTING CHECK SHEET

Residence of Hunter			Total No. Days Hunted	Deer Shot			Camp Deer	Bear	Deer on		Dead Deer Seen
Within Forest	Name of State	Outside of State		Spike Horn	Does	Adult Male		Male Female	Increase	Decrease	

Use this sheet only at Checking Out Stations
(Use a line for each hunter.)

Summarize the results for the entire Forest on Sheet Summary of
G Fish & Game Form 91 - R 9 and return to the R. O. not later than December 15.

- Cost Data-

Unit Acres-Miles-etc.	Estimate			Accomplishment		
	Labor	Material	Total	Labor	Material	Total

On back of each Data Sheet

Due December 15

SUMMARY OF FORM 91 R-9"COOPERATIVE DEER HUNTING"

Date _____

Forest Ranger District Work Area	Hunting "Take"				% of Hunting Take	Success Ratio	Days to Kill a Deer	Total Acres Hunted Over	Hunting Accidents	Total Hunters Actual° Estimated°	Total Bear Killed
	B	D	F	Total							
	11	12	13	14	15	16	17	18	19	20	44

15. Percent of Hunting Take - This figure should be based on the Fall population not including Fawns or $\frac{\text{Total Hunting Take X 100}}{\text{Fall Population Minus Fawns.}}$

16. Success Ratio - $\frac{\text{Total Hunters}}{\text{Total Deer Shot}}$

17. Days to Kill Deer - $\frac{\text{Total Man-days Hunting}}{\text{Total Deer Killed}}$

20. Cross out one. Indicate whether actual number of Hunters for the Forest District was determined or if it was estimated on the basis of a sample area.

-Cost Data-

Unit Acres-Miles-etc.	Estimate			Accomplishment		
	Labor	Material	Total	Labor	Material	Total

On back of each Data Sheet.

5. DEER MORTALITY

The deer population is depleted from a number of causes other than hunters. These losses may be just as detrimental in reducing the breeding stock as is hunting, and should be carefully watched by the Forest Officer for the purpose of reducing them wherever possible. All dead or dying deer found by Forest workers in the woods should be recorded on a map and reported to the Ranger and Supervisor, so that a competent man may make an examination of the animal or carcass to determine the cause of death.

The examination and report of such deer should include the following items:

Observer, date, location, sex, general condition of animal, as condition of flesh, hair and lesions on any part of the body, whether partly eaten by carnivors, and any signs which might indicate the cause of death. The examination should also include position of wounds, condition of nostrils and mouth, stomach, intestines, lungs, heart, liver and genital organs. Pregnant females should be examined to determine the condition of development and number of young.

External and internal parasites, or parts found to be abnormal, should be examined and properly labeled. Parasites and pathological materials should be sent to the agencies indicated under "Collection and Preservation of Plant, Animal and Pathological Materials." A copy of the report should be sent with the material to be identified or diagnosed.

Deer Mortality may be classified as follows:

a. Mortality of wounded deer left in the woods following the hunting season.
b. Mortality due to predatory animals.
c. Mortality due to other causes, as starvation, disease, etc.

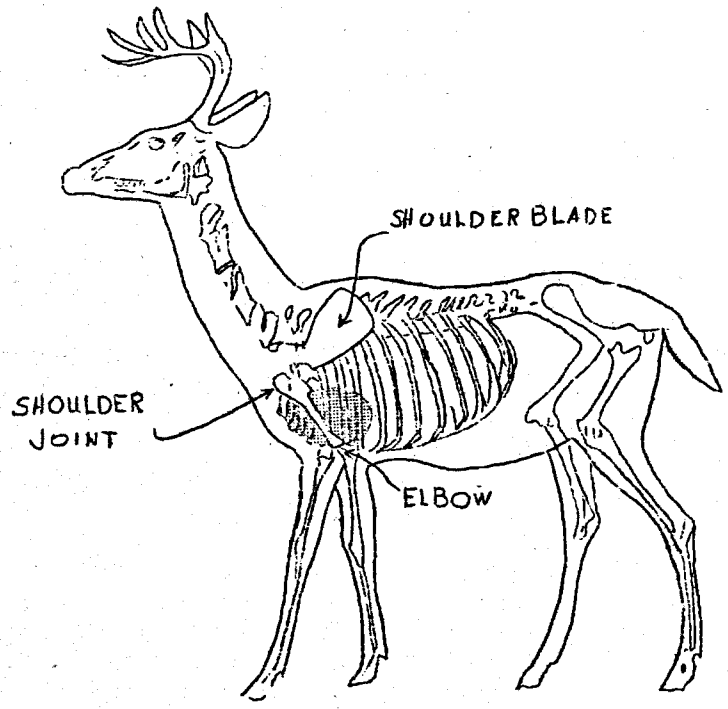
The following discussion takes up the causes of each class of loss under separate headings:

Mortality Due to Wounded Deer Left in the Woods Following the Hunting Season

It is obvious that many deer of all ages and of both sexes are wounded during the hunting season. Carelessness in distinguishing between the sexes, combined with poor shooting, are responsible for most of these losses. Some of these losses can be eliminated by the education of the public as to how to hunt. Foresters can accomplish a great deal by Public Relations work in the education of the hunting public through the use of news articles, public addresses and personal contact. The following item, taken from the back page of the Digest of Game Laws for Michigan, 1933-34, was designed for this purpose:

"Don't Leave a Cripple"

" The heart area is the shaded section, between the forelegs, to the rear of the shoulder joint. Note that the latter is well forward of the line of the forelegs. A low shot that is placed behind the shoulder will strike the heart area. However, the shoulder joint is very often confused with the elbow, which is located at the junction of the foreleg and the body. All shots should be placed forward of the elbow - not behind it.



" The above is reprinted from "Whitetailed Deer" by William Monypeny Newsom. (Published by Chas. Scribner's Sons, 597 - 5th. Avenue, New York, City.) Copyrighted 1926."

The losses due to shot wounds should be carefully checked on sample areas consisting of not less than one, or more than two sections to a ranger district. These samples should be checked not later than ten days following the hunting season by men crossing the area, and close enough together so that all intervening ground can be seen. These checks should be carefully organized and the men instructed to look under evergreen trees and in other sheltered places.

The samples should be located in areas which were most heavily hunted, and should include the forest types in which deer seek shelter when disturbed. The results should be recorded as follows:

Loss of Deer Due to Wounds Received During the Hunting Season

Date _____

Acres Surveyed _____

T _____ R _____ Section _____

Bucks	Does	Fawns	Acres per Dead Deer	Intensity if Hunting		
				Heavy	Medium	Light

° Report dead and wounded deer found by Forest workers but outside area checked.

Under unsuitable weather conditions, such as heavy snow following immediately after the hunting season, the above method will not be effective and should not be put into operation.

Mortality Due to Predatory Animals

Winter mortality of deer by predators will vary with the density of the predatory population, the density of the deer population and the ability of the deer to escape, depending on their physical condition and the snow conditions of the range, etc. In the Lake States, it is believed that timber wolves and feral dogs are the principal predators of deer. Elimination of dogs, which are known to be driving deer, should be accomplished according to law and in cooperation with the local Conservation Office.

Dead deer, reported by Forest workers, should be inspected by a competent man to determine the cause of death, if possible. Only animals that show unmistakable signs of being killed by predators should be recorded as dying from this cause. Many deer which die of starvation may be partly eaten by carnivors, but these animals are not the primary cause of death and should not be charged with the kill. The dead deer should be carefully watched for when the sample plots are being run for determining the spring breeding stock. See " Determination of Breeding Stock."

Mortality Due to Other Causes, Including Starvation, Diseases and Accidents.

Starvation is directly or indirectly responsible for much of the winter loss of deer. Frequently deer yards are so closely browsed that fawn and yearlings are not able to reach the food and

may die from starvation or indirectly from diseases as secondary causes when the animals' vitality is low, due to poor quality or insufficient food. A careful check should be made to determine if losses are occurring from starvation, and if such is the case, measures should be taken to correct it. See "Correlation of Timber Management Activities in Relation to Deer."

Diseases of Deer

By Dr. E. C. O'Roke, School of Forestry and Conservation, University of Michigan, Ann Arbor, Michigan

External parasites - Ticks, lice, louse-flies and various species of biting flies annoy deer and moose considerably. We are greatly in need of field data and collections of these parasites in order to determine their relationship to the transmission of diseases to animals.

Internal parasites - Nose bots. These thickbodied white "grubs", studded with brown dots that feel like sandpaper are commonly found in the inner nasal passages of deer. They are the larvae of deer bot flies. They interfere with breathing and may cause lesions through which secondary infections enter the system. The genus known to infest deer is Cephenomia.

Lungworms - Adult lungworms are as large around as a linen thread or small wrapping cord and are up to two inches long. They are found in the lower branches of the bronchial tubes. In order to make an examination for lungworms, one must cut the bronchial tubes and their branches open with fine scissors and search diligently. There may be from one to many in one animal. The larval lungworms which are the offspring of the adults are to be found in scrapings from the air passages, oesophagus and in the lung tissue. They are microscopic in size and remain alive and active several days after the death of their host. At least two genera of lungworms, Dictyocaulus and Protostrongylus are known from deer in the Lake States Region.

Tapeworm Cysts - Pearly-white, liquid-filled bladders up to an inch in diameter may be found attached to the liver or among the visceral organs. These are larval tapeworms, the adults of which are found in carnivorous mammals.

Liver flukes - Thick, leaf-shaped flat worms of the genus Fasciola, ranging up to an inch in length, may be found in the livers of deer. When such worms occur in large numbers in the liver of sheep they produce a disease known as liver rot. Information is needed as to whether such parasites are pathogenic when found in deer.

Other parasitic worms - Several kinds of round worms and tapeworms are found in deer. Evidence of their presence may be in the finding of their eggs in fresh feces or the actual worms in the intestinal tracts of the animals upon making an autopsy. We have very little information as to their pathogenicity.

Infectious diseases - Pneumonia. Fatalities in late Winter or spring are often due to pneumonia. The lungs of deer that have died from pneumonia are dark in color, filled with liquid and have a liver-like consistency. Pneumonia is probably secondary, following unfavorable circumstances for the well being of the animal. A common speculation is that lungworms are the pre-disposing cause of the disease. Records and data are needed in order to test this assumption.

Sore mouth. When sores are found in the animal's mouth it is believed that the infection is acquired through lesions caused by too coarse food or food unsuited to the animal's needs. Actinonyces necrophorus has been isolated from deer suffering from sore mouth. This disease may be fatal.

Foot and mouth disease. This serious infectious disease of live stock has been known to occur in mule deer in California where it was eradicated by employing drastic measures. This is a problem for the skilled veterinarian, and should the disease be suspected, it should be reported to the state veterinarian immediately. There is said to be no foot and mouth disease in the United States at present.

Warts. Black skin warts which may become broken open and infected have been reported from both deer and moose. They are readily recognized. Little is known of their pathogenicity.

Winter losses - When the deaths of large numbers of animals occur in late winter or spring, we refer to them as winter losses. Such losses may be due to several causes. Insufficient or unsuitable food or both are perhaps the main causes of loss. The actual cause of death, however, may be secondary, such as disease or parasitism which would not cause death provided conditions for existence were otherwise favorable.

If the losses occur in aged or decrepit individuals, it is possible that they constitute natural deaths; if the fawns in particular suffer, it would appear that over-population and competition for food are the basis of loss.

Serious study of winter losses made as soon as possible after the animal has died will yield valuable information and clear up points that at present are speculative.

oooooooo

The total deaths on each forest area should be summarized and tabulated. Where the sampling method is used the total for the Forest should be calculated on this basis. Otherwise, actual losses should be used. The tabulation should be as follows:

Total Mortality for Forest

Date _____

Forest _____ Total Area in Acres _____

	Hunting Mortality (Died of Wounds)	Predatory	Starvation	Disease	Cause Unknown	Total
Bucks						
Does						
Fawns						
Total						

Removal of Diseased or Crippled Deer

Lame deer or those that show signs of being diseased or crippled should be removed from the range. Such deer should be removed only after consultation with and in cooperation with the State Conservation officers. Such Departments of Comservation, in cooperation with State Universities, are equipped to make a thorough examination of animals to be removed. A report of the post mortem of such animals should be requested from the State and a copy of this report sent to the Regional Office.

6. ANALYSIS OF DEER AND MOOSE WINTERING YARDS TO DETERMINE THE CONDITION OF BROWSE PLANTS

High population of deer are desirable to the point where the range is effeciently utilized and no permanent damage to the forest cover takes place. The high breeding potential of deer, however, makes the balance between suitable populations and numbers that do permanent damage to the forest cover one of paramount importance. The examples of destruction of trees and shrubs on the Kaibab Forest in Arizona and in the forests of Pennsylvania make it necessary to watch this point carefully in any plan for managing deer.

In our northern forests where snow conditions force deer to yard in restricted areas the lack of browse in these areas is one of the limiting factors in deer production. Illinois and Missouri will probably compare more nearly to Pennsylvania as to weather and general conditions of variety of plant life and will probably carry more deer per unit of area. Depth of soil and fertility will also make some difference in the productivity in terms of deer because of the more luxuriant growth of ground cover and shrubs on such soils.

Browse Conditions.

Sample plots for measuring browse intensity and plant damage should be placed in deer wintering swamps. ° Bartlett (Michigan Conservation Department) has classified these winter yarding grounds as follows:

a. Cedar Yards - Yards in which cedar is the predominant tree. Forest Service, type 4 (Acquisition Manual).
b. Hardwoods - Little or no conifers, typed as M (Acquisition Manual).

Plots to determine the condition of browse for deer should be 1/2 chain wide by 2 chains long. The plots should be marked with stakes at least four feet high and each sample designated by a number, so the same plots can be examined each year. The time to examine the plots should be in the fall before yarding of deer begins, and after the leaves drop, and in the spring before the leaves come out.

These plots should be given an indication as to the possibility of deer dying from starvation and should indicate to the Forest officers whether action is needed to save deer from starvation. Where these determinations are made before the hunting season it will also help to indicate the number of deer that should be removed by hunting.

The number of sample plots should vary with the number and size of the wintering swamps. There should be at least one sample

° I. H. Bartlett, Proc. Mich. Academy of Science, 1931.

plot in each such swamp, and at least two sample plots to each 640 acres of contiguous swamp.

Measurements should be made on form #90 R-9. The winter studies must be sent to the Regional Office by November 1, and the spring studies before June 1.

A clear understanding of the difference between rabbit cuttings and deer browsing should be obtained before attempting to make the survey. Rabbits clip the stems at an angle of 45 -60 degrees. This angle is characteristic and gives a definite clew if rabbits have fed on the stems. Deer and moose have teeth only on the lower jaw and pinch or pull the stems off. Thus stems browsed by deer or moose show as square cuts, have a fringed cut, or a pinched appearance.

Degree of Utilization of Browse

In classifying the degree of utilization of browse, consider only the current year's growth. In the case of shrubs use the entire bush as the unit instead of individual stems. With trees and reproduction use the individual stems as a unit. The four classes of damage to browse plants will be as follows:

a. 1% to 33% - This shows a slight clipping of leaves and branches and is detected only after careful examination.
b. 34% to 66% - This willshow as medium heavy browsing with a marked clipping of about half of the new growth on top of the bush in case of deer damage or the sides or lower half in case of rabbit damage.
c. 67% to 100% - This will show as a distinct "deer line" up to 6 to 8 feet in case of deer or moose work or as a stunted dwarfed appearance of shrubs or young conifers.

Directions for Use of the Browse Tally Sheet

a. The man making this check should become familiar with the native species or trees and shrubs before making the measurements.(See Shrubs and Herbs Important as Animal Foods.")in Appendix.
b. Use a separate blank form 90 R-9 for deer and rabbit utilization for each sample plot. Every unit of browse should be indicated on each form in one of the four columns.
c. Indicate the exact location of the sample by measurement from well established landmarks.
d. Be sure the boundary of the sample plot is clearly indicated. A string should be run between the marking stakes while the measurement is being taken.
e. Indicate each unit by a dot in the column which classifies the degree it has been utilized. The dot system is as follows:

f. The total number of dots on the deer and rabbit sheets should be equal, but the degree which each plant is utilized will be different.

g. Arrange a list of twenty species used by deer and also twenty used byrabbits in the order of their preference.

Estimate of Damage.

Browsing of plants by animals may damage the plants by destroying the terminal buds, injuring the terminal sheet or cutting down the leaf surface. Trees are exposed to fungus attack if the bark is stripped off.

The degree of injury from browsing will vary with the different species of trees and shrubs.

BOOKS

Field Book of American Trees and Shrubs -F. S. Mathews (Putnam)
Book of Shrubs - Alfred C. Hottes (The A.T.De La Mare Company, New York, N. Y.)
Deer Damage to Forest Trees in Pennsylvania - Le Roy Frontz (Research Circular 3, Department of Forests and Waters, Harrisburg, Pennsylvania, 1930.)

The Deer Problem in Pennsylvania - Henry E. Clepper (Department of Forests and Waters, Harrisburg, Pennsylvania, 1931.)

G
Fish & Game
Form #90 R-9

°For
Deer (cross our one)
Rabbit

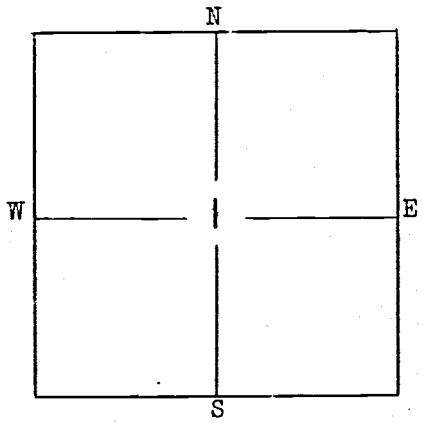
UTILIZATION AND DAMAGE OF BROWSE PLANTS

Forest _____ Ranger District _____ Date _____

T _____ R _____ Observer _____

Location of Plot (Example) 1 ch. West -4 ch. south of N. E. section corner of S.W. 1/4 of Section 26.

(This form is to be used for both deer and rabbit utilization of browse. Use one sheet for deer and one for rabbit. °Indicate which sheet is used for each. Use sheets for both deer and rabbit for each sample studied.)



	Plants not utilized	1-33% Utilized	34%-66% Utilized.	67%-100% Utilized	Part Used Leaves-L Buds - B Stems -S
Maple, Sugar					
Maple, Silver					
Maple, Striped					
Maple, Mountain					
Maple, Red					
Basswood					
Mountain Ash					
Birch, Yellow					
Birch, White					
Birch, Sp.					
Beech					
Black Locust					
Elm					
Hickories					
Oak, White					
Oak, Red					
Oak, Scarlet					
Oak, Chestnut					
Willows					
Aspen, Quaking					
Aspen, Large-toothed					
Poplar, Tulip					

	Plants not Utilized	1-33% Utilized	34%-36% Utilized	67%-100% Utilized.	Part Used: Leaves-L Buds -B Stems -S
Cherry, Wild Black					
Cherry, Choke					
American Hornbeam					
Hop Hornbeam					
Sassafras					
Ash, Black					
Ash, White					
Butternut					
Black Walnut					
Pine, White					
Pine, Red					
Pine, Jack					
Spruce, White					
Spruce, Norway					
Cedar, White					
Balsam, Fir					
Tamarack					
Hemlock					
Hawthorne					
Dogwood, Panicled					
Dogwood, Red Osier					
Dogwood, Flowering					
Hazelnut					
Witch Hazel					
Wild Crabapple					
Honeysuckle					
Rhododendron					
Mountain Laurel					
Sheep Laurel					
Wild Gooseberry					
Wild Currant					
Huckleberry					
Elderberry					
Sweetfern					
Sumac, Poison					
Sumac, Staghorn					
Raspberry					
Blackberry					
Service Berry					
Cranberry, Highbush					
Tag Alder					
Virginia Creeper					
Grape					
Labrador Tea					
Barberry					
Bearberry					

After the browse has been checked for degree of utilization for each sample, list twenty species in the order of their preference for both deer and rabbits.

Preferred by Deer	Preferred by Rabbit
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10
11	11
12	12
13	13
14	14
15	15
16	16
17	17
18	18
19	19
20	20

7. DEER YARD MANAGEMENT

Little is known as to the why, when and wherefore of the yarding characteristics of deer. It is apparent that wind has less sweep in a cedar or hardwood swamp than it has on the highlands. It also appears that browse materials are more available in the swamps than in the uplands during the winter time. It is known that deer yard in greater concentrations with snow four feet or more deep than when snow is three feet or less in depth.

In order to determine the yarding activities of the deer herds in relation to snow conditions and to better manage the deer, it will be necessary to keep a close check on the following points:

1. Depth of Snow from January to April
2. Time and Place of Yarding
3. Recommended Activities for Preventing Deer from Starving

Depth of Snow

The depth of snow will be determined by placing a snow marker or stake at the corner of each browse study plot. The stake will be of sawed material 2" X 2", eight feet long and marked with black marks at one inch intervals, beginning with the zero mark eighteen inches from the bottom of the stake and extending to within one half foot from the top, numbered at each 1" interval. The zero mark will be at the ground level when the stake is placed in position. Paint the top one half foot of the stake red so that it will be easy to find when the snow is present. These stakes should be visited each 30 days beginning with January 15 and ending April 15, and the snow depth recorded to the nearest inch.

Time and Place of Yarding

As the snow depths are recorded, a close check should also be made on the location and concentration of the deer in the yards as well as the physical condition of any deer seen. The extent of the winter yards will be marked on a map and the estimated concentrations given as follows:

1. Light Concentrations - Less than 50 Deer per Section
2. Medium Concentrations - Between 50 and 150 Deer per Section
3. Heavy Concentrations - Over 150 Deer per Section

These figures will not be used as census figures as they may vary from 100% to 200% in correctness.

Recommended Activities for Preventing Deer from Starving

Deer sometimes concentrate in restricted swamp areas where the browse is scanty or a variety of browse plants is lacking. In such swamps the herd is likely to get into bad physical condition in a short time, particularly if snow conditions are such that the deer are not able to move around freely. Under such conditions artificial feeding at once suggests itself. This remedy is very expensive and is likely to be limited because of the physical difficulty in purchasing and moving large quantities of forage.

Two types of supplementary foods have been tried in preventing deer from starving in New York°. They are:

1. Storing and Distributing Baled Hay in Deer Swamps
2. Feeding of Concentrates in Deer Swamps

Storing of Baled Hay

The Forest Service has no authority to expend funds for hay for deer preservation. It can however, furnish transportation and labor to transport and provide storage place for hay, provided the feed is furnished by the State Conservation Department or by Service clubs such as Izaak Walton Leagues etc. Where deer swamps are badly browsed out and deer have been known to starve on previous winters, it would be well to provide caches of alfalfa or clover hay during the fall so that this feed could be distributed when snow conditions prevent the use of natural food.

Placing of Concentrates in Deer Swamps

A product has been developed in New York which consists of concentrated feed formed into a cake with molasses and inclosed in a sealed tin. This tin of food is fastened in place on trees at a time when the swamps are accessible and the covering tin is stripped off by a man on snow shoes when the deer are in need of supplemmental feed.

This method of feeding is subject to the same restrictions as hay as far as the Forest Service is concerned. This method is worthy of trial however if funds can be made available thru service clubs or conservation groups. The Regional Office will furnish the reference as to where such concentrates can be purchased if funds are made available as described above.

Making Food Available

The feeding of large numbers of deer is a task of large proportions and it is likely that the more deer can be saved by making available browse material thru silvicultural operations than by any other method. Trees such as cedar and hemlock can be trimmed, thus making the twigs and foliage available for deer food and at the

° "Food Preferences and Requirements of the White-Tailed Deer In New York State.
By: L. A. Maynard, - - Robert Darrow
Gardiner Bump - - J. C. Woodward

period of food shortage.

The operation suggested above may be carried out on narrow strips from the browsed out part of the swamp to a part where food is more abundant or more available. The deer will follow such operations and may be led to spread out more and thus relieve the condition of food shortage on part of the area.

The methods suggested above are emergency operations and steps should be taken to remedy the primary cause of such emergencies. Either there are too many deer on the area, or the swamps are not in the proper condition to carry the number of deer present. Under these conditions recommendations should be made to remove part of the herd by hunting and efforts also should be made to improve the productivity of the deer swamps. See "Correlation of Timber Management in Relation to Deer."

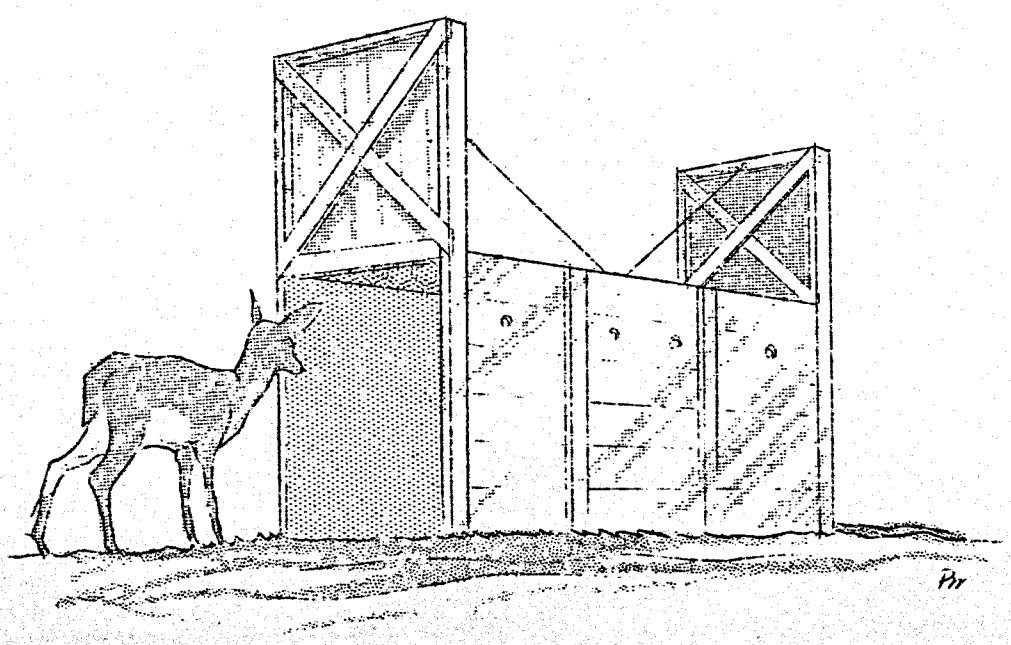
8. MISCELLANEOUS MANAGEMENT PROCEDURES

A number of miscellaneous procedures have a specific bearing on the management of deer. Some of these are:

a. Restocking
b. Daily and seasonal movements
c. The time of rutting, time and number of fawns dropped, barren does, the number of yearlings in the spring and the time that males drop their horns.
d. Supplementary feeding.

Restocking.

As yet no inexpensive method has been found to transfer deer from range that is too heavily stocked to areas that are thinly stocked or lack deer entirely. Where some areas are overstocked and deer can be spared for restocking of other barren areas, trapping is a practical way of transferring them. Deer can be led into a trap by scattering hay from a yardling area into an enclosure.



STEPHENSON TYPE DEER TRAP
Michigan Conservation Department

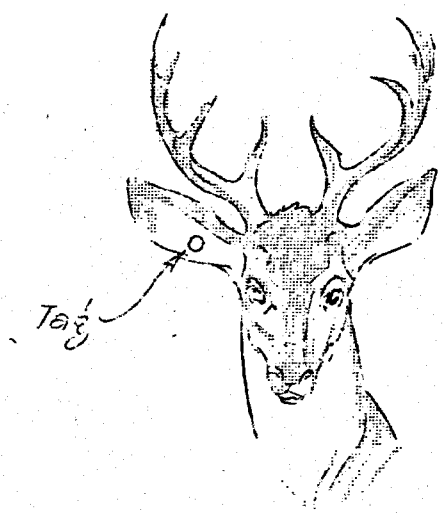
Where the transfer of deer appears to be necessary, the Regional Office should be consulted. The State Conservation Department and local conservation office should also be advised of such contemplated action. Detailed directions will be found in the appendix.

Daily and Seasonal Movement.

Intelligent management of deer depends somewhat on knowing the general movements of deer during the various seasons of the year and also knowing the daily and local movements, particularly the difference between the movements of the sexes.

One of the ways so far devised for gathering information on the movements of deer is to tag the ears of adult animals that are trapped or fawns that are caught soon after they are born in the spring. Tags needed for this purpose should be requested from the Regional Office in advance.

Deer may be tagged in the ear about an inch from the under edge and one third of the length of the ear out from the side of the head.



Fawns may be found in wooded areas or on the edges of swamps at the base of trees or near logs, where they are left by the does during the day. After they get to be a week or ten days old they can be captured only by stealth. On seeing a fawn one must walk past the spot, then dive so as to take them unaware but care should be taken not to injure them or move them from the position where they are found. These animals can be tagged in the ear as described above. A record should be kept of the location, sex, date, approximate age and a description of the mother doe if she is observed. (See record sheet in the appendix.)

All deer tagged should be marked on a map with the following symbols and the number of the tag:

Adult male	a	♂	d
Adult female	a	♀	d
Yearling	y	sex	d
Fawn	f	sex	d

Time of Rutting, Time and Number of Fawns Dropped, Barren Does, Number of Yearlings in the Spring, Dropping of Horns

Careful observation of the above activities are important to a management. Where a "one buck" law is in force it may be possible to so unbalance the sexes that the rutting season is prolonged, and the fawning season extended much later than is normal. The result of this prolonged rutting season may be fawns that are not old enough to withstand the hardships of the winter. Likewise where there is a shortage of mature bucks the use of immature and defective males may result in stock of poor quality and of inferior size. Obersvations made in the fall during the rutting season will help to determine the cause of those effects.

Obersvation of the time fawns are dropped in the spring will help to determine whether the observations made in the fall were correct. A careful record should be made of singles or twins seen, for it is believed that does will produce one fawn at first fawning, and may produce twins at later fawnings. Irrespective of the cause, where twins are common the herd will increase at a much faster rate than where only one fawn is produced.

Barren does are usually determined by their sleek, fat appearance during the summer and the fact that no fawns are seen with them. Their barren condition may result from disease or lack of opportunity to breed because of the absence of males. This results in a deer population much below its potential producing power.

The first winter is without question the most critical time of year for deer of less than a year old, because they may be crowded away from browse or are not large enough to reach it. The mother doe is able to help them a great deal during this critical period by breaking pathways in the snow and helping them to obtain food.

The number of yearlings that survive the winter is highly important, as it is this class of stock that must fill the gaps resulting from hunting and other losses..It is difficult to determine the number of yearlings that survive except by direct observation and then some may be confused with other classes of stock.

Observation of the size of horns, their condition, when they were dropped, and other facts relating to age and virility of males should be observed and recorded. The Forest Officer should learn the complete life history of the deer in his forest as soon as possible, and should so organize the information gathered in his unit that these observations may be recorded and placed in a cumulative record of the activities on the entire area. A report should be built up containing the following items:

Forest _____ Date _____

Compilation by _____

Beginning	Ending	Peak	Beginning	Ending	Peak	No. single Fawns	No. prs. twins	No. Barren Does	Time Horns are Dropped

(Note: The gestation period for the Northern whitetailed deer is a little over 200 days - Seton '27,p.258 and Newsom '26,p.142. The length of life of a deer has been determined for at least one individual western deer to be 16 years.)

Supplementary Feeding

The feeding of roughage or grain has not proved practical in handling large deer herds which are spread out over extended areas of forest land. Where extra feed is needed to save deer from starvation it should be furnished as described under "Correlation of Timber Management Activities in Relation to Deer."

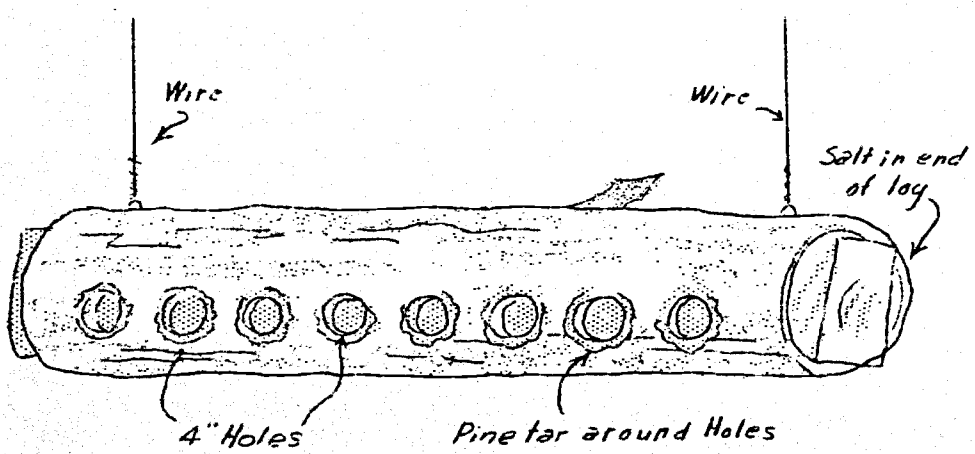
Salting of Deer- Gorman foresters provide natural rock salt for their deer herds at regular feeding places in troughs and mixed in soil. In the western forests the deer probably get a sufficient

amount of salt from the salt blocks placed for domestic stock. To date little work has been done in salting of deer under conditions as are found in Region Nine and the eastern states.

The National Forest Manual recommends a pound and a half of salt per head of sheep for the summer season. This is probably as nearly right for deer as can be determined. When salting for deer is done, the following principles should be observed.

1. Place salt in dense cover so as not to expose deer unnecessarily to illegal hunters either while using the salt or in going to and from the salt lick.
2. Place the salt away from water so as to utilize good grazing areas which are not in close proximity to water.
3. Place the salt so the least possible damage will result to valuable trees and shrubs around the salting location.

The Biological Survey has suggested a method of salting and controlling nose bots at the same time. The salt is placed in a salt feeder made of a hollow log in which holes are bored, where the deer lick out the salt. Pine tar is placed around the holes so some of the tar is smeared on the nose of deer when they lick the salt. The tar acts as a repellant for the adult bot flies which lay the eggs in the nose of the deer. ° Bartlett has tried a similar device for preventing nose bots while salting deer.



° Bartlett - Michigan Dept. of Conservation Bulletin December, 1934

The danger of attracting and having the salt consumed by porcupine instead of deer is always present where salt is placed in the forest. Is is suggested that where log troughs are used that they may be suspended by a wire at least three feet from the ground. Salt is also made in the form of blocks, or in the form of cylinders with a hole through the center. Where the latter is used for salting they can be strung on a stick or wire and hung from a tree about three feet from the ground. This should prevent porcupines from consuming the salt.

It is a practice with hunters to leave any surplus camp salt on stumps and logs at the close of the hunting season. Likewise, natural salt licks or places where salt is present in the soil around abondoned building sites are found on many forests. Such salting places are without question a hazard to deer because of the ease with which pot hunters may secure game around those locations.

One of the methods suggested above should be tried out on each ranger district. Observations should be made on the results obtained, and these results, together with additional suggestions, included in the annual Fish & Game Report.

MOOSE

Objectives

To protect and shelter the moose where he is naturally found, and to attempt management on a sustained yield basis after increasing their numbers to the maximum carrying capacity of the land in respect to other land uses. Sufficient studies should be made in respect to the influence of civilization, predators and disease to determine the proper management procedures.

History

The moose is a native of all three of the states bordering Lake Superior, namely, Minnesota, Wisconsin and Michigan. On the Chippewa only about twenty animals remain, but there are now perhaps 3,000 animals on the Superior. Only a few animals are reported from the Upper Michigan Forests although they were found there in former times. During the past logging days of the Superior region moose were very numerous, and according to some old woodsmen were as abundant then as deer are now. However, the incessant killing by meat hunters and newly-arrived settlers seriously decimated their ranks.

Then, disastrous forest fires and the wood tick plagues further reduced their numbers, until now only a pitiful remnant remains within the borders of the National Forests.

Management Suggestions

Control of Poaching

Game wardens report that after every deer season many moose kills are found, as many as eight having been detected in a relatively small area. slaughtered by men who killed only for the lust of killing.

It is needless to say that every Forest Officer on the Superior and Chippewa Forests should be on the alert to help local wardens detect these "sportsmen".

Other kills of moose are made by the local settlers and Indians, but it is doubtful if the loss is very great, as deer are more numerous and easier procured than moose.

Predators

The timber wolf is the only natural predator with which the moose must contend. Undoubtedly, where deer and rabbits are scarce, the moose is prayed upon extensively by the wolves, but

where deer are plentiful or where there are rabbits, the wolf will not bother the moose to any appreciable extent. Wolves must be controlled where they become too numerous, but should not be exterminated for the sake of saving a few sick or weak moose or deer.

Wherever it is felt that wolves are destroying moose and deer beyond a reasonable limit, Forest officers should send requests for control to the Regional Office, and these requests will be relayed to the Biological Survey for prompt action. All requests should be accompanied by a detailed report of the approximate number of wolves, number of kills found and area of concentration of wolves.

Diseases°

The disease associated with the wood tick°° has of late years killed many moose, and according to some investigators, has been responsible for the great destruction which has befallen the herds.

During certain years the ticks were especially abundant. Both larvae and adults attach themselves to and feed on the moose, often covering the anal regions completely so it is impossible to put down the point of an unsharpened pencil without touching a tick.

Symptoms - Moose attacked by the disease are weak, anemic and in many cases decidedly unafraid of man and will allow men to approach within several feet of them. Often the head is held to one side and the animals appear to be partially blinded. Such moose possess a peculiar tendency to favor a certain locality, and often refuse to leave, or if forced away by man quickly return.

Causitive organism - None of the investigators of this malady have been able to isolate a pathogene from the blood or any of the vitals of moose which is capable of being carried and transmitted by the tick. Some are of the opinion that when large numbers of ticks become attached to an animal the combined action of their activities are sufficient to produce the symptoms, because of the toxic effect of their saliva and the infection of their bites. There is no doubt that the ticks cause the animals much pain and suffering, as evidenced by the bare hairless patches of hide where the animals have attempted to rub off the pests.

Control of the disease - It is requested that all sick or recently dead moose on the Superior or Chippewa Forests be reported by telephone to R. Fenstermacher, Division of Economic Zoology, University Farm, St. Paul, Minnesota. The telephone charges may be reversed. Further research will undoubtedly explain the cause, and perhaps produce a cure or control for the

°See "Diseases of Deer," Deer Mortality, Wildlife Handbook
°°Dermacentor albipictus

disease. Any dead moose found on the Michigan Forests should be reported to Dr. Don R. Coburn, c/o Anatomy Bldg., East Lansing, Michigan, by telephone. The telephone charges may be reversed.

Food

During the summer the moose, according to Adolph Murie°, feed on poplar, birch, hazel, dogwood, alder, mountain ash, pin cherry, hard maple, bush honeysuckle, sedges, large-leaved asters, pondweeds, ground hemlock, water lilies, willow and mushrooms. Willow, aspen, hard maple, balsam, white cedar, etc., are eaten in winter extensively, the same authority states.

Habits

The moose is not a gregarious animal, but prefers to be alone or in company only with his immediate family. Also, he is monogamous, and seldom does a single bull serve more than one cow. The period of gestation is about eight months, and the calves are dropped sometimes in May or early June. Rather poor and scattered observations, due to lack of adequate research, indicate that only about fifty percent of the female moose bear young each year. However, this figure may be low.

During the winter, moose may yard together in small groups, but never in large compact herds. They move about freely along ridges and swamps, browsing cedar, willow, etc., and if unweakened by ticks appear to withstand the heavy snows and winter conditions much better than the deer.

Moose are often spoken of as a wilderness animal, shunning man and his habitations. Some proof has been found that their fear of man is instinctive and that the mere presence of man drives them back into the wilderness.

However, there is testimony to prove that moose when protected become docile and unafraid, and it sometimes appears that hot lead has been the compelling force in driving the moose into the wilderness areas, and not merely the activity and presence of men.

Census

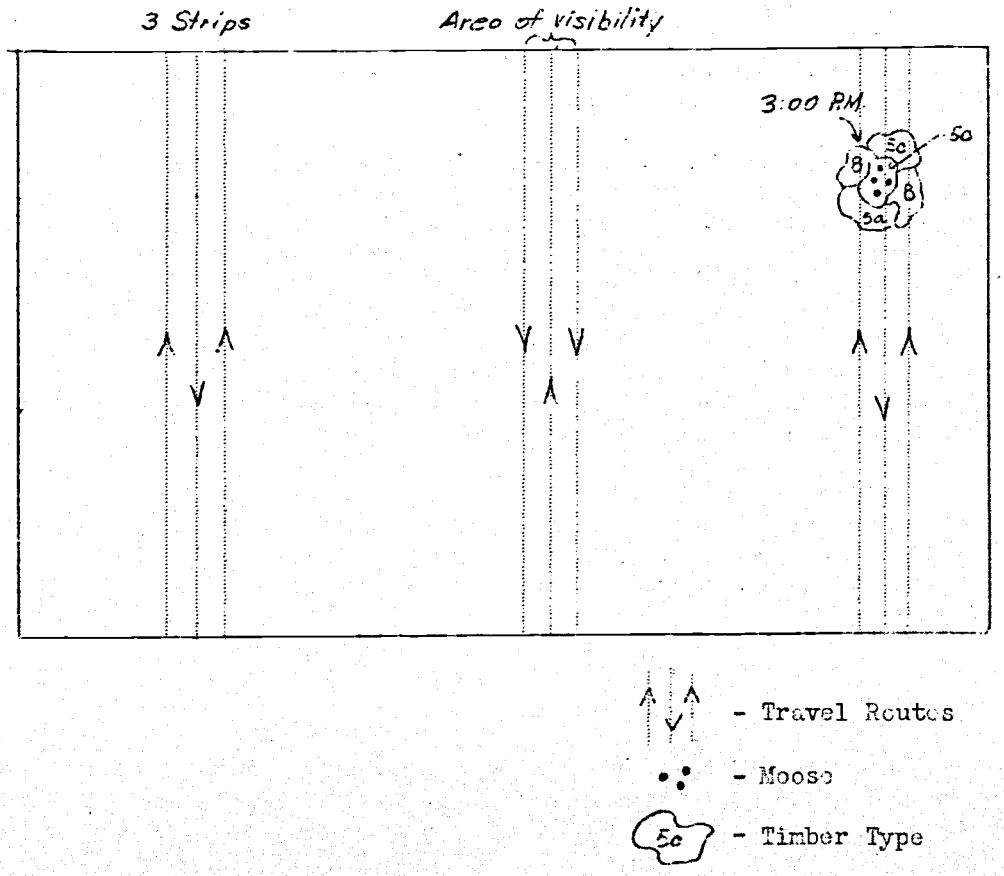
Census of moose by airplane holds great possibilities for an accurate, quick method of determining numbers of moose in certain areas, and also in determining the dispersion of herds or the places where they are found and also where they are absent.

A method of census which may prove valuable is herewith given.

°The Moose of Isle Royale - University of Michigan Press, Ann Arbor, Mich.

Travel back and forth over moose-inhabited country at an elevation of 500' on lines at distances apart which will allow the observer to see well all the intervening ground. The distance these lines are apart will be governed by the visibility. The record of the census should ascertain the number of moose per forty acres. At least a 400 square mile tract of land should be covered for the survey, but this area should be censused in several strips (see drawing below) so that the whole Forest area is covered. The same pattern should be followed each year.

Once an animal or group of animals are located the pilot should circle the area in order to pick up all individuals in surrounding territory. The observer should have an accurate map of the census plot, and when moose are seen he should locate them on this map; also time of day and timber type in which the moose are found. This census method should be attempted and suggestions made for refining and improving it.



Sample Moose Census Map

of an

Entire National Forest

SMALL UPLAND GAME

Small upland game includes the ruffed grouse, pinnated grouse, sharptailed grouse, bobwhite quail, pheasant, wild turkey, woodcock, rabbits, hares and squirrels. Management directions will be omitted for some of these species and will be sent to the field later in such form as to be inserted in the Wildlife Handbook.

Index of Game Bird Productivity

One of the indices of game bird productivity is the number of eggs which are produced and incubated each season by each female. The number of eggs which can be incubated by a single bird is called the "clutch."

The Clutch

The number of eggs in a clutch varies both as to species and also with the same species for different years. The average number of eggs in a clutch must be determined for each species under management according to the following directions:

All nests found by forest workers, planting crews, etc., should be checked for the number of eggs present. The nest will be marked by placing a white cloth on a bush near the nest and indicating its general location from some conspicuous landmark. The nest and number of eggs in it will be reported to the technician responsible for wildlife work in each camp. The technician will investigate the nest not more than five days later to determine whether the number of eggs have changed. Each nest should be checked until it is determined that the number of eggs remain constant. An average of all of the nests so checked should be determined for each species.

This data is needed for items 66 - 76 - 90 - 102 - 114 - 126 of G. Fish and Game Form 128 R 9 and should be reported to the Regional Office according to the schedule of reports due.

THE RUFFED GROUSE

The ruffed grouse, commonly called the partridge or "pat", is one of our best game birds. It is typically a woodland creature, although it requires openings for dusting and drying off after rainy periods. A great deal of work has been done on this species in the way of discovering its food and other life habits, but so far very little has been published on the subject. R. T. King of the University of Minnesota has developed a method for taking a census of ruffed grouse and has discovered many other important facts about its life history. The steps in determining the numbers of grouse at various stages during the year is as follows:

1. A census of birds just before the hunting season.
2. Checking the actual birds taken during the hunting season.
3. Determination of the birds killed or crippled but not bagged.
4. Determination of the breeding stock at the beginning of the breeding season in the spring.
5. Correlation of Silvicultural Work and Logging with Grouse Requirements.
6. Mortality

CYCLIC FLUCTUATIONS

The ruffed grouse is a bird that goes thru cyclic fluctuations. These fluctuations vary in length from seven to eleven years and appear to be less pronounced near the southern border of the grouse range and more pronounced as one advances north. Several theories have been advanced for these periodic fluctuations. One is thought to be related to disease, possibly tubaremia, while the other is thought to be related to the varying quality of available food which, in turn, causes the fertility and number of eggs per clutch to fluctuate during the period of the cycle.

Neither of these theories has been proved, so more work must be done in order to determine the cause of the cyclic conditions. It is possible that we may be able to manage the grouse so as to smooth out this variation in yearly populations. It is logical to believe that during the years when the populations are high, more birds should be shot than during the times of low populations. The adaption of a varying bag limit or a hunting season of varying length is something that should be based on accurate census results. This will have to be worked out in cooperation with the State Conservation bodies that set the bag limits and the length of the hunting season.

MANAGEMENT PRACTICES

It is obvious that census operations and environmental measurements will have to be made on samples of the area involved; therefore one or possible two census areas of approximately four sections each should be set aside as census areas in each ranger district. In

selecting the census plots the following items should be kept in mind

1. The census areas should be selected in typical ruffed grouse range for the district. Where the ranger district is made up of a mixture of the various cover types, the census area should be picked so that all of these types are represented. If all of the types cannot be represented in one area then it is possible that two different plots will have to be used.
2. The areas should be so placed that they are accessible by roads and trails. The more easily the area can be reached by roads, the easier it will be to take the census and the greater will be the possibility that it will be hunted over normally.
3. Marking out the Plots - The census plot or plots should be selected before the hunting season. They need not be entirely Government-owned land. The boundaries and all quarter and forty lines in both directions should be blazed out and the directions marked so that the game man may follow the lines readily and without confusion. These are the census lines. The marking of these plots can be done by the use of C.C.C. help. The work should be done with the compass and chain so the location of the lines will be reasonably accurate and clear.
4. Taking a Census - Method developed by R.T.King, University of Minnesota.

All actual census work should be done by a trained game man. The entire census should be completed in a relatively short period of time, with no lapse of time intervening. Weather permitting, the work should be carried to completion within five days. In case the work is interrupted for more than two days, the census should be started over again. Census operations should not be carried on during blizzards, rains or when the brush is very wet or during high winds. Snow on the ground does not interfere with census operations however.

The actual census operation requires the following out of all the census lines. The censusing consists of walking along all of the quarter lines and forty lines once, and of covering half of the boundary lines. No line should be counted if traversed the second time. If roads follow any boundary or other lines the line of census should be offset from the road. The pattern of travel is not important except that half of the boundary must be omitted...

There are two readily recognizable color phases of grouse which will aid in preventing duplications at the corners where lines intersect. These two color phases are red tails and gray tails. If a second grouse is flushed on the intersection of two lines and they are of different color phases, then both should be counted. If two observations of the same color phase are made, and the two observations occur within four hours of each other, then the second should not be counted.

5 - - Correlation of Silvicultural Work and Logging Operations with Grouse Requirements

Ruffed grouse require different forest conditions to satisfy different needs of food and cover during various seasons of the year.

It is known° that grouse are not apt to penetrate deep woods farther than 300 feet. This means that unbroken stands of dense timber are not desirable for optimum grouse production. Research° in New York indicates the following types and amounts of food and cover are optimum for grouse production.

%	Cover Type	Composition
30	Spring Nesting Grounds	Hardwoods 4-8 inches in diameter with some hemlock or spruce.
10	Summer Feeding Grounds	Slashing
20	Fall Feeding Grounds	Brushy lands with dogwoods, viburnum, thornapple and other fruiting shrubs.
30	Winter Shelter	Conifer woods with birch and willow interspersed.
10	All year	Open lands

Forest types lacking hardwood mixtures are not likely to be suitable for ruffed grouse. Likewise, areas more than three miles from roads are not likely to be hunted because of difficulty of access. These two restrictions limit the area on which correlation of timber management and grouse management need to be considered.

The intensity of the management will depend on the demand for grouse. Where the demand is high, release cuttings for timber production should leave small groups of food plants at intervals of 100 feet.

Species which are desirable for food include:

Mountain Ash	Flowering Dogwood
Panicled Dogwoods	Viburnum
Nannyberry	Highbush Cranberry
Hawthorn	Wildgrape
Black Elderberry	Wild Rose
Bittersweet	Virginia Creeper

The conifer species needed for winter cover can be supplied by the underplanting of hardwoods with conifers. Here again interspersing of types should be allowed for, by not underplanting all of the hardwoods and leavings openings that are already present.

The slash area and the open spaces can be cared for by a modified system of marking for timber sales. Trees can be marked

°Frank C. Edminister, Jr."Developing Ruffed Grouse Areas." Transactions of Twentieth American Game Conference, 1934.

in groups so as to leave openings at irregular intervals. Log roads can also be made to provide needed openings. Seed trees of hardwood species must be left for producing a perpetual supply of hardwoods. Openings will also result from this type of restocking. Fire lanes with mineral soil exposed will help to keep permanent openings as well as control fire.

6. Mortality

Ruffed grouse losses vary according to the age of the birds and the type of habitat. Losses from predatory animals will vary with the density of predators and the effectiveness of protective cover. Little attention need be given these fixed loss factors until more information is available, except to keep a record of all losses whenever they appear.

Losses from diseases is taken up under "Parasites and Diseases of Upland Game Birds " under Bobwhite Quail. The proper disposition of dead birds is described under " Collection and Preservation of Plant, Animal and Pathological Specimens".

G
Fish & Game, R-9
Form 77 R-9

SMALL GAME CENSUS-FIELD SHEET

Species_____

Forest _____ Ranger District_____

Location - T_____ R_____ Section_____

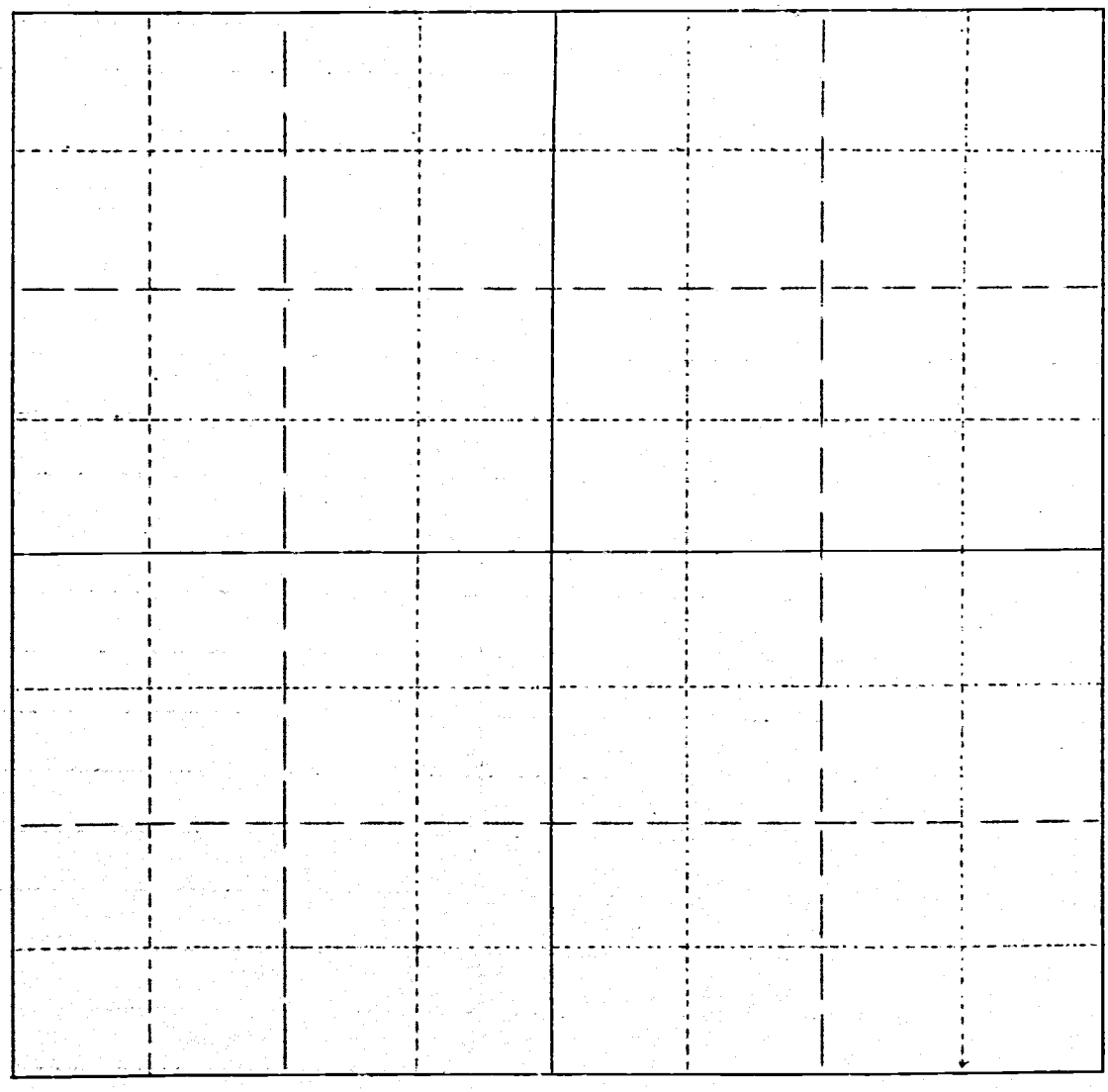
Date: From _____ To _____ Before)Hunting Season
After)Breeding Season-Observer_____

Date	Time	Obs. No.	Color Phase	No. of Birds Flushed	Flushing Distance	Cover Type	Standard F. S. Type

(Fill in the following on last sheet of each census)
Total Acres Censused _____ Average Flushing Distance_____

Acres per Bird _____ Birds per Section_____

(Over)



-Cost Data-

Unit Acres-Miles-etc	Estimate			Accomplishment		
	Labor	Material	Total	Labor	Material	Total

On back of each Data Sheet.

G
Fish & Game
Form No. 78,R 9

SMALL GAME HUNTING RECORD SHEET

Species _____

Forest _____ Ranger District _____

Location T. _____ R. _____ Sections _____

Observer _____

Date	No. of Hunter	Hours Hunted in Census Area	Bird shot in Census Area	Remarks

Summarize the results of allsheets for census areas on G. Fish & Game Form 111 R 9 and return to the Regional Office following the hunting season. "See Schedule of reports Due."

Unit Acres-Miles-etc	-Cost Data- Estimate			Accomplishment		
	Labor	Material	Total	Labor	Material	Total

On back of each Data Sheet.

G
Fish & Game, R-9
Form # 111 R-9

SUMMARY OF SMALL GAME CENSUS AND HUNTING

Due November 15.

Species _____ Year _____

Forest Ranger District Work Unit	Spring Census	Fall Census		Hunting Data					
	Birds or Mammals per Section	Birds or Mammals per Section before Hunting	Birds or Mammals per Section after Hunting	Actual Take per Section°	Total Hunting Loss per Section	% of Hunting Take	Man-hours to kill a bird or Mammal	Total Co. Hunters Actual°° Estimate°°	Total Population Actual°° Estimate°°
	79	80	81	82	83	84	85	86	87

° If number of birds or mammals per section are determined on other than sample areas, please indicate.
°° Indicate whether actual number of hunters were determined or were estimated on the basis of a sample area.
°°° Explanation of headings on reverse side of this page.

Birds or Mammals per Section-(Sample) = $\frac{\text{No. of Birds or mammals by Census}}{\text{No. of Sections}}$

Actual Hunting Take per Section-(Sample) = $\frac{\text{Actual Take per Sample}}{\text{No. of Sections in Sample}}$

Total Hunting Loss per Section - (Sample) =
$\frac{\text{Pre-Hunting Census - Post Hunting Census}}{\text{No. of Sections Hunted Over}}$

Percent of Hunting Take = $\frac{\text{Known Hunting Take X 100 (Sample or Total)}}{\text{Pre-Season Census (On same Basis as above line)}}$

Avg. No. of Man-Hours to Kill a Bird = $\frac{\text{Total Man-Hours of Hunting on Sample}}{\text{Total No. of Birds or Mammals Killed on Sample.}}$

Total No. of Hunters - The number of Hunters for each Forest will either be determined by an actual check or estimated on the basis of a sample.

Total Population of Birds or Mammals - Summarize these results to get total for entire Forest.

-Cost Data-

Unit Acres-Miles-etc.	Estimate			Accomplishment		
	Labor	Material	Total	Labor	Material	Total

On back of each Data Sheet

PINNATED GROUSE

(Prairie chicken, Square-tail)

(Tympanuchus cupido americanus)

The pinnated grouse is a rather large, dark-meated bird, having a short, stubby tail and distinct transverse black bars on the vertical portions of its body.

This bird was once found abundantly on the prairies of North Dakota, South Dakota, Minnesota, Iowa, Kansas, Nebraska and Missouri, but farming activities and settlement of the country have gradually depleted the number and driven them elsewhere. First the market hunter made serious inroads and later the habitat of the bird was ruined by fires and the plowing up of the prairie sod for farm crops.

Today the chicken holds its numbers only in the well-sheltered and isolated patches of the poorer lands which have escaped the plow and "development" of the country. Also where frontiers have pushed up into the wooded sections of the country and clearings have been made, the prairie chicken has made new colonizations and appears to be doing very well. In recent decades prairie chickens have become quite abundant throughout most of the prairies of the western Canadian Provinces and large numbers are hunted there successfully each year. It is believed the chickens followed agricultural operations and the wheat farmers into their new homes, and while intensive farming activities drove them from their former haunts, extensive farming on the Canadian prairies made possible their surviving where once it was impossible for them to exist. There is no doubt that if they are managed and hunted within reason they will form a valuable game bird to the North American sportsman.

Habitat

As stated before, the open prairie is the home of the pinnated grouse, but during persecution he will fly into heavy brush or wooded swamps. During the winter large packs are often seen occupying the tops of trees where no doubt they are eating buds. Specifically speaking, the chicken is a bird of the tall grass lands rather than of the short grass plains. They are found most commonly around the breaks of the prairie cover where, for instance, there appears a swale or willow-choked creek bottom. However, he is not a bird which prefers the brushy northlands where the sharp-tailed grouse is to be found.

Grain fields adjacent to or surrounded by hay lands or tall swamp grasses are always favorable localities in which to find chickens. It is necessary that the areas mentioned be very large,

contiguous and fairly well-watered. Small meadow lands surrounded by brush or slash areas are not favorable habitats, but are more suited to the environmental requirements of the sharp-tailed grouse.

Food

Insects such as grasshoppers, beetles and grubs form a conspicuous portion of their diet during late spring and summer, but in the fall and early winter they will feed extensively upon seeds of all kinds, and where they live in proximity to oak trees, it has been noticed that they fill their crops with acorns. During the pinch of winter, if the seed supply is exhausted, or has been covered up by snow, the chicken will eat buds, as is the habit of all the grouse, and can live on such a diet for extended periods. Aspen, elm, cottonwood, basswood, maple and willow buds are all eaten, although the birds will turn to more palatable food whenever it is available. Of the greens they prefer white clover, although they are found feeding on northern alsac and alfalfa whenever they can find it. Buckwheat is the favorite crop food, but they partake of wheat and corn whenever these grains are available.

Migrations

A marked flight of the female birds is noticed every fall, when large packs gather together and travel long distances from their breeding range to more southerly climes. The males remain on the nesting grounds and brave the rigors of the northern climate, but they are not abandoned by their mates for long, as the females return the first part of spring. Not all the females leave, however, many hens remaining with the males during the winter. In late years the migratory tendency has not been very manifest in certain areas, there being enough food on the northern breeding grounds to hold the birds over, according to a recent theory.

Mating Habits

The males select a slightly elevated mound in a prairie or meadow as a dancing or "booming" ground. There they strut and "boom" to attract the hen birds. As many as twenty males will use the same place for their courtship, and the hens are attracted from quite a distance. First, the cocks perform a sort of "dance" marked by rapid stamping of the feet; then, with heads outstretched, the wings are dropped to the ground as shields, and the tail feathers spread out fan-like. Two large yellow sacs just posterior to the ears are dilated when the booming noise is made, and a group of neck feathers (pinnae), representing horns, are erected over the head. The sacs act as resonators which magnify the sounds and carry them long distances.

Feeding

Winter feeding is often necessary where the birds have no access to weed beds and are wintering on large open prairies. Shelters of the lean-to type can be made near their runs or "using" grounds and corn, buckwheat, wheat, etc., placed in simple automatic feeders for their disposal.°

Whenever winter feeding is contemplated by the Forest Service, the field crop method should be used.°

If game birds are well fed during the latter part of the winter, they are capable of producing and raising more and healthier offsprings than if they come out of the winter poor and half-starved.

None of the National Forests are in the best breeding range of the chicken, although quite a few are to be found inhabiting the forest units where repeated fires and logging operations have denuded the forest cover. It is doubtful if the prairie chicken will remain on the denuded areas after these forests regenerate to timber growth, but if in time the chicken must move to more open lands, his place will be occupied by the sharptailed grouse which at the present time is a common bird on our more brushy forests. Therefore, regarding the pinnated grouse, there is little that can be done to perpetuate it if the denuded areas are planted up, but there is no doubt that some of his kind will always remain , following closely upon cut-over areas. His close relative, the sharptail, can be actively managed on the open and newly-logged tracts of the northern forests for all times.

The hens are found wherever the cocks congregate and promiscuity is probably very common. Both the sharptail and the prairie chicken will be found useing the same dancing ground.

Nests

Nests are located either in clumps of tall grass or low brush types, or else in apparent careless abandonment in open grassy meadows but always the nests are cunningly hidden and if unmolested by man are quite safe from their natural enemies. Nesting birds are found from early April to the latter part of May, depending upon the latitude and the advance of spring. Hens usually scratch out a shallow depression to fit their bodies for a nest, lining the cavity with grass and feathers.

MANAGEMENT PROCEDURES

A number of management procedures are practicable for pinnated grouse.

° See Management Practices, " Sharptailed Grouse" Wildlife Handbook.

Control of Fire

Burning hay meadows and swamp lands in the spring has been in a large measure one of the means of eliminating the prairie chicken from his natural range. Every effort should be made to control fires and preach the gospel of fire prevention to settlers and farmers.

Haying

Although haying operations in the northern states do not interfere with the nesting birds, there are many farms and meadows where early hay crops and alfalfa crops are harvested when the chicken is brooding. It would be a safe policy to equip each mower with a flushing device (see drawing of flushing bar,"Bobwhite Quail," Wildlife Handbook), which will cause the birds to leave their nests in time to allow the farmer to raise the blade over the nest and leave a patch of grass for protection. Often this method will save the old bird as well, for often the hen will remain on the nest until cut down by the blade.

° Progress Report of the Wisconsin Prairie Chicken Investigation, Conservation Department, Madison, Wisconsin.

SHARP-TAILED GROUSE

(Northern Grouse, Grouse, Prairie Chicken)

This bird has followed logging and fires into the forested regions of the Lake States and is now found far north of his former range. He is associated with the cut-over lands, and it can be said that the lumberman has done much to perpetuate and increase the numbers of this bird. Formerly the sharptail inhabited the ectone areas between the forests and the plains and was never found where he is so common today.

The sharptail thrives in low brushy country, but often seeks spruce and tamarack swamps when trying to escape inclement weather or hunters. Prairie willow, small birch and aspen associes are indicative of typical sharptail range. An interspersion of clover fields has been found to be very attractive as feeding grounds, and usually a slight elevation in such fields is selected for mating.

Although there is some doubt whether the pinnated grouse can survive on buds, there is little evidence that the sharptail cannot subsist on them as do ruffed grouse. However, investigators have not yet proved that either bird is able to exist on buds alone for a long period of time. Food plants and seeds sought after by the pinnated grouse are also desirable for the sharptail. Acorns are excellent food, as well as buckwheat, corn, wheat, ragweed and smartweed.

Mating and nesting activities are practically identical to the habits of the pinnated grouse and will not bear further elaboration here.

Management Principles

Cutting Procedure

There is no doubt but that there will be sufficient burned and cut-over areas in our forests for many years to come, applicable to grouse management, but it is evident that with an increase in sound forestry practice these open areas will soon disappear if the rotation cuts within the working circles are not made within certain limitations.

Small openings are not desirable for these grouse, but it appears they desire a large range of brush and wild hay country. Logging by selection or by a pure shelter-wood system would, of course, not be sufficient to open up the stands and allow the grouse to become established.

Clear cutting or the group seed tree method is practically the only way forests can be cut and at the same time manage the sharp-tailed

grouse. This, of course, does not mean that improvement cuttings cannot be made within timber stands. Such a cutting policy, however, should be adhered to only when the results will be warranted, and the value of the bird crop will be equal to any excess costs which may be entailed in clear cutting over some other method of logging.

For example, jack pine can be managed for pulpwood in a 60,000 acre working circle on a sixty-year rotation, cutting 1/60 of the area annually, which will leave 60 cuts divided over a period of 60 years. During this time there will be one cut made made each year, and if each of these cuts are clear logging jobs it will mean that 1/60 of the working circle will be slash and brush area each year, suitable for the development of the sharptail, and by the time this cut-over land grows up the other blocks of timber can be harvested and subsequent prairie-like areas exposed. If 60,000 acres are included in this circle, approximately 10,000 acres will be capable of producing birds at all times, as it will take ten years for jack pine to close in and represent unfavorable conditions for sharptail. Ten thousand acres should produce at least an annual increment of 2,000 birds, if properly managed. One thousand acres under this rotation and cutting method will be logged off each year and planted at a cost of around $4.00 per acre, or a total cost of $4,000.00. A sharptail is worth about $1,00 in meat value; therefore our planting costs occasioned by the clear cut method will be partially offset by the actual cash meat value of the bird crop. The recreational value of these birds will probably raise the total value far above the dollar price, but such a value is hard to define and discuss.

Feeding Stations

Sportsmen and conservationists can be organized and their help obtained in wintering the sharptail and pinnated grouse. Two methods can be employed with good results, each if properly handled resulting in the congregation of large wintering flocks.

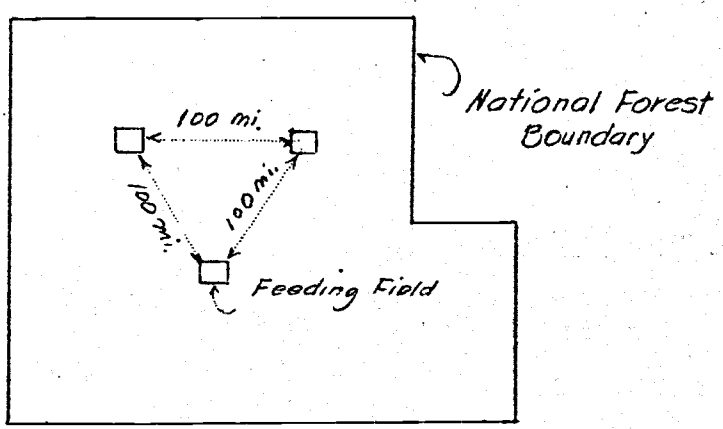
It is desirable to plant either buckwheat, wheat or corn, with soil and climatic conditions governing the species of plant to be sown. Strips five feet wide of the grain should be left standing adjacent to the edges of the field, and the remainder of the crop can then be harvested and shocked, in the case of corn, or stacked if wheat, etc. When snows cover the strips of standing grain the grouse are unable to feed, and the shocks or stacks should then be opened to allow the birds ready access to them. Shocks and stacks must be re-opened and re-arranged continually so that the birds can find the grain, as they will not have to open the shocks or stacks themselves.

Such fields should be either within refuges or be refuges in themselves, with a 1/4 mile protection strip isolating them. One twenty-

acre field planted to wheat or corn will act as a feeding station for prairie chicken (pinnated grouse) within a radius of fifty miles. As sharptail do not possess the migratory instincts of the chicken and therefore do not possess as wide a cruising radius, smaller and more numerous field crop patches will be necessary where sharptails are to be managed. In this case it is suggested that five-acre plots be sown and harvested, and that the radius between plots be only five or ten miles.

The Forest Service field men should pick the best available cleared fields for this purpose, fertility of the land being a prime consideration. These sites will be checked by the Regional Office and will then be put into production if possible to acquire them and enlist public support for the measure. If possible, there should be cooperation between local sportsmen and the State Conservation Departments in buying planting seed, etc. Local help should be hired for plowing, harvesting and caring for the crop.

Below is a general pattern of the plan:



Distribution of Prairie Chicken
Feeding Stations on a National Forest
(Sharptail Feeding Stations five or ten miles
apart and five acres each)

These feed fields can be located and planted on the following forests:

1. Chippewa (all units involved)
2. Superior (Mesaba Unit only)
3. Nicolet (all units involved)
4. Hiawatha (all units involved)

Artificial Feeding Method (by hoppers)

Local sportsmen should be interested in this method, as it is not within the scope of the Forest Service to buy corn and wheat to feed the birds, although the Service can buy seed for planting.

Shelters or hoppers can be built and corn or wheat placed under them.

Regardless of the application of this second method, fields should be planted as described above under "Food Patch Method."

Census of Prairie Chickens

(See "Dog Method of Taking Census of Quail.")

BOBWHITE QUAIL

The bobwhite quail is without question the most important of our upland game birds. In the southern National Forests of Region Nine it shares this honor with the wild turkey, and possibly in some cases with the ring-necked pheasant. The quail, however, furnishes the bulk of the shooting in the Southern areas and will therefore be carefully considered in the management of game on the National Forests.

LIFE HISTORY

The life history of the bobwhite quail has been carefully described by Stoddard°, and no attmept will be made to repeat it here.

Diseases of the Quail

Quail are subject to a number of diseases, the most common of which are briefly described in the following article by E.C.O'Roke, of the University of Michigan.

PARASITES AND DISEASES OF UPLAND GAME BIRDS

By Dr. E. C. O'Roke, School of Forestry and Conservation, University of Michigan, Ann Arbor, Michigan, Collaborator Disease Investigation of the U. S. Bureau of Biological Survey.

Experience indicates that ruffed grouse, prairie chickens, wild turkeys and quail in captivity are susceptible to the same types of diseases that attack related domesticated species. We have no evidence however, that any of these diseases of domesticated birds are widespread among upland game birds in the wild, particularly when far removed from sources of infection in domesticated birds.

Tuberculosis - characterized by yellowish nodules in the spleen and liver, these organs usually being enlarged. Sometimes the nodules are so small as to give the liver a fine granular appearance. One would not expect to find such lesions in birds less than three months old. This disease is infectious, being acquired from food contaminated with the germs of Bacillus tuberculosis, avian type. It should be looked for in places where grouse may intermingle with domesticated chickens.

Black head - Ruffed grouse and wild turkeys are especially susceptible. It has also been observed in prairie chickens and quail. The disease is characterized by circular ring-like, flat spots on the surface of the liver. These spots may be from an eighth to a half inch in diameter and may vary from few to many. The caeca may or may not be hardened and show scar tissue. The experienced diagnostician associates a peculiar offensive smell with the diseased organs of a bird that has black head. The causal organism is a protozoon, Histomonas meleagris. Infection is brought about through food contaminated with droppings of diseased birds. Domestic poultry harbor the germs but are not in themselves diseased. Caecal worms are believed also to have something to do with the transmission. Black head losses usually occur in birds from three weeks to six months old.

°Herbert L. Stoddard, "The Bobwhite Quail."

Bird Malarias and Malaria-like Diseases

Several species of blood inhabiting protozoa which are transmitted by biting flies and mosquitoes are known to infect upland game birds. Little is known about the pathogenicity of any of these in the Lake States Region. Their presence can be detected through microscopic examination of stained blood films. An enlarged, blackened spleen is indicative of this type of infection. If such disease cause losses, one would expect the losses to be most severe in young birds from ten days to three weeks old.

We have little information as to whether either Pullorum disease of coccidiosis, which cause heavy losses in young chicks, are destructive to young, upland game birds in the wild. Losses of this kind would be difficult for the layman to interpret.

Ulcerative enteritis is a serious infectious disease of captive quail, but so far as we know is not common in the wild. It is characterized by an inflamed condition of the intestinal tract simulating numerous ulcers. Upon autopsy, the intestines of a bird thus diseased are very fragile and easily broken.

Various species of upland game birds harbor numerous species of parasitic worms. Ordinarily we do not attach much importance to them unless they are present in large numbers. The round worms commonly found in the body cavity of a grouse that has been shot probably escaped from the digestive tract.

MANAGEMENT OF QUAIL

Quail Requirements

The excellent work of Stoddard°, Errington°°, and Leopold°°° in analyzing the needs of quail from the standpoint of food and cover will form the basis for management procedure.

The highest population of quail is found where there is an interspersion of open area, brush and woodlands. It has come to be an accepted fact that up to a certain limit the density of quail is in proportion to the amount of "edge". It is along these edges that the birds are able to move freely into the open for plant seeds, grit and various other foods and back to the vicinity of shrubs and trees for protection from the weather and enemies. Thus, within the forest, if areas are to be kept producing high numbers of quail, some areas must be kept open while other areas produce summer and perennial foods and protective cover. The interspersion of food, cover and openings must be found within an area of one-fourth to one-half of a mile.

There appears to be an additional close relationship between the soil as found in the valleys and the hatching of quail's eggs. Possibly this is a moisture effect. Until further effects are known, the bulk of the plantings for quail should be made in the valleys.

Relationship of Openings, Food and Cover

Where quail have a high priority, some of the area must be open. Openings located in an irregular pattern along the bottoms of valleys so that open spaces, food and cover will be available every one-half mile and arranged so as to be connected by "streets" of cover and food plantings and groups of permanent cover such as osage orange, black

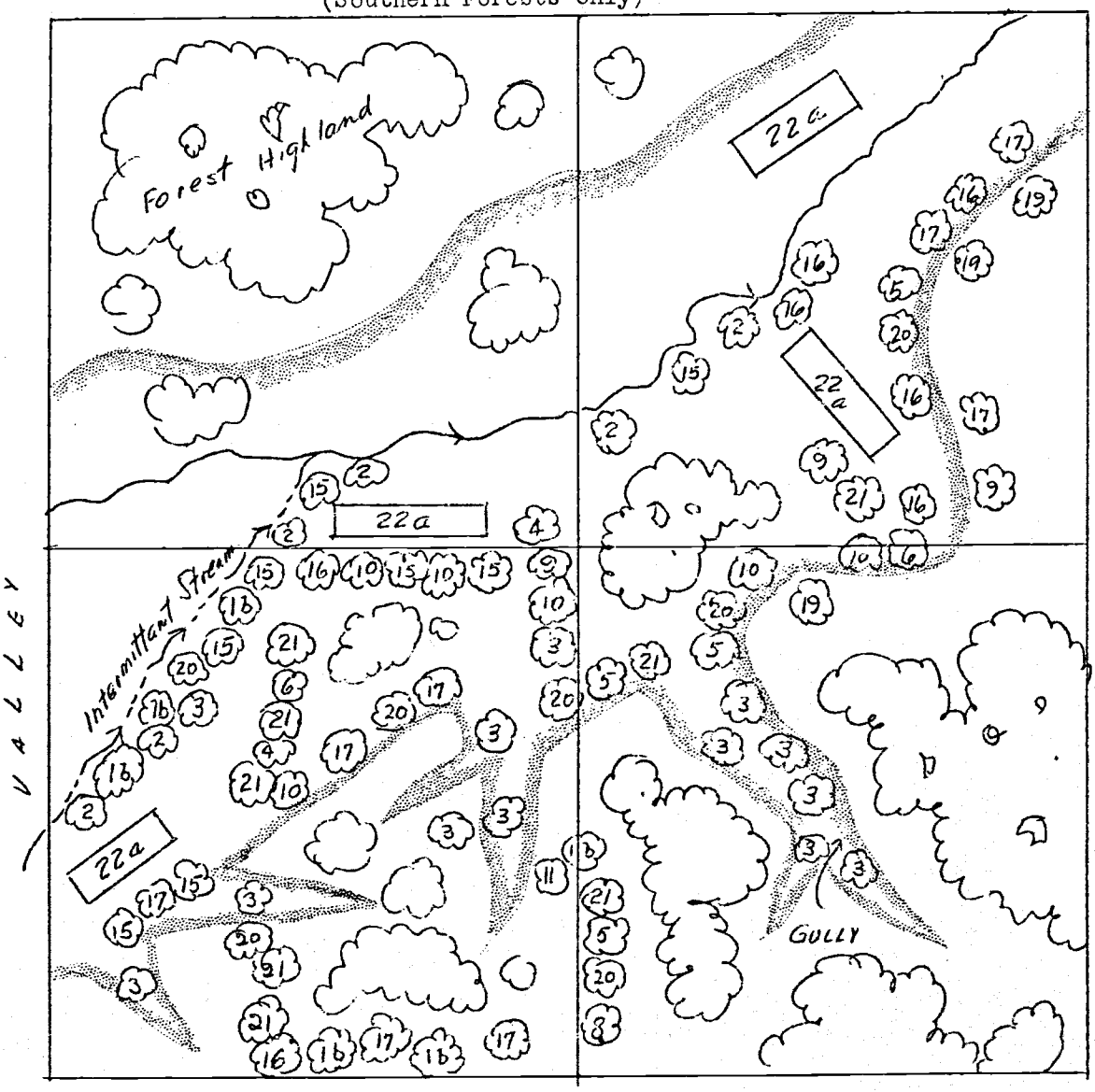
°Herbert L. Stoddard "The Bobwhite Quail." °° Paul L. Errington, "Predators and the Northern Bobwhite." °°° Aldo Leopold, American Forests, 1935. "Game Management, 1933."

locust, Black cherry, are most desirable. Where small farms and woodlands are scattered throughout the National Forests, no provision need be made for making other openings. The pattern of cover and food has been described by Wight°, Leopold°° and Grange°°° for agricultural lands, but not for the rough, hilly topography that is found in the National Forests of Missouri, Illinois, Indiana and Ohio. The principles are the same, however.

The sketch on the following page shows the arrangement of cover and food plantings and the connecting pathways between these features.

° H. M. Wight - Pheasnnt Management in Southern Michigan
°° Aldo Leopold - Game Management - 1933
°°° Wallace Grange - Improving the Environment for Wildlife.

DIAGRAM OF FOOD AND COVER PLANTINGS
(Southern Forests Only)



Trees

1a White Cedar
1b Red Cedar
2. Black Locust
3. Willow
4. Walnut
5. Mulberry (Female)
6. Hickory
7. Juniper
8. Beech
9. Cherry
10 Plum
11. Hackberry
12. Osage Orange
13. Sassafras

Shrubs & Vines

14. Highbush Cranberry
15. Wild Rose
16. Elderberry
17. Hazel
18. Bittersweet
19. Virginia Creeper
20. Dogwoods
21. Wildgrape

Annuals

22a Food Patch
22b Field Corn
22c Sweet Corn
22d Kaffir Corn
22e Soy Beans
22f Cow Beans
22g Chufa
22h Sorghum
22i Proso
22j Sudan Grass
22k Millet
22l Lespedeza
22m Sweet Clover
22n Flax
22o Sunflower

Plantings for Food

The food of the quail is approximately 80% vegetable matter and 20% animal matter. In the Southeastern States the month of October appears to be the time when the greatest amount of animal material is taken. (See "The Bobwhite Quail"). The tree seeds that seem to be most important for quail foods in the south are sweetgum, pines(various kinds) and oaks. The seeds of the black locust(Robinea pseudoacacia) are also readily eaten by quail. The use of locust will be discussed under cover plantings.

The Food Patch°

Localities where small fields of domesticated grain crops and woodlands are interspersed do not need food patches. In places where fire is kept at a minimum and the fields of grain are not present, the lack of food will soon become a limiting factor. This limitation can be partially removed by the plantings of annual food patches.

Size

The food patch would be from 1/2 to 2 acres or more in size. The number and dispersion of such patches rather than the size determine their value.

Number, Shape and Arrangement

There should be at least one food patch for each 160 acres on areas where hunting is heavy and food is a limiting factor. The shape should be rectangular, rather than square or round. Each patch should be arranged in three parts lengthwise so that one section can be left fallow to grow up to weeds, the second to be planted to a legume, preferably lespedeza and a third planted to fall and winter food plants. These strips with the exception of the Lespedeza patch, should be rotated each year. Where many small areas of lespedeza are being planted as a soil erosion control measure this item may be omitted.

Location

The food patch should be located not more than 300 feet from good cover, or at least connected by "streets" to good cover. Such cover may be a hedge, a planted gulley or a ditch with briers along it. Where such cover is not available close to a location suitable for a food patch, plantings can be made to provide a "street" or line of cover to such areas.(See cover plantings.)

Soil

The soil should be the best in the locality. Bottom lands are likely to be better than the uplands.

Protection from Livestock

- Food patches should be protected from grazing of all domestic animals.

Variety of Plants for Food Patches

The various food plants should be planted separately or at least no more than two plants grouped together. The best results may be obtained by planting crops separately, unless the soil is very fertile. The time of planting will vary with the locality, and should be determined from the nearest Agricultural Experiment Station. Not more than ten pounds of any seed per acre should be planted. Seed may be broadcasted, followed by a light harrowing. A drill may also be used for planting.

°Aldo Leopold -Specifications for Standard Food Patches (Unp. Mms.)

Field Corn	Millet
Sweet Corn	Lespedeza (Korean or Sericea)
Kaffir Corn	Flax
Soy Beans (Morse)°	Sunflower
Sorghum	Chufa
Proso	
Sudan Grass	

Plantings of Perennial Food Plants - The planting of trees and shrubs for food should be a part of the wildlife program. Fruit and nut bearing shrubs and trees can be used for this purpose. Many of the species important for food have already been listed.

Perennial food plantings should be made in scattered rather than concentrated sections so there is food available around permanent cover and along natural runs used by game. Plantings of vines should be made near natural or artificially created cover such as brush piles, partly-cut saplings, trees, etc. Trees and shrubs for game food should be planted not more than three rods apart along a line and the different species alternated. Hickory or butternut trees can be alternated with grape vines, dogwood shrubs, elderberry, cherry, plum and thornapple. These plantings need not interfere with the normal forest plantings except that a space one rod wide at each side of the line of plantings should be left, so that shade will not crowd them out. Eventually, the regular plantings will serve as permanent cover, and the trees mentioned will serve as a permanent source of food. (See diagram of Food and Cover Plantings.)

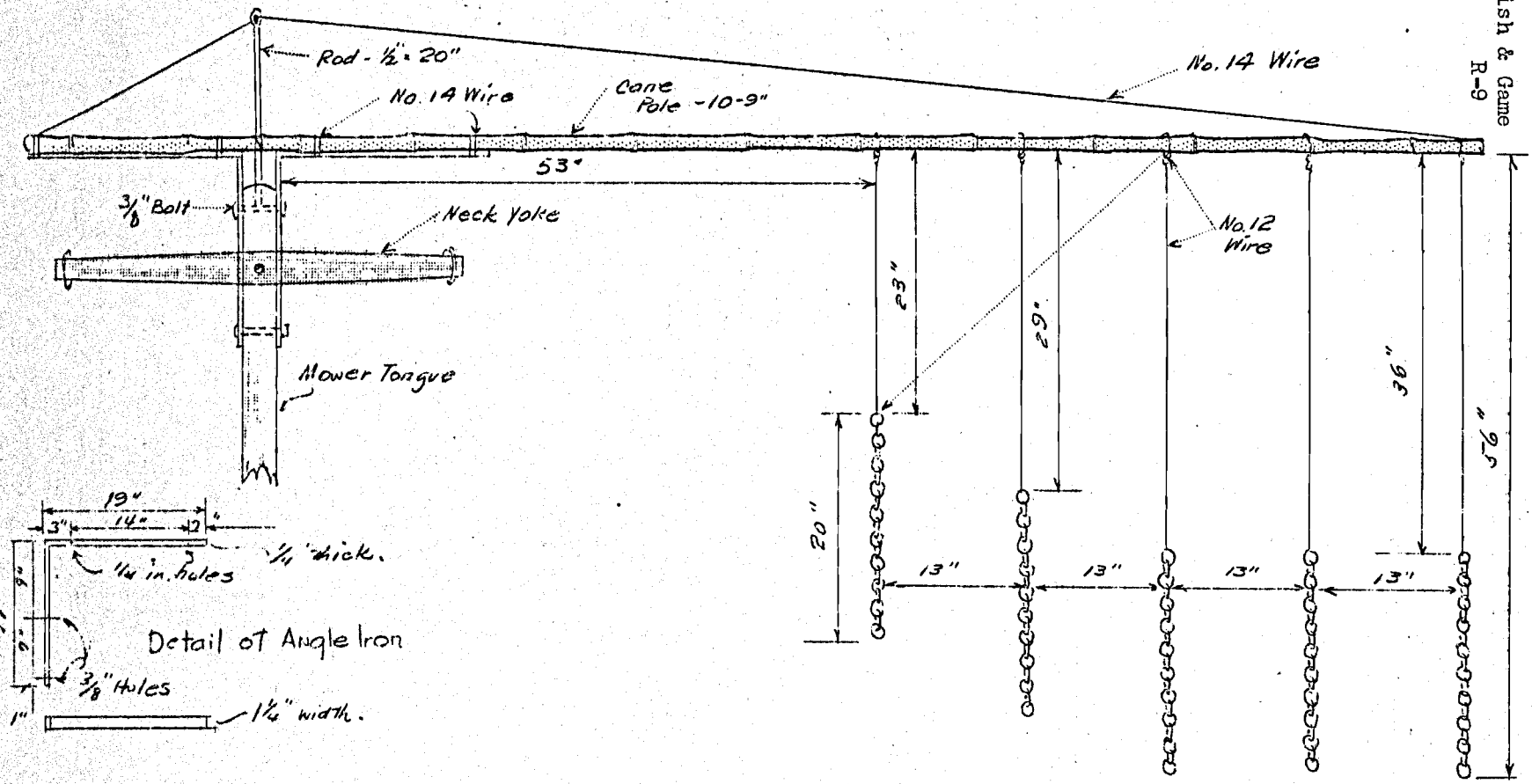
Cover - Cover is described by Aldo Leopold as a place to feed, hide, rest, sleep, play and raise young. This cover, if not in existence, can be created in the form of brush piles, hedges, brier entanglements, fallen or partly fallen trees and saplings.

Purposes of Cover for Quail -

1. Escape cover - protection from enemies, including men.
2. Loafing cover-cover which gives protection from the wind, sun, rain or snow. Such protection should be near a source of food.
3. Nesting cover - This is cover such as is furnished by tall grass or by farm crops such as hay or grain in which quail may find a place to nest. The quail seems to prefer cover for nesting which is open enough to allow them to move about with ease. There should be enough dead grass or rubbish so the birds can find enough material under which to nest.

Protection of Nests - Game birds frequently build their nests along roads or trails. Where the weeds and grass along the roads are cut each year with a mower, a number of birds' nests, including quail, are destroyed. An attachment for preventing this destruction of nests and nesting birds during the incubation period has been developed and improved by numerous people. It consists of a rod or pole with chains or burlap which flushes the bird before the cutting bar reaches the nest. The bird, as it flushes gives an indication of the position of the nest and allows the operator to leave a bunch of hay or weeds around the nest so the bird will complete the incubation of the eggs and bring off a brood. The sketch on the following page shows a flushing device worked out by Dr. P. F. English of the Michigan Conservation Department.

GAME BIRD FLUSHING APPARATUS



From Dr. P. F. English - "A Flushing Apparatus to Save Ground Nesting Birds and Mammals During Mowing Operations."

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A flushing device should be used on all roadside mowing operations, whether they are carried on by the Forest Service or by the county or township authorities, so that roadside nests and birds are not destroyed.

Cover Plantings - Woody plants or vines are the most satisfactory because they need to be planted only at long intervals. Plantings should be for a dual purpose wherever possible, such as is furnished by black locust, thornapple and wild grape etc. Cover plantings should be made in groups or along lines or "streets" so the birds can move freely between food patches and permanent cover. Additional cover can be made by lopping over worthless trees or saplings.

An ideal type of cover consists of a fallen tree with the branches left on. Vines like bittersweet and grapes can be planted along the edges of these fallen tress. Cover can also be made by the cutting and piling of brush into loose bunches.

Census of Quails - The selection of the census area for quail should follow the same principles as described under ruffed grouse. It should be representative of the ranger district in which it is located. The method most satisfactory for censusing quail is the one described by Wight°° in which a bird dog is used. A good bird dog under the direction of an effecient handler is used to flush the coveys of quail on the census area. A count is made as each covey is flushed, and the direction of flight noted. As adjacent strips are covered, the census taker should subtract the number of quail that have flown into the area from some other strips.

A dog, to be successful at this work, should be traines to work fast, to cover the ground thoroughly and to flush the birds as fast as they are found. He should be under control of the handler at all times and be trained to come back or move rapidly to another point of the area. The results of a quail census should be kept on G Fish & Game Form 77R-9 and transferred to G Fish and Game Form 111 R-9, as soon as the operation is completed. Census work should be carried on previous to the hunting season, within ten days following the hunting season and just previous to the nesting season in the spring.

Checking the number of Birds taken by Hunting - The hunting take can be checked on representative areas in much the same manner as described for ruffed grouse. The same form (G Fish & Game Form 78R-9) as is used for ruffed grouse should be used for keeping a record of the hunting take for quail. The summary of the census and hunting results should be reported on G Fish & Game Form 111R-9, except that quail should be substituted for the words "ruffed grouse."

Adoption System for Rearing Quail - The adoption involves the use of wild trapped cock birds for caring for young quail chicks produces artificially. This system has the advantage of being much cheaper than hand rearing, and produces a stock that is hardy and self-supporting. The following description of this method is taken in part from Stoddard's "The Bobwhite Quail," pp. 473 to 478.

Trapping of Unmated Male Bobwhites

Cock quails should be trapped in April or May by the use of the cock and hen trap. This trap has acompartment in the center for placing a decoy female quail.

° Aldo Leopold - Game Management - 1933
°° H. M. Wight - Michigan Game Dog.

The remainder of the trap is divided into four sections, with a trap door swinging into each section. The doors should be made so they will trip when the male birds enter. Thus a number of unmated males can be taken from a territory without disturbing brooding birds in the area. (See diagram of trap and description in appendix.)

Cocks for use as foster parents should be trapped about two days previous to the time of receiving the quail chicks. These males should be placed in adoption chambers.

After the chicks are received, ten should be placed with each foster parent. The doors should be closed until the brood is adopted, which usually takes place quickly. The chicks should be placed in the adoption chamber during the warmer hours of the day so they will not chill before being adopted.

Feed the captured males clabbered milk (cream removed) and equal parts of chick grain and German millet. A little "starting mash" should also be added. If the quail are to be kept more than one day, also feed very finely chopped clover or lettuce leaves.

Releasing the Quail.

The foster parent and brood should be taken to a good quail location near a thicket on the border of a weedy field. A patch of brambles is a good cover location. The adoption box should be handled very gently. Place in a good location and open the screened part so that the chicks can run about. Half an hour later open the main door so that the cock can come out. If this operation is performed properly the cock will come out quietly and will claim his family without excitement or fear.

COTTONTAIL RABBIT°

The cottontail rabbit is by far our most important game animal if considered from the standpoint of total numbers shot over the entire United States. They are important in the southern forests of Region-9, but are found in the northern part of the region in local concentrations.

Stocking

One rabbit can be produced for each acre where proper conditions of food and cover are present. This number of rabbits ordinarily should not interfere with forest plantings except under unusual climatic conditions. A harvest of 50% of the fall or 100% of the spring stock each year will not deplete the stock except in low points in the cycle, at which time no open season on cottontail should be allowed.

Breeding Habits

Rabbits breed from February to August, the first broods appearing about March 1. In southern Michigan the average brood is five young with two and possibly three broods a season. The young are deposited in shallow ground nests and are fed and protected by the mother for several weeks.

Cruising Radius of the Rabbit

The cruising radius of the rabbit varies somewhat with the presence and proximity of food and cover, but is approximately from 1/4 to 1/2 mile in extent, which is about the same as that of the quail.

Food

Rabbits eat a large quantity of leafy material and stems of plants. Grains are also eaten and are highly desirable as a supplementary food. The supply of food becomes a limiting factor during the late winter and early spring. It is at this time that an ample supply of nutritious material is needed for supplying the breeding requirements of the animal. Corn, oats and barley are all relished by rabbits. Fruits, such as apples, thornapples and berries are also eaten freely. Grasses, weeds and legumes are eaten during various seasons of the year, alfalfa and dandelions being favorite summer combinations. When fresh materials or grains are not available, bark, buds and stems are used. The plants which furnish the most desirable bark and stems are the apple, the basswood, the black cherry, the catalpa, the red osier, staghorn sumacs and canes of various berry vines. Some of the species which seem to be resistant to rabbit damage and can therefore be used as cover plants are black walnut, mulberry and panicled dogwood. The bark of almost all of the deciduous trees, and the buds and stems of many coniferous seedlings will be eaten during times when other foods are scarce.

Annual Food Plantings for Cottontail

The food plantings for cottontail and quail should be incorporated in the same operation. The corn and sorghum percentage should be relatively large to provide extra food for rabbits late in the winter, as this is the time they are short of nutritious food and are most in need of supplemental sustenance. The legume part of the food patch should also contain at least an acre of area to care for a heavy population of rabbits.

°R. E. Trippensee-The Biology and Management of the Cottontail Rabbit, 1934.

When lespedeza is to be used in erosion control measure, this extra area will help to supply the extra amount of forage needed for cottontails.

The cover requirements of the rabbit are somewhat parallel to that of quail. A grassy form is needed in the winter for daytime cover, and dense grass, conifers etc., are needed to break the force of winds and storms. In the summer a dense shade is desired, such as would be furnished by the leaves and branches of mulberry or by a thick cluster of berry vines. Enough grass should be present so that a "form" can be made in which the rabbits can hide. For escape cover the rabbit uses any dense thicket such as young evergreens, locust, osage orange or prickly ash. During extremely cold weather or when chased by dogs the rabbit uses skunk or woodchuck dens, hollow logs or even hollow trees. Woodchucks should not be killed where high populations of rabbits are in demand, because of the escape cover their holes supply for cottontails. Cover can be made as described for quail, except that more small items such as partly cut trees, saplings with the limbs not lopped and cover shrubs should be provided. A flock of quails will use a single cover, but each individual rabbit needs a shelter, as rabbits, particularly during the breeding season generally do not tolerate others of their own kind in close proximity at such time. Leopold°° suggests piling brush in openings where bluegrass will grow up through it. This makes ideal places where rabbits can make forms. Rabbits are very sensitive to both extremes of temperature, and should be provided cover that will protect them against temperature changes.

The Hunting Season

Cottontails shoud not be hunted before October 15 and not later than February 1. Hunting with ferrets should never be allowed, as by this method the breeding stock is likely to be destroyed. The digging out of dens by hunters or dogs should also be discouraged.

Parasites and Diseases of Rabbits

The rabbit is subject to many parasites and possibly many diseases, although few of the latter are known . The most common external parasites are fleas and ticks. Warble fly larvae are something found under the skin of rabbits. The most conspicuous internal parasites are the bladder worm cysts of the common dog tapeworm, (Taenia pisiformis) and the mature form of rabbit tapeworm, (Cittotaenia ctenoides).

The cysts spoken of are jelly-like sacs found along the intestines or on the kidneys. If those cysts are eaten by dogs along with rabbit entrails they become tapeworms in the dogs. The true rabbit tapeworms are found within the intestines of the rabbit. Neither of these parasites injure the rabbit for human food. The entrail should not be fed to dogs, however, as the dog will contract tapeworms if the cysts are eaten.

Tularemia

Tularemia is a disease which kills rabbits and also may be contracted by man. The disease cannot be detected in rabbits by visible means . Anyone handling rabbits should always use rubber gloves. Cooking of the flesh destroys the disease. The disease in man is indicated by a fever and inflamation of the various glands.

° R. E. Trippensee - The Biology and Management of the Cottontail Rabbit, 1934.

°° Aldo Leopold - Game Management - 1933

It is not fatal under ordinary conditions, if the patient has proper medical attention. The fact that rabbits have tularemia does not mean that they should not be produced for game purposes, as many other animals, including domestic stock, are subject to diseases that are fatal if contracted by man.

The following description of tularemia is given by the Bureau of Biological Survey:

" Various animals and birds are not infrequently affected with tularemia. Cottontail rabbits regularly succumb to this infection, while many other species may be diseased and show no outward evidence. It is possible, however, for these species to transmit the infection to other animals and birds as well as man, through being handled in dressing as game or scientific autopsy."

"Symptoms - Affected cottontail rabbits show a stupidity early in the course of the disease, rapidly becoming unable to run, and die after the course of a few days. Snowshoe hares and grouse may be apparently normal in appearance and show no symptoms, even though actively affected.

No satisfactory field diagnosis is possible."

Census

To date no satisfactory census method for the cottontail has been developed.

FUR BEARERS

The fur bearers vary greatly in their requirements of foods, cover and general type of habitat. In point of total numbers of skins harvested each year, the muskrat leads all others, with the skunk as a close second. The total value of furs in a single year reaches astounding figures. During the year of 1919 the total value of the fur trade conducted by New York merchants° alone reached the sum of $375,000,000 or an amount equal to the total cost of the Panama Canal. Under the heading of fur bearers the muskrat, beaver, skunk, mink, otter, marten, fisher, raccoon, fox, opossum, wild-cat badger, woodchuck, weasel, wolf and coyote will be considered.

Handling the Fur Resources on the National Forests.

At present the take of fur bearing animals are regulated only by a limitation in the length of time the trapper is allowed to catch fur bearers. A system is needed whereby the furs can be harvested on a sustained yield basis. It will be one of the objectives of the Forest Service to develop such a system in cooperation with the Conservation Department of the various states.

MUSKRAT

The muskrat leads all other fur bearers in total numbers produced. This animal furnishes the pelts which form the backbone of the fur industry. The muskrat lives in almost any lake, stream or marsh, but different types of habitat apparently yield different quantities of rats per unit area.

° Ruhl lists dry marshed, timbered swamps and leatherleaf bogs and deep open water areas as supporting comparatively few muskrats per acre. Cattail stands, rice beds and sagittaria and sedge beds as able to produce six to eight rats per acre annually. Numerous beaver flowages and marshes in the National Forests that are now devoid of muskrats should be producing large populations of rats. This can be brought about by establishing stable water levels and by planting suitable foods. (See " Duck and Muskrat Foods," Relation of Beaver to Ducks."

Life Habits- Breeding Habits

Mating of muskrats begins about February 15 or later, and the first broods are born in March. There are numerous theories as to the number of broods per season, and the age at which the young breed for the first time, but it seems to be generally accepted that the

° Charles E. Johnson - The Muskrat in New York, Its Natural History and Economics - Roosevelt Wildlife Bulletin - Forest Experiment Station, New York, State College of Forestry, Syracuse, N. Y.

°° Harry D. Ruhl, Fur Bearers in Michigan Forest Areas - Papers of Michigan Academy of Science, Arts and Letters, Vol XV. 1931 Published 1932.

early spring young may breed the same year they are born. The gestation period is from three to four weeks and the litters vary from three to nine with the average about five. Authorities disagree as to whether the animals are monogamous or polygamous, but it is generally conceded that the latter is the true conditions.

Habitats

It has been indicated that the muskrat will live in a variety of habitats, but certain conditions are better suited to their needs than others. It has been found that during a series of dry years, the muskrat catch falls off many thousands of pelts. The Louisiana Department of Conservation has found that areas of wet lands that had a thick layer of humus of at least 90% vegetable matter and 10% mineral matter produced the best quality of rats. Dr. Charles E. Johnson in New York State found the dense cattail swamps were the best suited to muskrat production.

The National Forest areas that have constant water levels with some open water and borders of cattail or bulrushes are good habitats for these animals. Beaver flowages that have been exhausted of aspen should also make good muskrat habitats. (See "Relation of Beaver to Ducks".)

Muskrat Houses

Muskrats build houses in the fall by piling together stacks of vegetation. Chambers are eaten out of these houses so as to form rooms in the inside above the water line. The entrance holes are below the water line and are approached through a network of runways. These runways are escape routes from the feeding grounds. The houses protect the rats from cold weather during the winter months. Many rats drown where water levels fluctuate to a point above the levels of the tops of the houses. As these houses are eaten and decay, they settle into the marsh and disappear. A stake driven into the marsh at an angle of 30° at intervals of a chain apart will act as a base on which the rats will build their houses.

Food

The muskrat will eat almost any kind of plants and also seems to relish some forms of flesh, as the bodies of fresh water mussels. There are, however, a few staple vegetable foods on which muskrats thrive. These are wild rice, the broad and narrow-leaved cattail, sagittaria, rice cut grass, and wild celery. Bur-reed, smartweed and many of the other marsh plants are also used as food. (See "Duck and Muskrat Foods.")

Enemies of Muskrats

Among adverse conditions, and enemies of the muskrat may be listed the following: dry weather, fire, the mink, snapping turtles, stray dogs and cats and predatory birds. The effect of dry seasons

can be somewhat reduced by holding back run-off water in old beaver flowages or marshy areas by dams. (See the "Development and Maintenance of Water areas to Wildlife Handbook, R-9.)

Fire, as a rule, is a menace to muskrats and their food and cover. In some parts of the south, the rat marshes are burned over with the purpose of improving the conditions of the vegetation. It is a doubtful practice, however, and should not be used because of the hazards it presents.

The mink, itself a valuable fur bearer, seems to thrive where muskrats are plentiful. The mink is known to be fond of muskrat flesh, especially the young. Where the muskrat is of primary importance as a fur animal, mink control in the form of intensive trapping, should be used to keep the number of minks from becoming excessive.

Snapping turtles are considered an enemy of muskrats, but just how many they consume, is not known. Where these turtles are known to be numerous, control measures should be undertaken as outlined under "Competitors and Predators of Ducks." Where turtles are captured, the flesh should be utilized for food, if possible.

Feral dogs and cats are among the worst enemies of the muskrat. The loss from these sources is probably not so great in forest areas as in agricultural sections, but it is known that summer dwellers leave an unknown number of both of these animals to shift for themselves at the end of the summer season. Forest officers should determine whether feral cats and dogs are present in the forest and should cooperate with local game wardens in eliminating these predatory creatures.

Management Procedure

Dams which will hold water levels constant are of great value in the management of furbearers. Water should not be more than four feet deep to be ideal for muskrats. The construction of dams is already discussed under "Maintenance of Water Levels Etc." so need not be discussed here. At least one area suitable for muskrat production should be set aside on each Forest as a refuge and demonstration area. Food and cover improvements should be made on this area immediately. See "Planting of Duck and Muskrat Foods." Cattails, bulrushes and various other plants will make excellent food and cover for "rats" and will grow on such places. If muskrats are not present on such areas, they should be introduced.° Such an area should be kept as seed fields for restocking additional areas with both food plants and muskrats. This area will also help to stock adjacent areas because of the rats that wander to other areas during the breeding season, and the overflow of animals due to over-population. Other areas should be improved as the demand for fur increases.

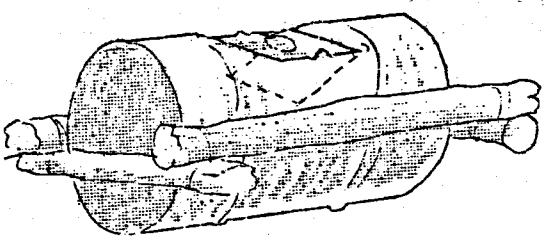
Grazing cattle are a menace to muskrats in that they destroy both food and cover and also step through into the burrows in the

°H.W.MacKenzie-Minutes of Wildlife Conference, Milwaukee, Wisconsin. 1934, Unp. Mms.

bank and thus destroy the nests and runways. Livestock also compete for food which grows along the banks of rivers and marshes and destroy the food and house-building material which would ordinarily be used by the rats.

Trapping of Muskrats

Trapping of muskrats alive is not a difficult task. In "Muskrat Farming"° a floating barrel device is described, in which a barrel is attached to a platform and floated on the water. A square hole is cut in the top of the barrel and a trap door arranged on a swivel. A carrot or parsnip bait is fastened to the trap door, so when the rat attempts to eat the bait, he will be tipped into the barrel. Rats can be removed by the use of a net or by tongs.



° - Muskrat Farming - Fur Farms Publishing Co., Utica, N. Y.

A rabbit trap, eight inches square and two feet long, can be made with a screen over one end and a door on the other end. The door should be made to swing in and trip by a trigger to which the bait is fastened.

Numerous other live traps are made. Information on these can be obtained by writing to the Regional Offices.

Trapping for Pelts

If trapping is done in late fall, many immature rats are taken. Winter and early spring have been found to be the most satisfactory time to take rats for pelts if state laws so permit.

Traps should be set far enough from houses so there is little danger of taking females. When pregnant females or those suckling young, as indicated by the nipples, are caught, it indicates that the season is too far advanced or that the sets have been made too close to the houses. Care should be taken to keep as many breeding females on the marsh as possible, for on these females depend the next year's production. Crippling can be prevented by fastening a weight to the trap and placing it so that the rat will be drowned before it is able to pull or chew off its feet. If the above rules are followed there is little danger of depleting the breeding stock or maiming animals.

BEAVER

The beaver has been present in North America as long as man has known anything about the country. Beaver skins were the first natural resources of the North American continent to be sought after,

and furnished the principal item of trade for this continent for several hundred years. Products from beaver also furnished materials for clothing, food and medicine to the early settlers.

During primeval times, the numbers of beaver were probably much smaller than they are in many parts of our forests today. Large areas of mature forests were not conductive to high populations of beaver because of the lack of aspen. Following extensive fires or lumbering operations, dense stands of aspen have come in, and the beaver has multiplied in great numbers, reaching a point in many places in our National Forests where more than the annual growth of aspen is being utilized. Under such conditions, the beaver must move, be trapped out, or starve because of lack of food. It may be desirable to increase the production of aspen along some of the water courses so that a high beaver population may be produced.

Life Habits

Beavers are aquatic animals with bodies that weigh from forty to sixty pounds. The hind feet are webbed, the nail on the second toe of the back foot being cleft. Perhaps this cleft toe is for the purpose of cleaning chips from between the animal's teeth or possibly for combing the fur. The tail is flattened horizontally, and is scaly and hairless. It is used as a prop when the animal is cutting a tree and also used in guiding the animal while swimming.

Beavers are community creatures, the gregariousness of the colony varying somewhat with the different seasons. They are known to wander during the spring and summer, but come back into family groups during the fall and early winter. Beavers breed from March to June, when one year old, but usually have but one young at this age. At two years of age, they are mature and may have from four to six young; four being the normal number for a mature female.° Only one litter is born each season. The young stay with the family group from two to three years.

Law of Limited Numbers

There seems to be a biological law that beaver will tolerate only a limited number of animals in a given habitat. Bradt°° found that the number of beavers in a small lake in a Michigan refuge remained at twelve for three seasons, although additional kits were born. Another colony in an enclosure remained at six. (Errington°°° seems to have discovered the same phenomenon of the limited carrying capacity of a habitat in studying the Northern Bobwhite Quail.) It appears that the removal of mature beaver from a colony each year after the colony becomes established is the safe way to conserve beaver. Such removal will also conserve the food supply for the animals that are to be carried over for breeding stock.

° Vernon Bailey - Tech. Bulletin #21, U. S. D. A. 1927
°° G. W. Bradt - Michigan Conservationist - February, 1934.
°°° Paul L. Errington - American Forests - January, 1935.

Food

Bark is the principal item of food for beavers, although probably fleshy roots and stems of water plants and even fruits and seeds are eaten during the spring and early summer. The dams are built during the early spring and summer, and a supply of wood, mostly aspen, is sunk to the bottom of the ponds in the fall. As the specific gravity of green hardwood is nearly the same as that of water, sinking of the stems is accomplished with little difficulty. The bark of these submerged stems is used during the winter for food. Beaver farmers figure one to two cords of poplar, birch, cherry and a little cedar for each pair per year. This may be too conservative an estimate of the amount of wood needed per beaver, as there is always some waste in lodged trees and material left on the ground. Alder and willow make better summer foods than aspen, as they do not seem to be as susceptible to fermentation.

Activities of Beaver

Beavers are noted for their industry and persistence. Among their activities may be listed the following - tree cutting, dam building, canal building and house building.

Tree Cutting

Trees and shrubs are cut by beaver for food, dams and houses. The species particularly desired for food are aspen, cottonwood, willow, cherry, oak, and small quantities of birch, alder, maples, and hazel. The bulk of the cutting is done in the fall, beginning in September, although some cutting is done continuously to build and repair dams. Trees are cut while the beaver is sitting on his haunches and holding himself in position by his tail. Trees, after being felled, are cut into lengths so that they can be transported to a pond or canal which leads to the dam or house. About four chains (264 feet) seems to be the limit of distance that beaver will go for aspen, although it will vary with the slope of the ground bordering the pond or lake.

Dam Building

Dam building is one of the most interesting and intricate of the activities of beavers. One or several dams may be placed in the same flowage, the second or third dam are possibly emergency structures in case the main dam is destroyed. Logs, stones, sticks, grass, brush, or trees and mud are all used to construct the dam. It is built from the upstream side with the tree butts heading upstream. Dams vary in size and solidity, depending on the length of time they have been is use. The dam is kept level for its entire length and a slide is built by the beavers for going back and forth over the top of the dam. Beavers apparently know the condition of the dam by watching the water level in the houses. If the water recedes the colony immediately inspects the dam for leaks. It is patrolled each night and is repaired where necessary.

The upstream side of the dam is well plastered with mud and presents a solid appearance. It is from this side that the beavers

approach the dam, and it is, therefore, kept smooth. The downstream side is rough in appearance, with many sticks and branches protruding.

Canal Building

The beaver is better able to travel and handle its food supply in water, and often digs canals from a pond to a supply of trees. These canals vary in length as conditions demand. They are about two feet wide and vary in depth to two feet. Where wood is transported along these canals, the bottom and sides are kept smooth and clean. Such canals often extend beyond the edge of the beaver pond and make available surplus aspen that would not be otherwise accessible for beaver use.

Home Building

Beavers live in two types of domiciles - houses or bank burrows. Houses are usually located above the dam and frequently to one edge of the flowage. The entrance is always submerged so that ingress and egress to the house can be made without exposing the beaver. Newly built houses have the appearance of loose piles of brush, but additions are made before winter begins so that a thick wall of peeled sticks and mud extend far enough above the water to provide several rooms at different levels above the normal water level. The nests are of dry sticks and grasses, and the beavers spend the winter in these quarters when not securing food from the bottom of the pond. The entire colony lives in this house until crowding forces the young to leave, at which time they construct houses of their own.

The houses are dome-shaped and of various sizes, depending on their age. The rooms and canals are made by the beavers cutting and digging their way up from the bottom into the interior of the structure. The thickness of the walls is increased by adding mud and sticks to the outside. During freezing weather this coating of frozen mud provides an armor that is difficult to penetrate.

Beavers often live in bank burrows. These have their openings in the bottom of the ponds under water and slope upwards into the bank so as to terminate above the water line forty to sixty feet back into the bank. The burrows are large enough for a man to crawl through and end up in an enlarged nest cavity which may contain moss or other nesting materials.

Enemies of Beaver

Beavers have few enemies under natural conditions that have much effect on their populations. The bear, timber wolf, bobcat, lynx, and the feral dog are among the animals that prey on the beaver and its offspring, but the limited number of these animals now existing probably do little harm in reducing the number of beaver.

Management of Beaver

It has been determined quite definitely that under ordinary conditions, beaver are detrimental to trout streams and trout culture.

Therefore, it is necessary to remove them from streams which have high potential qualities for trout production. These qualities can be determined by a stream survey. (G Fish & Game Form #91-R 9.

The amount of bark to support a beaver during the winter has not been determined; therefore, it will be necessary to investigate the amount of bark needed per animal so that only the number of beaver in a colony will utilize the increment of aspen. Beavers above this number should be trapped or moved alive. At present, Michigan and Wisconsin maintains a crew of trappers for taking beavers alive for restocking other areas. The Regional Office should be notified if colonies of beaver are found which have depleted their food supply.

Beaver frequently cut aspen trees that become lodged in other trees. These should be recovered currently during the cutting season (August, September and October.)

Census of Beaver

Beavers are difficult to count because of their nocturnal habits and are often difficult to find because of being hidden in bank burrows. Houses that show the results of activity are our easiest means of estimating their numbers. W. T. Cox° found that Minnesota beaver averaged five to a good sized house, and he used this method for estimating the population of beaver. The average number of beavers per house should be determined for at least ten houses each season. This can be done by either draining the flowage and counting the beaver or by watching the houses from a blind. Bank burrows should be listed as houses where they are known to exist.

The report should be as follows:

BEAVER CENSUS

Forest_____ Observer_____ Date_____

Ranger District	No. of Active Houses and Bank Burrows	Average per House	Total Beaver

° W. T. Cox - "Beaver Habits and Experiments in Beaver Culture" Tech. Bull. #21, Oct. 1927, U. S. D. A.

Trapping of Beaver

Under ideal conditions, beavers should be taken alive and only two or three year old animals retained for pelting. This saves much of the loss sustained when immature animals are taken, and also prevents crippling.

Trapping for pelts should be done in the spring when the ice begins to thaw on lakes and streams. The traps should be set not nearer than ten feet from the houses and only adult beaver weighing over 30 pounds should be retained. Killing can be done by striking them a blow on the nose.

Feeding of Beaver

Trapping areas can be made more productive and greater numbers of beaver can be retained on a limited area by bringing aspen to them during the time they are storing wood for the winter. Aspens should be brought to the edge of the water where the animals are active, in quantities which will be removed by the beaver in two nights' work. This process should be repeated until there is at least a ton of wood stored for each beaver. Bailey° figures that the annual growth of an acre of aspen is sufficient to feed a beaver for a year.

Beaver Management Units

Where suitable conditions of water exist, and where there are no other conflicting uses, small beaver management units may be considered for establishment even though food may not be adequate to sustain a large colony from the beginning. Such an area must be on land owned by the Forest Service. If there is no aspen present, it will have to be planted. Other species, like willow, alder and cedar should also be planted if they are absent. If aspen was present and had been depleted by beaver, or replaced by other species, the area should be divided into one quarter to one half acre patches in such a way that one-fifth of the area can be clear cut every five years. In this way, there should always be the following age classes present along the beaver flowage.

1/5 - 20 years
1/5 - 15 "
1/5 - 10 "
1/5 - 5 "
1/5 - clear

Other species of plants like cattails, wild celery and sagittaria should be planted in the flowage to keep adequate supplies of summer food for the beavers. The number of beavers in such an area should be kept at such a number as not to eat more than the annual increment of aspen.

° Vernon Bailey - Tech. Bull. #21 U. S. D. A.

All of the area must be within 20 rods of the water in the beaver flowage.

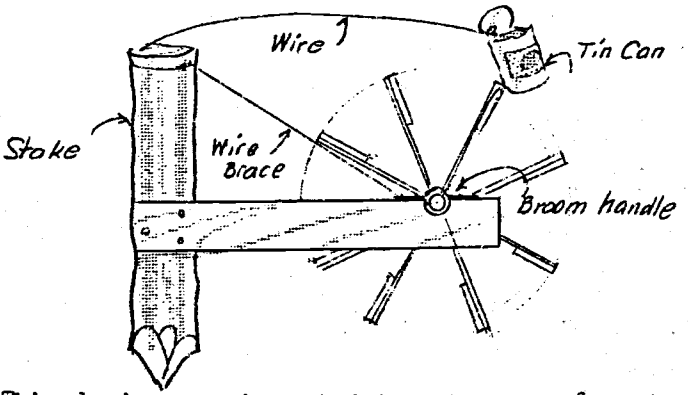
In Summary

1. Correlate the size of the colony with the amount of food present.
2. Areas supporting adequate food should be handled as described.
3. Areas deficient in food should be planted and placed under the same type of management described.

The procedure described will demonstrate the possibility of sustained timber production for beaver food. Rivers which have a high priority for trout, or lake and river shores which have a high priority for recreation must not be used for such operations.

Keeping Beaver from Rebuilding Dams

Streams which have a high value as trout streams must not be allowed to be destroyed by the presence of beaver flowages. The following device has been used on the several streams:

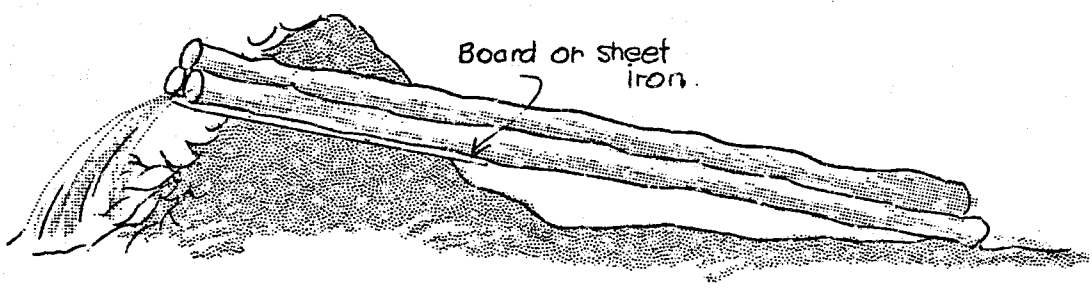


This device was invented by T.W. Agnew°. It consists of a paddle wheel built of half inch stock set between two arms on an axle made from a broom handle. A can is hung above the paddle wheel in such a way that the paddle strikes the can as it revolves, making an outburst of noise. The noise is apparently sufficient to prevent beaver from rebuilding dams where improvement devices are being made on trout streams.

Constant Water Levels in Beaver Ponds

A sluiceway through the beaver dam arranged so the beavers cannot interfere with the flow can be made by placing three straight logs on a flat timber or plank so they extend through the dam and allow an opening for water to flow through. The lower two should be slightly apart and the top of the opening protected by the third log laid on the first two.

If the work is carefully done, the water will remain at a constant level and the beaver will not be able to change this level by increasing the height of the dam.



From"Beaver Habits and Experiments in Beaver Culture."
Vernon Bailey, U. S. D. A. Tech. Bull. #21.

SKUNK

Skunks reach their maximum numbers in a territory that is settled and contains much open area. Johnson° describes them as having a greater total value than any other fur bearer in New York State. The fact that skunks are able to maintain stable numbers regardless of yearly open seasons and unjustified persecutions as a bird destroyer makes them stand out as a resource worthy of attention.

Life Habits

Skunks wander over fields and along fences at night and hide during the day time either in tall grass, under buildings or in holes. They hibernate in dens during the coldor months of the year, but come out during warm periods as spring approaches. Wight°° describes the mating as taking place in the dens. The gestation period is from sixty to seventy days, and the young born during the first part of May, the litter consisting of from three to eight young. The mother and young are often seen during the summer season as the family is out hunting for insects and berries.

Food of the Skunk

The skunk is an omnivorous animal, eating both fruits and flesh. °°°Its animal foods consists mostly of insects with traces of other animal foods mixed in. Of the mammals, mice furnish the bulk of the animal diet. Fruits, as dogwood, raspberries, blackberries and mulberries are eaten freely during the late summer and fall seasons. Carrion also furnishes a part of the supply of food for this slow moving creature.

Signs of Skunks

Trails through the grass and droppings are signs that indicate the presence of skunks. Droppings are found near the dens and along fences, in berry patches and on trails and stone piles. The droppings

° Charles E. Johnson - "The Muskrat in New York".
°° H. M. Wight - " Reproduction of the Eastern Skunk."
°°° Ned Dearborn - " Foods of Some Predatory Fur-Bearing Animals of Michigan.

may be identified by the presence of seeds or insect remains. To date nothing is known about the carrying capacity of land in terms of skunks. It should be possible to determine this yield by consulting trappers who take their "catch" over known area.

Management Procedures

There is little that needs to be done to increase skunks other than what will be done for other forms of wildlife. Increasing the number of fruit and berry plants and the maintenance of open areas where insects will thrive will maintain their food supply. The protection of the breeding stock during the active breeding season should be encouraged. There should be a closed season on skunks except during the early winter months. The practice of digging skunks out of dens should be discouraged and laws should be enacted to make this practice a misdemeanor. Improvement of the stock may be attempted by introducing all black males into a locality from state fur farms.

MINK

Minks produce a valuable fur and are one of the important fur bearers in the North Central Region. Prime mink pelts vary in value as raw furs from two to ten dollars a skin.

Relative Abundance of Minks

Dearborn° describes the mink as being common throughout most of the counties of Michigan. A trapper in one of the Wisconsin National Forests related the taking of from 10 to 15 minks annually from approximately three sections of land previous to the time the Forests were closed to trapping. This number, approximately four per section, would constitute an annual yield which, according to the description, did not vary much over a period of several years.

Breeding Habits

The male mink is slightly larger than the female. The breeding season for minks extends over the period from February to April. The exact length of the gestation period is not known, but it is thought to be between forty-five and sixty days. The numbers of young produced per litter is from two to ten, with the average about five. Minks breed but once a year.

Food

Minks are carnivorous in their food habits, living on a variety of animal foods. Dearborn found that 68% of their summer foods were crayfish and 19% were composed of mammals, largely meadow mice and muskrats. Their winter foods are largely mammals and fish, the mammals appearing three times as frequently as the fish. Of the fishes, sun-

° Ned Dearborn - "Foods of some Predatory Fur-bearing Animals in Michigan."

fish and bass make up the highest known percentages.

Trapping for Mink

Late fall and early winter is the best time to trap mink, being the time when the skins are prime. Sets can be made along the water courses, using dead rabbits or birds as bait above a concealed trap. Mink can be taken in live traps by using a live rabbit or squirrel. A mink will often force its way into a closed rabbit trap to get a live animal already imprisoned.

Old trappers emphasize the importance of leaving females and of not trapping the area so intensively that the breeding stock will be depleted.

Census of Mink

Minks are not ordinarily found far from water courses or lake borders. The extent of their travel is not known, so it is difficult to determine whether tracks seen at intervals of several miles along a stream are made by one or more animals. The use of a factor or track index with a known "take" of minks for an area will in time yield results that will indicate the relation of tracks to total numbers. The following suggestion is given for the censusing of mink.

After a fresh snow, which is heavy enough for good tracking, run a strip sample across each water course at intervals of four miles at right angles to the water course. On this strip count each mink (weasel or otter) track as one animal. Be sure you are able to identify the tracks of the various animals accurately so that as little error as possible is made. This count should be made on a large enough area so counts on following days will not duplicate animals already counted. Where experienced woodsmen or trappers can be used, it will increase the accuracy of the count. If tracks go in two directions along the stream, each track should be counted as one animal unless it is determined by actually following the track that it was made by the return of the same animal.

Tabulate the results as follows:

Census of Furbearers

Forest_____ Observer_____ Date_____

Ranger Dist.	Stream or Lake	No. of Strips	No. of Mink Tracks	No. of Weasel Tracks	No. of Otter Tracks	No. of other Tracks
Kanite	Bush Cr.	1	2	1	1	1(35) 1(26)

Number each strip by consecutive numbers for each separate stream or lake shore. List each furbearer track for each strip by their correct key numbers:

23- Muskrat	26- Fisher	31- Fox
24- Mink	27- Otter	33- Wolf
25- Weasel	28- Marten	34- Coyote
		35- Bobcat or Lynx

OTTER

The otter is an aquatic animal found in small numbers in the National Forests. It is about four feet in length, having short legs and a tapered tail. It is deep brown in color and has fur that approaches perfection as to quality and appearance. Its feet are broad and its toes are webbed for use in the water. The otter is an excellent swimmer, and spends much of its time in the water.

It is a shy animal, although one of high intelligence. Where given any protection it will persist and though rarely seen will increase slowly. It is said that otter makes an affectionate pet when caught as a young animal and raised close to the habitat of man.

Otters are seen in pairs most frequently during their breeding season. Signs where they have made slides on the banks of rivers or lakes or where food is eaten indicates their presence.

Breeding Habits

Otters breed once a year and have one to five kittens in a litter. The male otter travels long distances during the mating season, but exactly how far is not known, The young stay with the mother until nearly full grown, usually about six months.

The fact that otters breed but once a year makes the increase so slow that they will not stand heavy trapping, even where state laws permitted such a procedure.

Food

Much of the food of the otter consists of fish which they are able to outswim and catch. Because of this fact, a few trout fishermen would have the otter condemned as a predator. The total fish eaten however, with such a scattered population of otters, is probably small. Until more is known about the kind of foods eaten every effort should be made to increase the number of otter on the National Forest.

Management

Management of otter will necessarily be indirect until more is known about their habits. The improvement of streams and lakes and the increase in fish production will tend to increase their numbers, especially if they are given protection by law and if the public is informed of their value as a forest resource. Every effort should be made to determine the number of otter present on each forest and to inform trappers and others of the value of the otter as a fur producer.

MARTEN

Early trappers considered the marten one of the best of the fur animals. It has a fine valuable fur, is easy to catch and is an inhabitant of the coniferous forests. This animal was reported as supplying some pelts in Michigan, Wisconsin and Minnesota as late as 1920. At present they are at a low point in numbers in all these states, if they exist at all. Every effort should be made to protect this animal and bring it back as a fur bearer, if for no other reason than to keep the numbers of red squirrels in check.

Breeding Habits

Mating of martens takes place in the late summer during July or August. The gestation period is from 259 to 275 days. The litters arrive sometime in May or early June, consisting of two to four kits, and it is thought that females will breed at the age of one year. The martin is a very shy animal, and its breeding has been much disturbed by the activities of man.

Food

Martens live part of their life in trees and eat red squirrels, chipmunks, fish, frogs, reptiles and carrion. Birds, brids' eggs and rabbits are also eaten by the animal.

Management

The marten should be protected in all National Forests for as long as is needed to bring its number back to proportions which make it safe from extermination. All forest personnel should inform themselves as to its appearance and habits, and should watch for signs of marten. Where they are known to exist, a sanctuary should be created with absolute protection from all disturbances by men. Local hunters, trappers and sportsmen should be informed of the nature and value of the animal, and asked to help in keeping sanctuary areas inviolate.

FISHER

The fisher is one of the largest of the weasel group and a wide ranging creature. Its place is in a wilderness area, and it should be allowed to propogate in such locations.

Management should consist of trapping the animals when they reach numbers that are unduly destructive to other varieties of life.

RACOON

Racoon is one of ourmost interesting and valuable animals. It is not only a valuable fur bearer, but likewise is a creature that gives sport for hunting during the late fall and early winter. It is commonly found near water where large trees are available for dens.

Life Habits

Racoons mate in the late fall or early winter. The gestation

period is from 60 to 65 days. The female produces from two to six kits once a year. The young are cared for in a nest and follow the mother until the next mating season.

Raccoons are nocturnal and, therefore, are not ordinarily seen in daylight. Their signs are quite apparent, however, so one can not mistake their presence once their tracks or other signs are learned. Racconns like to prowl around marsh or lake borders and will leave their tracks, which somewhat resemble the print of a baby's hand, in the soft mud of a creek or river. They also like to crawl over down or leaning logs and will leave their droppings on such promenances. The 'coon seems to have a circuit which it makes at night, with escape or rest trees along the way. These can be discovered by tracks at their base or claw marks on the bark.

Food

A variety of food is eaten by the raccoon. Fish, crayfish, mussels, insects, corn, berries - all go to make up the varied diet of this animal.

Management Procedure

Nest and hibernation trees are necessary for this animal. Therefore, at least one living hollow tree should be left for each acre of woods. While all trees may not be used for den trees, they will furnish escape cover for the animal during the open season. The creation of bodies of water will also help to furnish aquatic food which seems to be necessary for the raccoons. Trees felled into a lake or flowage will act as feeding grounds for 'coons.

'Coon hunting should be prohibited earlier than November 1. This will give the young time enough to develop into full grown animals. All dog hunting previous to the above date should be prohibited. Dogs which hunt alone should be tied up during September and October and feral dogs should be destroyed. Trapping should be allowed only in November and December and not more than half of the estimated population should be allowed to be trapped during any one season.

Where the habitat appears to be suitable, raccoon stock should be planted if none now exists. A nucleus of breeding animals should always be maintained by closing areas which are suitable raccoon habitats. A better grade of fur can be obtained by introducing dark-furred males into an area so that a breed of dark furred off spring will result.

OPOSSUM

The opossum is an animal that will inhabit only the forests in the southern tier of states in this region. It is valuable for its fur, although its flesh is prized in some localities. It is a slow, harmless creature, living on various kinds of foods. Its helplessness would seem to cause it to disappear, but it is increasing in many settled communities.

Life Habits

Young opossums are brought forth from the mother after a gestation period of only 11 days. They find their way into the marsupial pouch and there remain attached until they are sixty to seventy days old. They are carried in the pouch and on the mother's back for several weeks. The litter consists of from six to sixteen young, and more than one litter may be born each season.

Food

Opossums eat almost any kind of food they are able to capture or obtain. Fruits, especially apples, are relished in the fall and early winter. Any kind of carrion is taken, including entrails from domestic animals and bodies of animals discarded by trappers. These animals serve a valuable service as scavengers, as well as being valuable for their fur.

Trapping

The fur of the opossum is prime in late fall or early winter and should be taken at that time. At other times of the year, the animal should be given protection. Hunting opossum should be discouraged during the breeding season.

FOXES

Under this heading will be considered the red fox, black fox, cross fox and gray fox. The fox is valuable for its fur, as well as being an animal used for coursing dogs. Fox hunting in many parts of the country has come to be a popular and exciting sport.

The black fox is the most valuable for its fur, with the red next. Both of these species are residents of our Northern States, while the gray seem to be more common residents farther south.

Life Habits

Foxes rear their young in dens or under rocky ledges. They produce one litter a year and from two to six at one time. The gestation period is approximately the same as that of the dog. From 60 to 70 days.

Food

Opinions vary as to the food of foxes. It, no doubt, varies with the conditions of the country and the kinds of food available. Dearborn believes the fox lives largely on rabbits and mice, with ocassionally a bird. MacKenzie states that the gray fox is more destructive to game than is the red or black fox. Where rodents are plentiful the fox is without question an important factor in reducing their numbers.

Management Procedure

Foxes should be trapped only when their fur is prime, during

December and January. At other times, they should be protected, unless their number reaches such proportions that other game is being destroyed. Control should be accomplished by trapping or hunting with hounds. Fox hunting should be encouraged where any of the varieties of fox are known to be sufficient in number to need control. Laws should be encouraged which will prevent the digging out of fox dens or the possession of the young. The public should be informed of their value and encouraged to back legislation concerning their management.

WILD CAT

Two species of animals are considered here - the Canada Lynx or Lynx canadensis, and the bobcat or bay lynx - Lynx rufus. The former is found only in our northernmost areas and is only a remnant of a fast disappearing species. The latter is found over the entire North Central Region in varying numbers. Dearborn° found that trapping in Michigan refuges showed wild cats and foxes in a ratio of about one cat to twenty-five foxes.

Food

All evidence indicates that the principal food of the lynx group is the snowshoe hare, and is therefore, valuable for keeping the number of snowshoe rabbits under control. Wild cats probably pick up wounded deer following the hunting season and may kill deer during the winter yarding season. Dearborn's work showed no grouse remains in the droppings of wild cat.

Management Procedure

Trapping of the Lynx should not be undertaken except in refuges where other more valuable species are being destroyed and then only on sound evidence that there is an over-abundance of the animals present, and damage is being done. Where control is necessary, local sportsmen should be encouraged to hunt the wild cat with dogs and thus get a maximum of enjoyment out of the resources.

BADGER

Badgers are ground dwelling nocturnal creatures which live on ground squirrels, mice and rabbits and thus help to reduce these animals and prevent their destruction of forage plants that are valuable to other animals. Where the badger is plentiful enough to be killed for its fur, it provides a source of pelt which is valuable. Their burrows furnish retreats for rabbits and the soil removed from their burrows provides grit for birds of all kinds.

WOODCHUCK

Woodchucks are common in all of our National Forests in this Region. They are herbivorous, so are not destroyers of any forms of

°Ned Dearborn -"Foods of Some Predatory Fur Bearing Animals in Michigan".

animal life. They have a very positive value in the belt where cottontail rabbits den during extremely cold weather. The sleeping chamber of the woodchucks is off the main runway, so their presence does not interfere with the use of the den by rabbits.

R. T. King, of the University of Minnesota believes the woodchuck is very valuable to bird life because of furnishing grit for birds that are removed from the burrow.

WEASEL

This animal is closely related to the mink, but lives in a dryer, more upland habitat. It is one of the most effective destroyers of mice. Contrary to the common belief, it lives largely on mammals and destroys very few birds. Where weasels become unusually numerous, their numbers should be reduced by trapping during November and December.

WOLF

The timber wolf is a dog like creature closely related to the domestic canine. It is found in many of the National Forests, particularly those of the northern state. It ranges over a wide expanse of territory living on other creatures including mice, rabbits, muskrats and deer.

Life Habits

Wolves run in packs during the winter when food gets scarce. During the mating season a male and a female hunt together. The young are born during the middle of the winter. The female makes a nest under a log jam or in a sheltered ledge where from two to eight young are born. The male helps take care of the young by bringing food to the nest. By the time spring opens the young are able to go short distances from the nest and gradually learn to hunt as they develop size and strength.

Management Procedure

Much effort has been expended in reducing wolves as a method for increasing the number of deer. The exact value of this reduction is not based on sound evidence as little is known about how much wolves help deer by keeping down the number of their competitor, the snowshoe hare. Until this inter-relationship is better known, efforts should be expended in learning the truth rather than removing a factor of unknown effect.

Census Method

A census of wolves should be taken on snow in the deer concentration yards during the winter. This can be done when the forest officer is investigating the wintering conditions prior to taking the deer census on sample areas. From this reconnoissance, a close estimate of the number of wolves can be made.

COYOTE

The coyote is much like the gray wolf except smaller and a

slightly more tawny or yellowish color. It was formerly a western animal, but its range has moved eastward until it now includes most of Minnesota, Wisconsin and Michigan. Their movement has been hastened eastward because of coyote pups being brought east by tourists. These animals are very resourceful and adapt themselves to their environment readily.

The breeding domicile is a hole in the ground which the animals dig themselves, or may be an abondoned badger den. The breeding dens are carefully concealed and are difficult to locate.

The gestation period is 63 days or the same as a dog or wolf, the young being born in April. The average litter is six.° It is believed that the population adds 20% to their numbers each year where winter food is abundant.

The coyote is a carnivore and eats anything in the way of flesh that is available. He also eats fruits and berries where these items are available. Coyotes will kill the young of domestic livestock and deer and may also kill adult deer under certain conditions where snow is deep and the deer are weak from lack of food.

Where deer or other animals are being destroyed by coyotes, the Regional Office should be notified so that a request may be made of the Biological Survey for Government trappers.

° Ernest Thompson Seton - "Lives of Game Animals."

MANAGEMENT OF NON-GAME SPECIES

It is desirable to construct and erect bird houses at Ranger Stations, lookout towers, public camp grounds and guard stations, not only for the beneficial results obtained through the activities of the birds in destroying insects, but also for the edification of the public in the worth and proper care of our song birds.

Our insectivorous birds perform a great service to our forests by controlling insect pests. Without these birds insects would soon level the forests and destroy the crops in the fields. The birds are an indispensible part of the forests and in company with the trees form a great symbiotic community.

Through logging and burning of the timber tracts of this country many species of birds have been seriously reduced in numbers. Some authorities say the destruction of the nesting sites of the passenger pigeon was the direct cause of its extermination. It is a proven fact that many of our most valuable birds have decreased in number seventy-five per cent. Such a reduction in numbers is a serious handicap to the breeding rythm of a species. It may even cause extermination.

We must not allow any of our song birds to follow in the wake of the passenger pigeon.

MARTINS°

Purple martins are insect eaters, two thousand mosquitoes being the average daily meal for each bird. The house should be placed near the water, where the insects are plentiful and away from trees where the foliage would be an obstruction to the flight of the birds. The different stories or compartments of the house are made in the form of drawers to allow for cleaning out of the house after the birds leave each fall. The cross partitions divide each drawer into a number of chambers. If the cross-bridging is left out, the ventilation holes in the bottom are not necessary.

After the martins leave in the fall remove the drawers, clean them out and store them away until the next spring. Unless the drawers are removed, sparrows and starlings will occupy the house after the martins leave. A feeding tray can be placed in the frame where the drawers have been removed for the feeding of grain, bread, or nuts to winter birds.

In Central Wisconsin martins arrive in the spring about the middle of April, so the trays should be replaced a week or two before this time.

A note should be made of the exact date the martins arrive so the houses can be made ready in time for the birds.

Martin houses should be placed twelve feet from the ground. The pole should be at least 4 inches square and securely set in a

cement base of eighteen inches in diameter and three feet deep. Houses can be placed advantageously on garage roofs etc., where these buildings are not surrounded by trees.

WRENS °

The wren is a bird that is very easily attracted to man's domicile and its song is one of the most melodious of all the feathered songsters. The diet of the wren is exclusively insect worms, and as a result a pair of wrens will keep under control many noxious insects of the garden and lawn.

Two houses in the same vicinity will frequently be occupied by the same pair of wrens, as the same pair will very often raise two or more broods during one season. Therefore more than one house in the same locality is desirable. The house should be placed six to eight feet from the ground. A perch on the outside of the house is not desirable.

LEDGE FOR SWALLOWS AND ROBINS °

Barn swallows prefer a ledge nailed to beams in barns or garages. Of course, there must be an opening so the birds can enter the building. For robins the ledge should be nailed to the outside of the building just below the eaves of the roof.

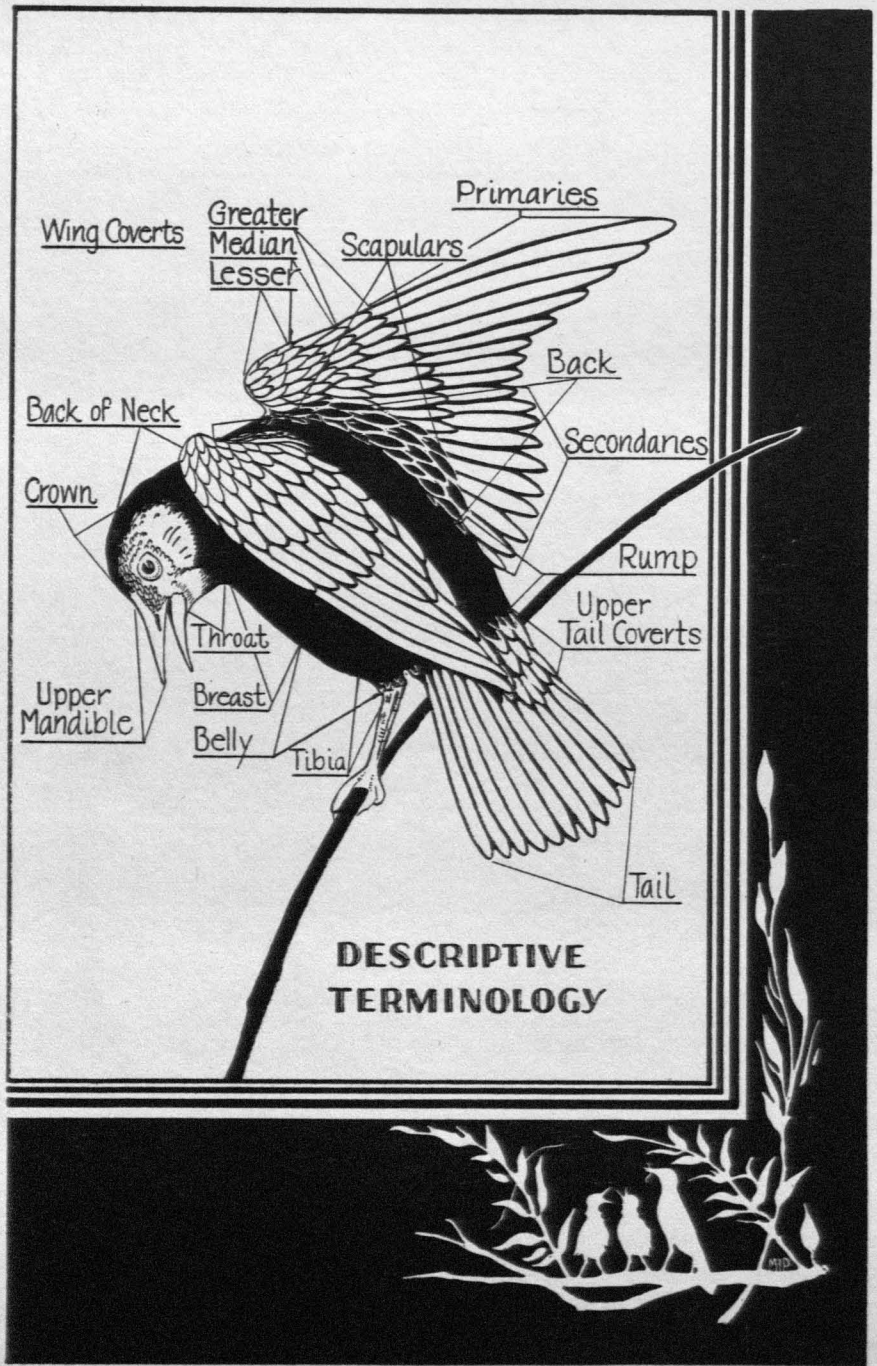
FLICKERS AND OTHER WOODPECKERS °

Flickers and woodpeckers live largely on insects; one flicker being able to eat four to six thousand ants each day. The style of house given in the cut may be altered to meet the varied sizes of the different birds. Most of the woodpeckers will be attracted by this type of house however. Place chips or sawdust in the bottom of the houses for the birds to lay their eggs on as these birds do not build nests.

TREE SWALLOWS AND BLUEBIRDS °

A single plan will serve for both tree swallows and bluebirds. For tree swallows the houses should be nailed to trees and stumps along the edge of water or on a fence in the vicinity of water. Bluebird houses are most successful on fence posts along the edge of wooded areas or orchards, and away from human habitation. If sparrows or starlings are numerous, leave out the bottom of the houses during the winter season, and do not replace until before the swallows or bluebirds arrive in the spring. Houses should be placed six or seven feet above the ground. They should be guarded from cats and squirrels.

°Prepared by L. A. Hautz


Primaries
Wing Coverts
Greater
Median
Lesser
Scapulars
Back
Back of Neck
Secondaries
Crown
Rump
Upper
Tail Coverts
Throat
Upper
Mandible
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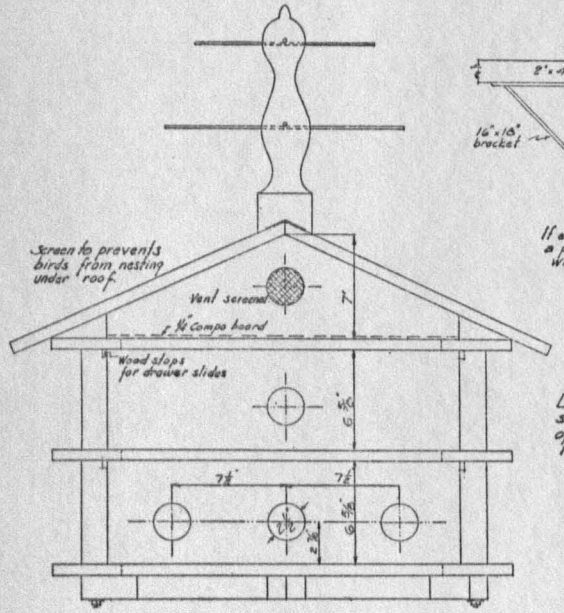
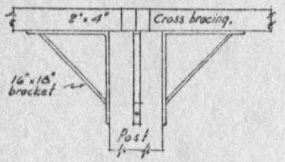
Belly
Tibia
Tail
DESCRIPTIVE
TERMINOLOGY



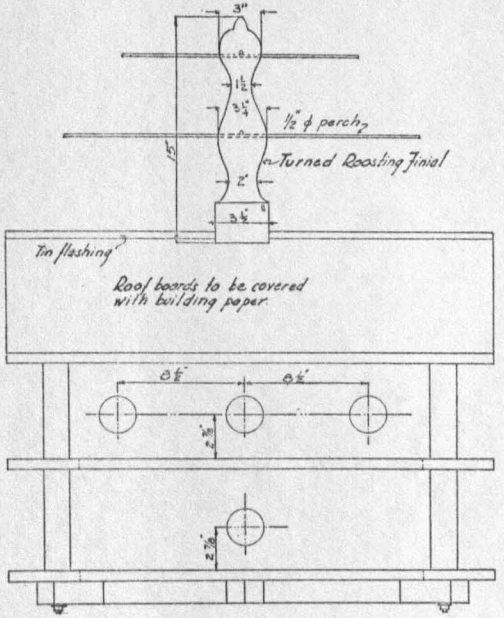
END VIEW



If erected higher than 12'0" a post larger than a 4"x4" will be required

·POST·

Drawers· Identically the same, except the location of the holes see side and front view

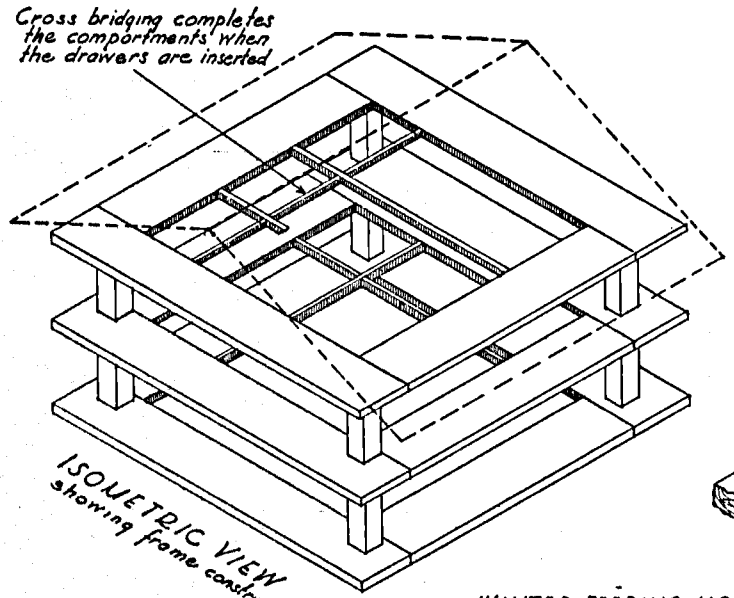


SIDE VIEW

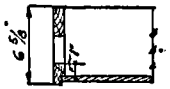
·NOTE·

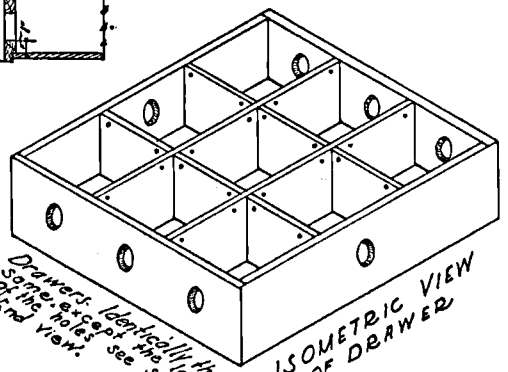
The house should be erected on cleared ground, away from trees and bushes, near water, about 12' to 20' feet high.

·16-ROOM·
·MARTIN HOUSE·



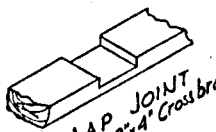
ISOMETRIC VIEW showing frame construction



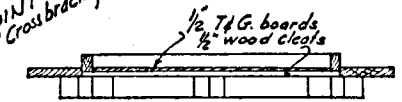


Drawers identically the same except the location of the holes. See side and end view.

ISOMETRIC VIEW OF DRAWER



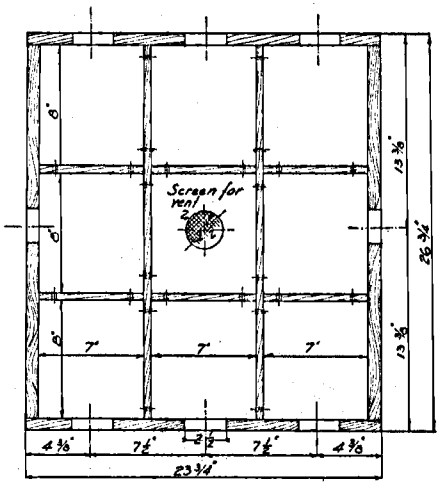
LAP JOINT for 2"x4" Cross bracing



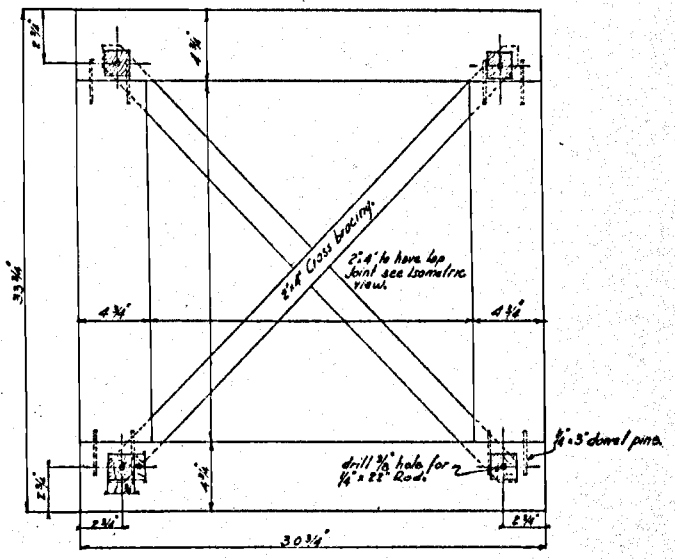
FEEDING TRAY

WINTER FEEDING NOTE:
To discourage occupancy of house by undesirable, such as starlings, sparrows in winter remove drawers and insert feeding tray, suet, grain, bread etc. will attract.

•DETAILS OF• •MARTIN HOUSE•

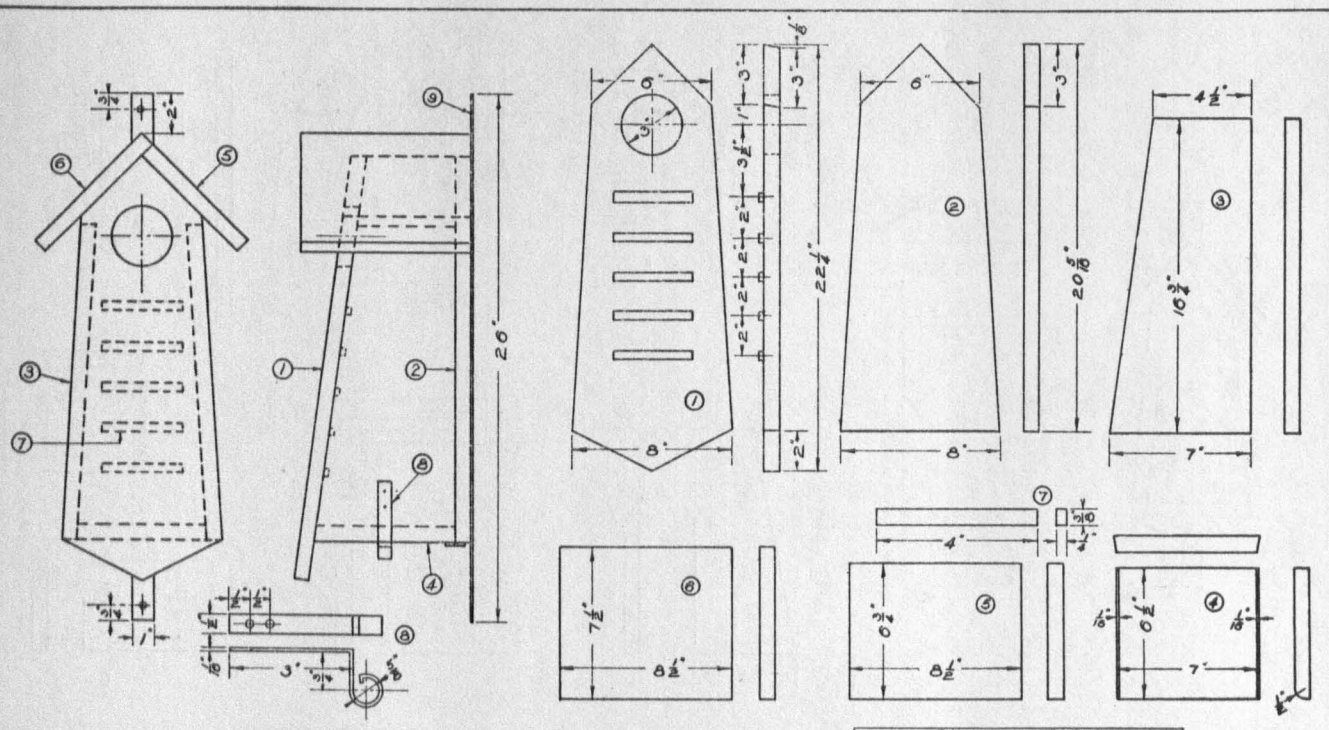


PLAN OF DRAWER
other drawer similar see side view.



PLAN OF FRAME
other frames similar see isometric view.

·PLANS OF·
·MARTIN HOUSE·

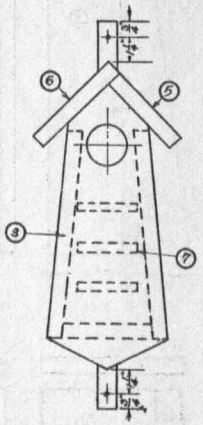


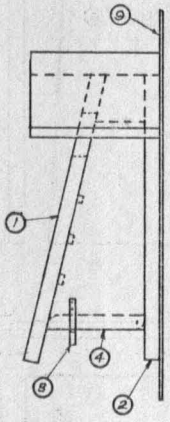
Cover bottom of house with two in of wood chips or sawdust. This material makes up the nest
Nail house to tree or pole 10 to 20 ft. above the ground. A dead stump is best. Do not place house
where foliage is dense. The cleats shown in drawing assist the young in climbing up to hole.
This same style of house may be used to attract other woodpeckers, as the Hairy, Red-headed
or the Crested Fly Catcher with dimensions as follows, base 6"x6", depth 12" with a 2½ hole placed
10 above the floor. (Don't forget the 2 in. of wood chips for all woodpeckers.) If constructed for Downey
use the following dimensions, base 5"x5", 10 deep with a 1¼" hole placed 8 above the floor

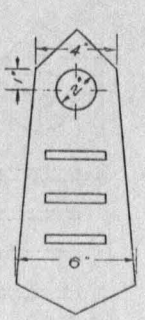
BILL OF MATERIAL

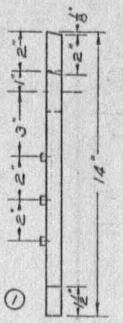
Pcs.	Name of Part	Ref No.	T	W	L
1	Front	1	⅞"	8"	22½"
1	Back	2	⅞"	8"	20⅝"
2	Side	3	¾"	7"	16½"
1	Bottom	4	⅞"	6½"	7"
1	Right Top	5	⅞"	6½"	8½"
1	Left Top	6	⅞"	7½"	8½"
4	Steps	7	¾"	¾"	4"
1	Hook	8	½"	½"	4½"
1	Band Iron	9	⅛"	1"	26"

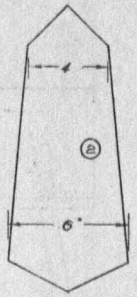
FLICKER HOUSE

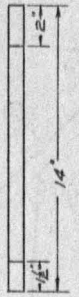


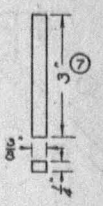


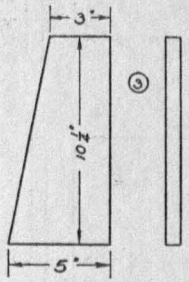


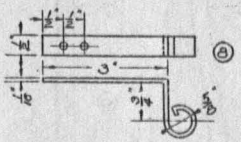


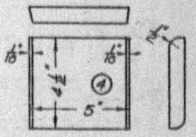


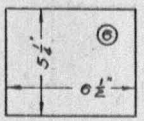


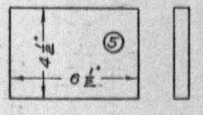










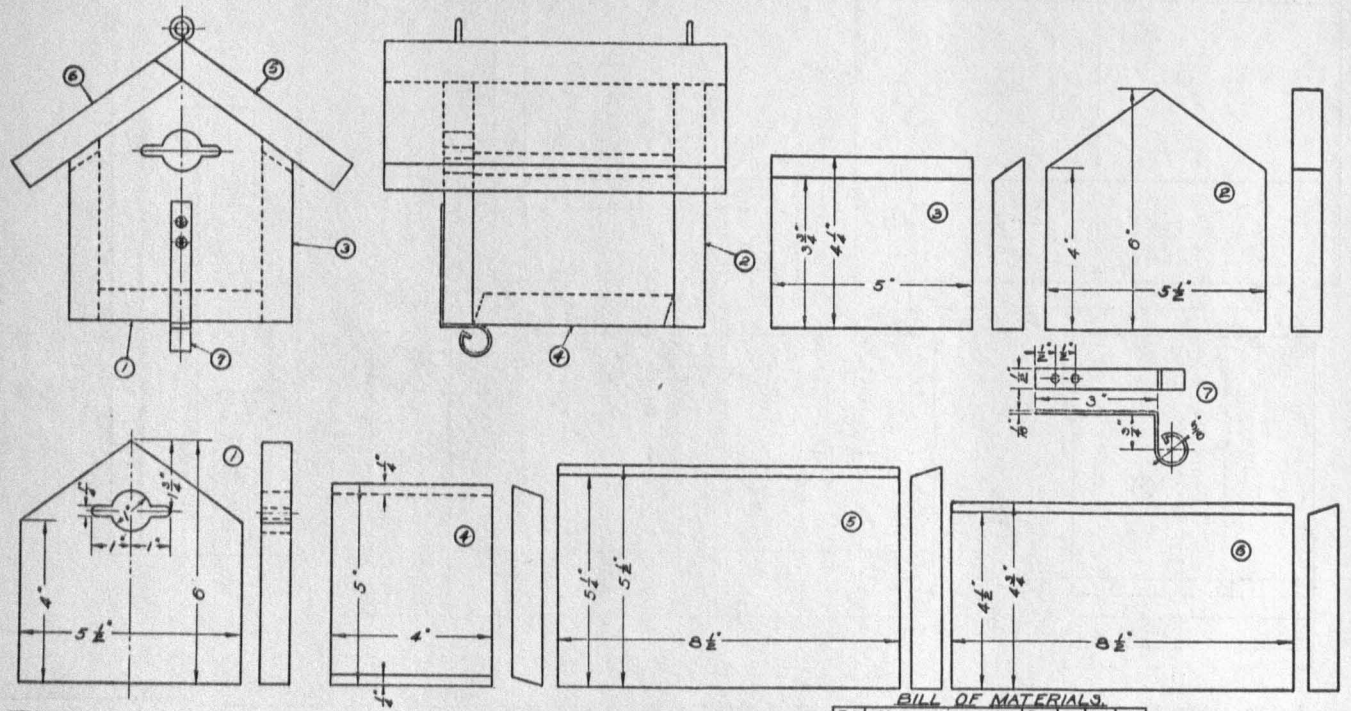


House is supported by either post or tree, from six to twelve feet above ground. The edge of a woods, or an orchard is preferable to the center of a thickly wooded location. Should be placed near water to attract tree swallows.

BILL OF MATERIAL

Pcs	Name of Piece	Item	T	W	L
1	Front	1	3/4"	6"	14"
1	Back	2	3/4"	6"	14"
2	Side	3	3/4"	5"	10 1/2"
1	Bottom	4	3/4"	4 1/2"	5"
1	Right Top	5	3/4"	4 1/2"	6 3/4"
1	Left Top	6	3/4"	5 1/2"	6 3/4"
3	Step	7	3/4"	2"	3"
1	Hook	8	1/4"	3/4"	4 1/2"
1	Band Iron	9	1/4"	1"	19"

BLUEBIRD AND TREE SWALLOW HOUSE

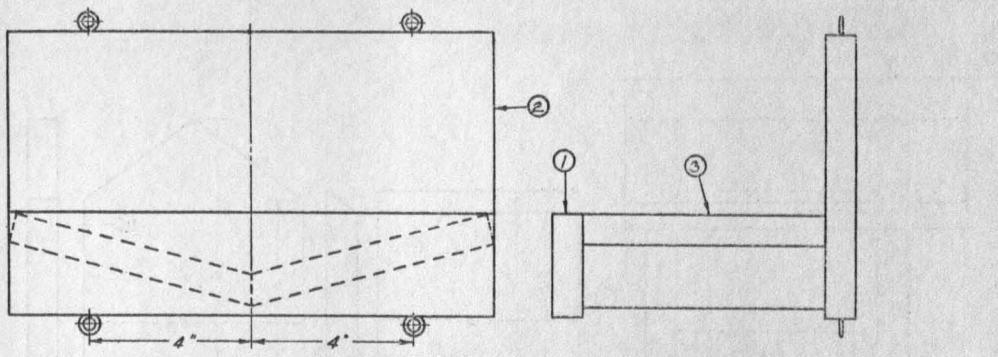


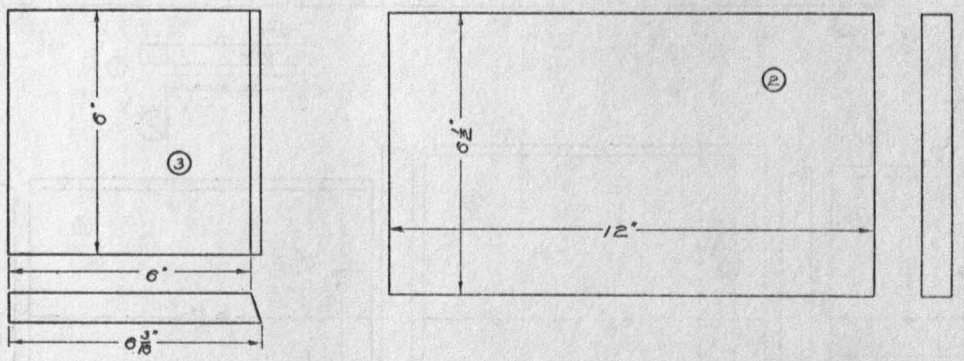
This model is made to hang from the limb of a tree. It is supported by means of two hooks which are screwed into the limb and spaced the same distance apart as the eyes on the house. When the house is hanging the hooks are closed far enough to avert whatever danger might be caused by swinging. These hooks make it easy to remove and replace the house.

BILL OF MATERIALS.

Pcs.	Name of Piece	Refer.	T	W	L
1	Front.	1	⅞"	5½"	6"
1	Back.	2	⅞"	5½"	6"
2	Side.	3	⅞"	4½"	5"
1	Bottom.	4	⅞"	4"	5"
1	Right Top.	5	⅞"	5½"	8½"
1	Left Top.	6	⅞"	4½"	8½"
1	Hook.	7	7/16"	⅜"	4½"

WREN HOUSE





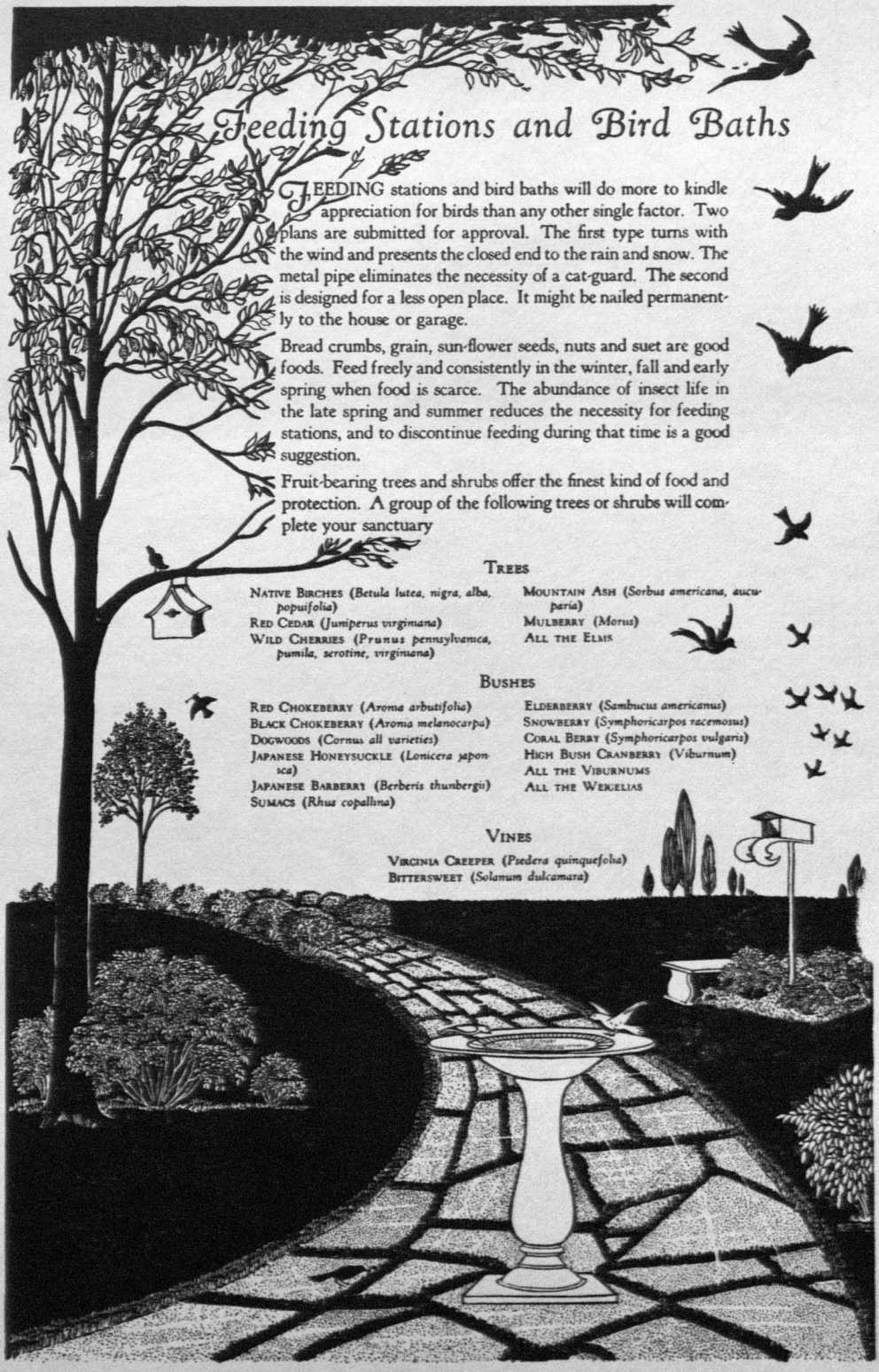
Nail the nesting shelf on the inside of the barn or shed just below the 2nd story beams, or, in the case of a single story building, 6 to 10 ft from the floor. Provide entrance holes from the outside

For outside use nail under and parallel to roof eve about 6" below intersection of roof and side. Robins may use it.

BILL OF MATERIAL.

Pcs	Name of Piece	Mat'l	T	W	L
1	Front	1	3/4"	2½"	12"
1	Back	2	3/4"	0⅞"	12"
2	Bottom	3	3/4"	6"	0 3/16"

BARN SWALLOW LEDGE



Feeding Stations and Bird Baths

FEEDING stations and bird baths will do more to kindle appreciation for birds than any other single factor. Two plans are submitted for approval. The first type turns with the wind and presents the closed end to the rain and snow. The metal pipe eliminates the necessity of a cat-guard. The second is designed for a less open place. It might be nailed permanently to the house or garage.

Bread crumbs, grain, sun-flower seeds, nuts and suet are good foods. Feed freely and consistently in the winter, fall and early spring when food is scarce. The abundance of insect life in the late spring and summer reduces the necessity for feeding stations, and to discontinue feeding during that time is a good suggestion.

Fruit-bearing trees and shrubs offer the finest kind of food and protection. A group of the following trees or shrubs will complete your sanctuary

Trees

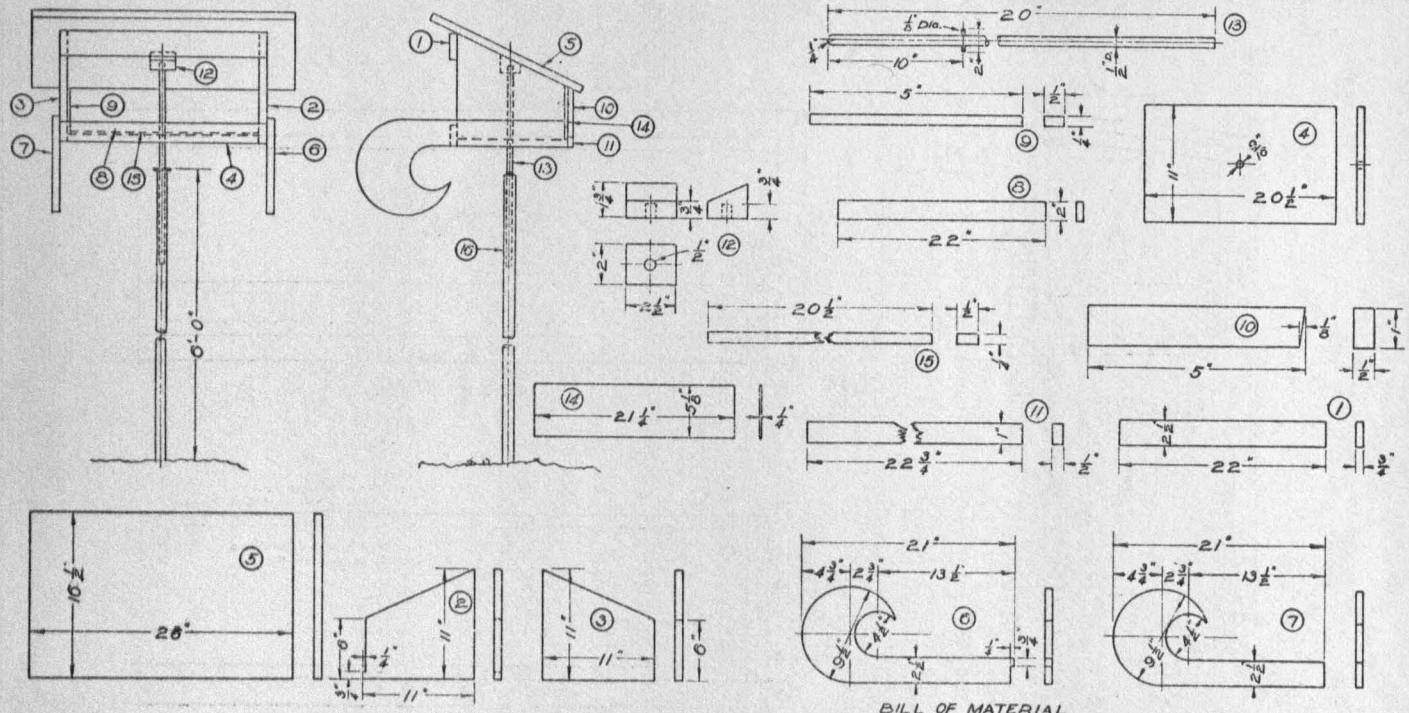
Native Birches (*Betula lutea, nigra, alba, populifolia*)
Red Cedar (*Juniperus virginiana*)
Wild Cherries (*Prunus pennsylvanica, pumila, serotine, virginiana*)
Mountain Ash (*Sorbus americana, aucuparia*)
Mulberry (*Morus*)
All the Elms

Bushes

Red Chokeberry (*Aronia arbutifolia*)
Black Chokeberry (*Aronia melanocarpa*)
Dogwoods (*Cornus all varieties*)
Japanese Honeysuckle (*Lonicera japonica*)
Japanese Barberry (*Berberis thunbergii*)
Sumacs (*Rhus copallina*)
Elderberry (*Sambucus americanus*)
Snowberry (*Symphoricarpos racemosus*)
Coral Berry (*Symphoricarpos vulgaris*)
High Bush Cranberry (*Viburnum*)
All the Viburnums
All the Weigelias

Vines

Virginia Creeper (*Psedera quinquefolia*)
Bittersweet (*Solanum dulcamara*)



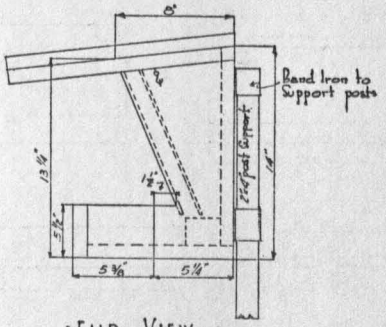
Winter feeding tray always faces away from wind, protecting food from the elements. A 1"- 9ft galvanized pipe, 3ft in ground supports pivot rod. Frosted glass in back eliminates trap appearance. A glass marble placed within pivot rod bearing above the pivot rod, facilitates turning.

BILL OF MATERIAL.

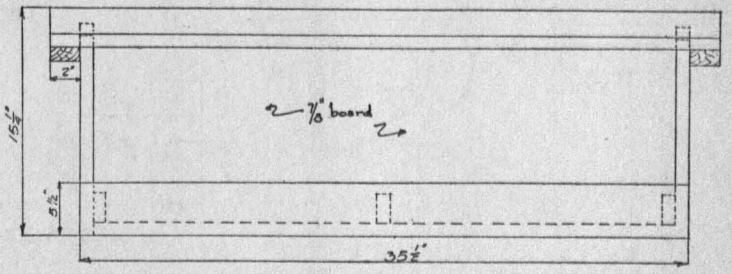
Pcs.	Name of Piece.	Rmk.	T.	W.	L.
1	Top Cross Piece	1	3/4"	2 1/2"	22"
1	Left Side	2	3/4"	11"	11"
1	Right Side	3	3/4"	11"	11"
1	Bottom	4	3/4"	11"	20"
1	Top	5	3/4"	16 1/2"	28"
1	Left Wing	6	3/4"	9 1/2"	21"
1	Right Wing	7	3/4"	9 1/2"	21"
1	Front Apron	8	3/4"	2 1/2"	22"

Pcs.	Name of Piece.	Rmk.	T.	W.	L.
1	Inside Cleat	9	1/4"	1/2"	5"
1	Outside Cleat	10	1/2"	1"	5"
1	Outside Cleat	11	1/2"	1"	22 3/4"
1	Pivot Rod Bearing	12	1"	2"	2 1/2"
1	Pivot Rod	13	1/2 a.	—	20"
1	Glass	14	1/4"	5/16"	21 1/4"
1	Inside Cleat	15	1/4"	1/2"	20 1/2"
1	Galvanized Pipe	16	1" a.	—	9'11"

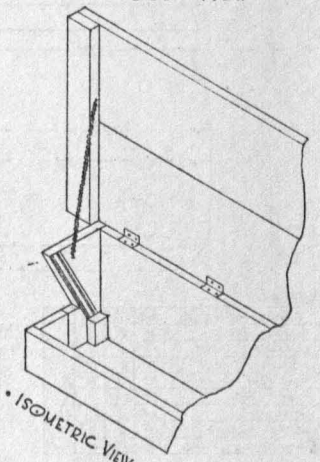
WINTER FEEDING STATION



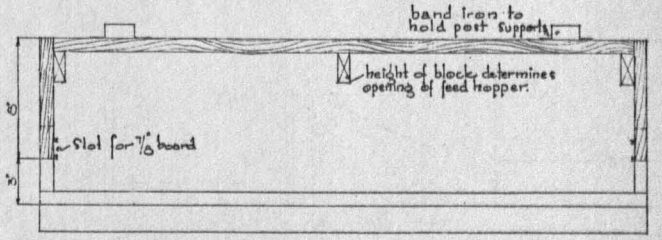
·END VIEW·



·FRONT VIEW·



·ISOMETRIC VIEW·



·PLAN·

NOTE:·
The hopper is supported on 2"x4"s driven into the ground. The height of hopper above ground depends on the type of birds you are feeding.

·UPLAND BIRD GAME·
·STATIONARY·
·FEEDING STATION·

WATERFOWL

NAME OF ARTICLE	AUTHOR	PUBLICATION
Distribution and Migration of No. American Duck, Geese and Swans	Cooke, Wells W.	U.S.D.A. Biol. Survey Bull. No. 26
Duck Decline in the Northwest		Published by "More Game Birds in America," A Foundation, New York, N. Y.
Duck Sickness - A Form of Botulism, Western.	Kalmbach, E.R. & Gunderson, M. F.	U.S.D.A. Bull. 411
Eleven Important Wild Duck Foods	McAtee, W. L.	U.S.D.A. Bull. 205
Far-Flying Wild Fowl and Their Foes	Brooks, Major Allan	National Geographic Magazine, Oct. 1934
Food Habits of the Mallard Duck in the U. S.	McAtee, W. L.	U.S.D.A. Bull. 720
Lead Poisoning in Waterfowl	Wetmore, Alex	U.S.D.A. Bull. 793
Malaria-Like Disease of Ducks, A - (Leucocytozoon anatiz, Wickware)	O'Roke, Earl C.	School of Forestry & Conservation, Univ. of Mich., Ann Arbor, Michigan.
More Waterfowl by Assisting Nature	McAtee, W. L. & Redington, Paul G. U.S. Bureau of Biol. Survey	Published by "More Game Birds in America," A Foundation, New York, N.Y.
Propagation of Aquatic Game Birds	McAtee, W. L.	Farmers' Bull. No.1612, U.S.D.A.
Propagation of Wild Duck Foods	McAtee, W. L.	U.S.D.A. Bulletin 465
Small Refuges for Waterfowl		Published by "More Game Birds in America," a Foundation, New York, N. Y.

WATERFOWL (continued)

NAME OF ARTICLE	AUTHOR	PUBLICATION
Some Common Aquatic, Game and Rapacious Birds in Relation to Man	McAtee, W. L. & Beal, F. E. L.	Farmers Bull. No. 497, U.S.D.A.
Water Areas - How to Create and Maintain Them		Published by "More Game Birds in America," A Foundation, New York, N. Y.
Wild Duck Foods of North Dakota Lakes	Metcalf, Franklin P.	U.S.D.A. Technical Bull. No. 221.

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Animal Communities in Temp. North America (see p. 86)	Shelford, V. E.	University of Chicago Press
Animal Ecology	Chapman, R. N.	Burgess-Brooke, Inc., Minneapolis, Minn.
Aquatic Insects of New York	Needham, J. G. & Betten, C.	N.Y. State Museum Bull. 45-48 Vol. 9, 1901.
Aquatic Nemocera Diptera	Johannsen, Augustus	N.Y. State Museum Bull. 68, 1903.
Crayfishes of Ohio	Turner	Ohio Biol. Sur. Bull. 13, Vol. 3, No. 3
Ecology of Trout Streams in Yellowstone Park, The	Muttkowski, R. A.	Roosevelt Wild Life Annals Vol. 2 #2, Oct. 1929.
Fishes of the Cranberry Lake Region, The	Kendall, W. C. & Dence, W. A.	Roosevelt Wild Life Bull. Vol. 5, #2, Feb. 1929.
Food of Trout Stream Insects in Yellowstone Park, The	Muttkowski & Smith	Roosevelt Wild Life Annals, Vol. 2 #2, Oct. 1929.
Fresh-Water Biology	Ward, H. B. and Whipple, Geo. C.	Published in 1918 by John Wiley & Sons, Inc., New York, N.Y.
Guide to the Study of Fresh Water Biology	Needham, J. G. & Paul R.	The American Viewpoint Society, New York, N. Y.

AQUATIC ANIMALS (continued)

NAME OF ARTICLE	AUTHOR	PUBLICATION
Inland Lakes of Wisconsin, The - the Plankton	Birge and Juday	Bull, #64, Scientific Series #13, Wis. Geological and Natural History Survey
Life in Inland Waters	Carpenter	The Mac Millan Co., New York City, N.Y.
Life of Inland Waters, The	Needham and Lloyd	Combstock Pub. Co., Ithaca, New York.
North American Caddis Fly Larvae	Lloyd, J.T.	Bull, #21, 1921, Ent. Series No. 1 in Lloyd Library
Observation on Breeding of European Carp at Havana, Illinois.	Richardson, R.E.	Bull, Ill. Lab. of Nat. Hist. Vol.9
Plankton (The Inland Lakes of Wisconsin)	Birge and Juday	Bull. #64 Series #13, Wis. Geological and Natural History Survey.
Plecoptera Nymphs of America	Classen, Peter W.	Published by Charles C. Thomas, 1931.
Quantitative Study on the Fauna of Some Types of Stream Beds, The	Percival, E. and Whitehead, R.	Journal of Ecology No. 2, 1929.
Shells of Land and Water	Baker, F.C.	Published by A. W. Mumford, Chicago, 1903
Stoneflies or Plecoptera of Illinois, The	Frison, T.H.	Natural History Survey Bulletin, Urbana, Ill. Vol. XX Article IV

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American Food and Game Fishes	Jordan and Evermann	Published by Doubleday, Page & Co., New York, 1905
Check list of the Fishes of the Great Lakes and Tributary Waters, with Nomenclatorial Notes and Analytical Keys, A	Hubbs, C. L.	University of Michigan, Museum of Zool. Misc. pub. No. 15, July 7, 1926.